Guide to the preparation, use and quality assurance of BLOOD COMPONENTS

European Committee (Partial Agreement) on Blood Transfusion (CD-P-TS)

EDQM
18th Edition
2015
Guide to the preparation, use and quality assurance of blood components

Recommendation No. R (95) 15

18th Edition

European Directorate for the Quality of Medicines & HealthCare
The Guide to the preparation, use and quality assurance of blood components is published by the Directorate for the Quality of Medicines & HealthCare of the Council of Europe (EDQM).

All rights conferred by virtue of the International Copyright Convention are specifically reserved to the Council of Europe and any reproduction or translation requires the written consent of the publisher.

Director of the Publication: Dr S. Keitel

Page layout and cover: EDQM

European Directorate for the Quality of Medicines & HealthCare (EDQM)
Council of Europe
7, allée Kastner
CS 30026
F-67081 STRASBOURG
FRANCE

Website: www.edqm.eu
To order: www.edqm.eu/store
FAQs & EDQM HelpDesk: www.edqm.eu/hd

© Council of Europe, 2015

Printed in France
FOREWORD

Founded in 1949, the Council of Europe is the oldest and largest of all European institutions and now numbers 47 member states. One of its founding principles is that of increasing co-operation between member states to improve the quality of life for all Europeans.

Within this context of intergovernmental co-operation in the field of health, the Council of Europe has consistently selected ethical problems for study. The most important such ethical issue relates to the non-commercialisation of human substances, i.e. blood, organs and tissues.

With regard to blood transfusion, co-operation among member states started back in the 1950s. From the outset, the activities were inspired by the following guiding principles: promotion of voluntary, non-

---

1 Albania, Andorra, Armenia, Austria, Azerbaijan, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Republic of Moldova, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, San Marino, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, ‘the former Yugoslav Republic of Macedonia’, Turkey, Ukraine, United Kingdom.
remunerated blood donation, mutual assistance, optimal use of blood and blood products and protection of the donor and the recipient.

The first result of this co-operation was the adoption of the European Agreement on the Exchange of Therapeutic Substances of Human Origin (European Treaty Series, No. 26) in 1958. It was followed by the European Agreement on the exchange of blood grouping reagents (European Treaty Series, No. 39) and of tissue-typing reagents (European Treaty Series, No. 84) in 1962 and 1976 respectively.

Around these three Agreements, the Council of Europe has established a blood transfusion programme, the aim of which is to ensure good quality of blood and blood products.

Since then, the Council of Europe has adopted a number of recommendations covering ethical, social, scientific and training aspects of blood transfusion. Whereas Agreements are binding on the States that ratify them, recommendations are policy statements to governments proposing a common course of action to be followed.

Major recommendations include Recommendation No. R (88) 4 on the responsibilities of Health Authorities in the field of blood transfusion or Recommendation No. R (95) 15, of which contains a technical appendix entitles: Guidelines on the use, preparation and quality assurance of blood components.

Work on Recommendation No. R (95) 15 started in 1986, when the Select Committee of Experts on Quality Assurance in Blood Transfusion Services published proposals on quality assurance in blood transfusion services.

Based on these proposals, the Select Committee produced a more comprehensive document entitled ‘Guide to the preparation, use and quality assurance of blood components’ referred to hereafter as the ‘Guide’. The immediate success and acceptability of this document was such that the Committee of Ministers adopted it as a technical appendix to what then became Recommendation No. R (95) 15.

The purpose of this Recommendation and its technical appendix is to provide blood transfusion establishments with a set of standards and
principles relating to the preparation, use and quality assurance of blood components. The Guide covers all blood components that will be prepared at a blood transfusion establishment and are intended to form the basis for standard operating procedures (SOPs).

The Recommendation does not cover plasma products obtained by fractionation. In respect of plasma-derived products, technical matters are addressed by the European Pharmacopoeia whilst the European Union has a substantial body of legislation regarding pharmaceutical products including plasma-derived products.

On 27 January 2003 the European Union adopted Directive 2002/98/EC on setting standards of quality and safety for the collection, testing, processing, storage and distribution of human blood and blood components. As regards technical requirements to be set under Article 29 of the said Directive, the European Commission and the Council of Europe work closely together to ensure that these requirements are compatible with this Guide.

As of the 15th Edition of the Guide, the content has been separated into two sections. The first, entitled Principles, encompasses background information that has to be considered in forming policy decisions as well as educational aspects thus providing the ‘why and how’. It also refers to developments that are not yet incorporated into standards, thus providing advance information about technical changes in the field. It was anticipated that in the coming editions of the Guide, apart from changes to its technical content, the Principles Section would be further expanded. The second section, entitled Standards, contains the matters that are considered to be ‘minimum standards’ aligning closely to the European Pharmacopoeia and European Commission Directives. It is intended to assist other jurisdictions to transpose these into legislation. The Standards section states ‘what must be done’.

Whereas blood establishments in EU member states are required to comply with legislation derived from the European Commission Directives, this Guide is intended to facilitate ongoing improvements on the preparation, use and quality assurance of blood components through education and the provision of non-
binding recommendations. The *Guide* therefore provides additional information and guidance on best practices consistent with current scientific knowledge and expert opinion. At any given time, implementation of these recommendations may vary among member states and individual blood transfusion establishments, and alternative procedures, practices and standards may be in place.

Recommendation No. R (95) 15 also states that its technical appendix, the *Guide*, will be regularly updated to keep it in line with scientific progress. This task was assigned to the European Committee (Partial Agreement) on Blood Transfusion (CD-P-TS), a Steering Committee of the Council of Europe pursuing activities in the field of blood transfusion. The European Directorate for the Quality of Medicines & HealthCare (EDQM)\(^2\) is in charge of the scientific secretariat for these activities.

This is the 18th Edition of the *Guide*, containing amendments which take into account comments made during the public consultation procedure of the draft in which National Health Authorities as well as interested parties were invited to comment on the proposed text.

The 18th edition of the *Guide* further consolidates recommendations for blood establishments and hospital blood banks to implement quality management systems in the form of the Good Practice Guidelines becoming an integral part of the *Guide*. They have been elaborated as an *ad hoc* co-operation between the EDQM and the Commission of the European Union and are considered, as is the section ‘Standards’, to be ‘minimum standards’.

The Good Practice Guidelines provide the initial grounds for the elaboration of the good practice guidance mentioned in Article 2 of Directive 2005/62/EC.

---

\(^2\) EDQM is a Directorate of the Council of Europe, created in 1964 on the legal basis of the Convention on the Elaboration of a European Pharmacopoeia, to which 37 member states and the European Union are signatory. Eight European countries, 17 non-European countries, the Taiwan Food and Drug Administration (TFDA) of the Ministry of Health and Welfare and the World Health Organization (WHO) are observers.
Due to the fact that the Council of Europe has now published the first Edition of the *Guide to the quality and safety of tissues and cells*, any reference to haematopoietic progenitor cells was taken out of this *Guide to the preparation, use and quality assurance of blood components*.

The elaboration of the text of the 18th Edition of the *Guide* was carried out with the assistance of a dedicated Expert working group under the aegis of the CD-P-TS. Special thanks should be made to all these Experts for their enlightening contributions and to the chairperson for her dedication. A detailed listing showing the composition of this working group is included. Participants in the public enquiry and members of the CD-P-TS who have submitted many constructive comments are also warmly acknowledged.

The drafting and the publication of the 18th Edition of the *Guide* was co-ordinated within the EDQM by Dr Guy Rautmann with the assistance of Ms Catherine Mischler and Mr David Crowe.
EUROPEAN COMMITTEE (PARTIAL AGREEMENT) ON BLOOD TRANSFUSION (CD-P-TS)

Chair
MACLENNAN Sheila
NHS Blood and Transplant
Leeds Centre
Bridle Path
UK – LEEDS LS15 7TW
sheila.maclennan@nhsbt.nhs.uk

Members

Austria
SCHENNACH Harald
Central Institute for Blood Transfusion and Immunology (ZIB)
TILAK – University Clinics – Regional Hospital
Anichstrasse 35
AT – 6020 INNSBRUCK
harald.schennach@uki.at
Belgium

MUYLLE Ludo
Agence Fédérale du Médicament et des Produits de Santé ‘AFMPS’
Eurostation Blok II
Place Victor Horta 40, Boîte 10
BE – 1060 BRUSSELS
ludo.muylle@fagg.afms.be

Bosnia and Herzegovina

HADZIC Hasija
Blood Transfusion Institute F BIH
Cekalu 5A 86
BA – 71000 SARAJEVO
hadzich@ztmfblh.ba

Bulgaria

MASHAROVA Natalia
National Centre of Transfusion Haematology
112 Bratia Miladinovi St.
BG – 1202 SOFIA
Nathalie_54@abv.bg

Croatia

VUK Tomislav
Croatian Institute of Transfusion Medicine
Petrova 3
CRO – 10 000 ZAGREB
tomislav.vuk@hztm.hr
Guide to the preparation, use and quality assurance of blood components

Cyprus
KIOUPI Stala
Cyprus Ministry of Health
Medical and Public Health Services
Giorgio Prodromou 1 and Hilonos 17
CY – 1449 NICOSIA
s.kioupi@cytanet.com.cy

Czech Republic
TUREK Petr
Thomayer Hospital
Videnskà, 800
RTC – 140 59 PRAHA 4
petr.turek@ftn.cz

Denmark
HANSEN Morten Bagge
Blood Transfusion Centre
Righospitalet
Blegdamsvej, 9
DK – 2100 COPENHAGEN
morten.bagge.hansen@regionh.dk

KRISTENSEN Marianne (substitute)
Danish Health and Medecines Authority
1, Axel Heides Gade
DK – 23000 S COPENHAGEN
mkr@sst.dk
**Estonia**

KULLASTE Riin  
North Estonia Medical Centre’s Blood Centre  
2 Adala Street  
ZES – 10614 TALLINN  
riin.kullaste@regionaalhaigla.ee

**Finland**

CASTREN Johanna  
Finnish Red Cross Blood Service  
Kivihaantie, 7  
FI – 00310 HELSINKI  
johanna.castren@bloodservice.fi

**France**

GACHET Christian  
EFS – Etablissement Français du Sang  
10 rue Spielmann  
FR – 67065 STRASBOURG  
christian.gachet@efs-alsace.fr

DANIC Bruno (substitute)  
Etablissement Français du Sang – Bretagne  
Rue Pierre Jean Gineste  
FR – 35016 RENNES CEDEX  
bruno.danic@efs.sante.fr

**Germany**

HEIDEN Margarethe (Vice Chair)  
Paul Ehrlich Institute  
Paul Ehrlich Strasse, 51-59  
DE – 63225 LANGEN  
margarethe.heiden@pei.de
KELLER Konstantin (substitute)
Federal Ministry of Health
DE – 53107 BONN
116@bmg.bund.de

Greece
POLITIS Constantina
Ministry of Health, National Blood Centre
Coordinating Haemovigilance Centre, Hellenic CDC
10 Averof Str,
GR – 10433 ATHENS
cpolitis@keelpno.gr

DADIOTIS Loukas (substitute)
General Hospital of Piraeus Tzaneio
GR – 18536 PIRAEUS
aimodosia@tzaneio.gr

Hungary
BAROTI TOTH Klara
Hungarian National Blood Transfusion Service
19-21 Karolina St.
H – 1113 BUDAPEST
barotine.toth.klara@ovsz.hu

Ireland
O’RIORDAN Joan
Irish Blood Transfusion Service
National Blood Centre
James’s Street
IRL – DUBLIN 8
joan.o’riordan@ibts.ie
Italy

GRAZZINI Giuliano
Italian National Blood Centre
Istituto Superiore di Sanità
Via Giano della Bella No 27
IT – 00162 ROME

giuliano.grazzini@iss.it

DE ANGELIS Vincenzo (substitute)
Udine University Hospital
P. le S. Maria della Misericordia, 15
IT – 33100 UDINE

deangelis.vincenzo@aoud.sanita.fvg.it

Latvia

STEINERTE Anna
Latvian State Blood Donor centre
Selpils street 6
LV – 1007 RIGA

anna.steinerte@vadc.gov.lv

JURSEVICA Evelina (substitute)
Centre of Blood Donors
Selpils 6
LV – 1700 RIGA

evelina.jursevica@vadc.gov.lv

Lithuania

NAUJOKAITE Alvyda
Ministry of Health of the Republic of Lithuania
Vilniaus St., 33
LT – 01506 VILNIUS

alvyda.naujokaite@sam.lt
Guide to the preparation, use and quality assurance of blood components

KALIBATAS Vytenis (substitute)
National Blood Centre
Zolyno Str. 34
LT – 10210 VILNIUS
v.kalibatas@kraujodonoryste.lt

Luxembourg
COURRIER Paul
Centre de Transfusion sanguine de la Croix Rouge luxembourgeoise
42 boulevard Joseph II
L – 1840 LUXEMBOURG
paul.courrier@croix-rouge.lu

Malta
LASPINA Stefan
Mater Dei Hospital Blood Bank
Pathology Department, Block C, Level -1
MT – MSD 2090 TAL-QROQQ
stefan.laspina@gov.mt

Montenegro
RASOVIC Gordana
Institute for Blood Transfusion of Montenegro
Dzona Dzeksona BB
ME – 81000 PODGORICA
gordana.rasovic@ztkcg.me

Netherlands
DE WIT Jeroen
Sanquin Blood Supply
Plesmanlaan, 125
NL – 1006 CN AMSTERDAM
hjc.dewit@sanquin.nl
Norway
FLESLAND Oystein
The Norwegian Knowledge Centre for the Health Services
PO Box 7004 St Olavs plass
NO – 0130 OSLO
oystein.flesland@nokc.no

Poland
POGLOD Ryszard
Institute of Haematology and Transfusiology
Indiry Gandhi 14 st.
PL – 02-776 WARSAW
rpoglod@ihit.waw.pl

Portugal
CHIN TAD MUON Mario
Centro de Sangue e da Transplantação de Coimbra
Quinta da Vinha Moura, São Martinho do Bispo
PT – 3041-861 COIMBRA
mario.chin@ipst.min-saude.pt

Romania
DOBROTA Alina Mirella
Regional Blood Transfusion Centre
St. Nicolas lorga, n 85
Constanta County
RO – 900587 CONSTANTA
alina_mirella@yahoo.com
Guide to the preparation, use and quality assurance of blood components

Serbia
VASILJEVIC Nada
Ministry of Health
Direction of Biomedicine
Vladetina 1-3
SRB – 11000 BELGRADE
vnada12345@gmail.com

Slovak Republic
ROSOCHOVA Jana
Narodna transfuzna sluzba SR
Limbova 3
SK – 833 14 BRATISLAVA
rosochova@ntssr.sk

Slovenia
ROZMAN Primoz
Blood Transfusion Centre of Slovenia
Slajmerjeva 6
SI – 1000 LJUBLJANA
primoz.rozman@ztm.si

Irena RAZBORSEK (substitute)
Blood Transfusion centre of Slovenia
Slajmerjeva ulica 6
SLO – 1000 LJUBLJANA
irena.razborsek@ztm.si
Spain
FERNANDEZ ALVAREZ Carmen
Ministry of Health, Social Services and Equality
Servicio de Hematologia Hospital de Cabuenes
Calle Los Prados nº 395
ES – 33394 GIJON
carmen.fernandez@sespa.princast.es

Sweden
NORDA Rut
Klinisk immunologi och transfusionsmedicin
Uppsala University Hospital
Akademiska Sjukhuset, ing 61
SE – 751 85 UPPSALA
rut.norda@akademiska.se

STROM Helena (substitute)
Socialstyrelsen
The National Board of Health and Welfare
SE – 106 30 STOCKHOLM
helena.strom@socialstyrelsen.se

Switzerland
JUTZI Markus
Swissmedic
Hallerstrasse 7
CH – 3000 BERN 9
markus.jutzi@swissmedic.ch
MANSOURI TALEGHANI Behrouz (substitute)
Croix Rouge Suisse
Service de la Transfusion Sanguine
Laupenstrasse, 37
CP 5510
CH – 3001 BERN
behrouz.mansouri@blutspende.ch

‘The former Yugoslav Republic of Macedonia’

DUKOVSKI Risto
Office of the Republic Macedonia of Blood Transfusion
National Institute for Transfusion Medicine
Vodnjanska, 17
MAC – 1000 SKOPJE
dukovski50@gmail.com

Turkey

ERTUGRUL ORUC Nigar
Blood Transfusion Centre
Diskapi Yildirim Beyazit
Training and Research Hospital
Ministry of Health
TR – 06110 ANKARA
nigarertugrul@gmail.com

United Kingdom

HEWITT Patricia
Blood and Transplant
Tooting Centre
17 Cramer Terrace
UK – SW17 0RB LONDON
patricia.hewitt@nhsbt.nhs.uk
Observers

**Albania**
DURO Vjollca  
Boulevard Bajram Curri  
AL – 1001 TIRANA

**Armenia**
DAGHBASHYAN Smbat  
Center of Haematology  
Ministry of Health  
7 H. Nersisyan Str.  
AM – 0017 YEREVAN

armhaem@gmail.com

**Australia**
SMITH Glenn  
Office of Scientific Evaluation  
136, Narrabundah Lane Symonston  
PO Box 100  
AU – ACT 2609 WODEN

glenn.smith@tga.gov.au

PROSSER Ian  
Therapeutic Goods Administration Laboratories  
136 Narrabundah Lane  
AUS –2606 SYMONSTON ACT

ian.prosser@tga.gov.au
Guide to the preparation, use and quality assurance of blood components

Canada
GANZ Peter R.
Health Canada
Centre for Blood and Tissues Evaluation
100 Eglantine Driveway
Tunneys Pasture
K1A 0L2
CA – AL0603C3 OTTAWA, CANADA
peter.ganz@hc-sc.gc.ca

AGBANYO Francisca
Centre for Biologics Evaluation
3rd floor, Room 3379 AL 0603C3
1000 Eglantine Driveway
K1A 0KP
CA – OTTAWA, ONTARIO
francisca_agbanyo@hc-sc.gc.ca

Georgia
AVALISHVILI Levan
The Jo Ann Medical Centre
21 Lubliana St.
GE – 0159 TBILISI
levanavali@gmail.com

Moldova
CEBOTARI Svetlana
National Blood Transfusion Centre
Str. Academi 11
MD – 2028 CHISINAU
cebotaris@mail.ru
Republic of Belarus
POTAPNEV Michael
Belarusian Research and Production Centre for Haematology – Tranfusiology
Dolginovski tract, 160
BY – 220053 MINSK
rspk@anitex.by

Republic of Singapore
TEO Diana
Health Sciences Authority
11 Outram Road
SGP – 169078 SINGAPORE

Russian Federation
BOGDANOVA Vera
Federal Medico-Biological Agency
Volokalamskoye shosse, 30
RU – 109074 MOSCOW
bodgdanova@nic-itep.ru

USA
EPSTEIN Jay
Office of Blood Research and Review
1401 Rockville Pike
USA – ROCKVILLE, MD 20852
jay.epstein@fda.hhs.gov

WILLIAMS Alan (substitute)
HFM 370
1401 Rockville Pike
USA – ROCKVILLE, MD 20852
alan.williams@fda.hhs.gov
DH-BIO (Bioethics Committee, Council of Europe)

FORUS Anne (Chair)
Norwegian Directorate of Health University
St Olavs Plass
NO – 0130 OSLO
anne.forus@helsedir.no

European Commission

VAN DER SPIEGEL Stefaan
Unit 6 Health and Law and International Substances of Human Rights
Froissart Straat 101
BE – 1040 BRUXELLES
stefaan.van-der-spiegel@ec.europa.eu

World Health Organization

Nomination pending
MEMBERS OF THE AD HOC
GROUP (GTS)

Chair
NORDA Rut
Klinisk immunologi och transfusionsmedicin
Uppsala University Hospital
Akademiska Sjukhuset, ing 61
S – 751 85 UPPSALA
rut.norda@akademiska.se

Members
ANTONIEZWICZ-PAPIS Jolanta
National Blood Centre
Miodowa 1
PL – 00-080 WARSAW
nck@nck.gov.pl
BAROTI TOTH Klara  
Hungarian National Blood Transfusion Service  
19-21 Karolina St.  
H – 1113 BUDAPEST  
barotine.toth.klara@ovsz.hu

BOGDANOVA Vera  
Federal medico-biological Agency, ‘ROSPLASMA’  
Volokalamskoye shosse, 30  
RU – 109074 MOSCOW  
bodgdanova@nic-itep.ru

CASTREN Johanna  
Finnish Red Cross Blood Service  
Kivihaantie 7  
FI – 003010 HELSINKI  
johanna.castren@bloodservice.fi

DE ANGELIS Vincenzo  
Udine University Hospital  
P. le S. Maria della Misericordia, 15  
IT – 33100 UDINE  
deangelis.vincenzo@aoud.sanita.fvg.it

DE KORTE Dirk  
Sanquin  
PO Box 9190  
NL – 1006 AD AMSTERDAM  
d.dekorte@sanquin.nl
Members of the ad hoc group (GTS)

DOBROTA Alina Mirella
Regional Blood Transfusion Centre
St. Nicolas lorga, n 85
Constanta County
RO – 900587 CONSTANTA
alina_mirella@yahoo.com

ERTUGRUL ORUC Nigar
Blood Transfusion Centre
Diskapi Yildirim Beyazit
Training and Research Hospital
Ministry of Health
TR – 06110 ANKARA
nigarertugrul@gmail.com

FERNANDEZ ALVAREZ Carmen
Ministry of Health, Social Services and Equality
Servicio de Hematologia Hospital de Cabuenes
Calle Los Prados nº 395
ES – 33394 GIJON
carmen.fernandez@sespa.princast.es

FLANAGAN Peter
New Zealand Blood Service
Private Bag 92071, Victoria Street West
NZ – 1142 AUCKLAND
peter.flanagan@nzblood.co.nz

FLESLAND Oystein
The Norwegian Knowledge Centre for the Health Services
PO Box 7004 St Olavs plass
NO – 0130 OSLO
oystein.flesland@nokc.no
FONTANA Stefano  
Blutspendedienst SRK Bern AG  
Murtenstrasse 133  
CH – 3001 BERN  
stefano.fontana@bsd-be.ch

GACHET Christian  
Etablissement Français du Sang  
10 rue Spielmann  
FR – 67035 STRASBOURG CEDEX  
christian.gachet@efs-alsace.fr

GARRAUD Olivier  
Institut National de la Transfusion Sanguine  
6 rue Alexandre-Cabanel  
FR – 75739 PARIS  
olivier.garraud@efs.sante.fr

GUDMUNDSSON Sveinn  
Blood Bank  
Snorrabraut 60  
IS – 105 REYKJAVIK  
sveinn@landspitali.is

HOPKINS Andrew  
MHRA  
151 Buckingham Palace Road  
Victoria  
UK – SW1W 9SZ LONDON  
andrew.hopkins@mhra.gsi.gov.uk
ILLOH Orieji  
Food and Drug Administration  
10903 New Hampshire Avenue  
USA – SILVER SPRING, MD 20993-0002  
orieji.illoh@fda.hhs.gov

KELLER Anthony  
Australian Red Cross Blood Service  
69 Walters drive, Osborne Park  
AU – WA 6017 RIVERVAL  
akeller@arcbs.org.au

KLUTER Harald  
Institut für Transfusionsmedizin und Immunologie  
Friedrich-Ebert-Strasse 107  
DE – 68167 MANNHEIM  
harald.klueter@medma.uni-heidelberg.de

LACHERT Elzbieta  
Institute of Hematology and Transfusions Medicine  
Indiry Gandhi 14  
PL – 02-776 WARSZAWA  
elachert@ihit.waw.pl

LASPINA Stefan  
Mater Dei Hospital Blood Bank  
Pathology Department, Block C, Level -1  
MT – MSD 2090 TAL-QROQQ  
stefan.laspina@gov.mt
MACLENNAN Sheila  
NHSBT  
Leeds Blood Centre  
Bridle Path  
UK – LEEDS LS15 7TW  
sheila.maclennan@nhsbt.nhs.uk

NAUJOKAITE Alvyda  
Ministry of Health of the Republic of Lithuania  
Vilniaus St., 33  
LT – 01506 VILNIUS  
alvyda.naujokaite@sam.lt

O’RIORDAN Joan  
Irish Blood Transfusion Service  
National Blood Centre  
James’s Street  
IRL – DUBLIN 8  
joan.o’riordan@ibts.ie

PINK Joanne  
Australian Red Cross Service on behalf of the TGA  
44 Musk Avenue  
AU – KELVIN GROVE QLD, 4059  
jpink@redcrossblood.org.au

POLITIS Constantina  
Ministry of Health, National Blood Centre  
Coordinating Haemovigilance Centre, Hellenic CDC  
10 Averof Str.  
GR – 10433 ATHENS  
cpolitis@keelpno.gr
REHACEK Vit
University Hospital Hradec Kralove
Transfusion Department
Sokolksa str. 581
CZ – 500 05 HRADEC KRALOVE
rehacekv@lfhk.cuni.cz

ROCKWELL Joyce
Food and Drug Administration
10903 New Hampshire Avenue
USA – SILVER SPRING, MD 20993-0002
joyce.rockwell@fda.hhs.gov

ROSOCHOVA Jana
Ministry of Health of the Slovak Republic
National Transfusion Service
Limbova 3
SK – 83314 BRATISLAVA
rosochova@ntssr.sk

SÄFWENBERG Jan
Uppsala University Hospital
Blood Centre
SE – SE751 85 UPPSALA
jan.safwenberg@akademiska.se

SCHÄRER Christian
Swissmedic
Hallerstrasse 7
CH – 3000 BERN 9
christian.scharer@swissmedic.ch
SCHENNACH Harald
Central Institute for Blood Transfusion and Immunology (ZIB)
TILAK – University Clinics – Regional Hospital
Anichstrasse 35
AT – 6020 INNSBRUCK
harald.schennach@uki.at

SORENSEN Betina
Aarhus University Hospital
Brendstrupgaardsvej 100, Skejby
DK – 8200 AARHUS N
betisoer@rm.dk

VASILJEVIC Nada
Ministry of Health
Direction of Biomedicine
Vladetina 1-3
SRB – 11000 BELGRADE
vnada12345@gmail.com

VUK Tomislav
Croatian Institute for Blood Transfusion
Petrova 3
HR – 10000 ZAGREB
tomislav.vuk@hztm.hr
Contents

FOREWORD ................................................................. 3

EUROPEAN COMMITTEE (PARTIAL AGREEMENT) ON BLOOD TRANSFUSION (CD-P-TS) ........................................ 8
  Members ................................................................. 8
  Observers ............................................................. 19

MEMBERS OF THE AD HOC GROUP (GTS) .................... 23
  Members ................................................................. 23

Recommendation No. R (95) 15 ........................................ 51

Guide to the preparation, use and quality assurance of blood components ...................................................... 55

PRINCIPLES ................................................................ 57

Chapter 1  Introduction .................................................. 58

Chapter 2  Principles of donor selection .......................... 59
  1. General remarks ..................................................... 59
  2. Overview .............................................................. 60
  3. Medical assessment of the donor .............................. 61
     Age of the donor .................................................... 61
Guide to the preparation, use and quality assurance of blood components

Hazardous occupations .................................................. 61
Donor deferral ............................................................... 62
Conditions requiring permanent deferral .......................... 62
Conditions requiring temporary deferral (suspension) ...... 62
Vaccination ................................................................. 62
Conditions requiring individual assessment .................... 62
Post-donation information ................................................ 64
Infectious diseases ........................................................ 64
History of malignancy .................................................... 66

4. Specific considerations for donors of different components 67
   Quantity of whole blood donation .................................. 67
   Frequency of whole blood donation ............................... 69
   Laboratory examination before donation ....................... 69
   Apheresis donors ...................................................... 70
   Designated donations ................................................ 74
   Directed donations .................................................... 75

Chapter 3 Principles of blood collection .......................... 76
1. Overview ................................................................. 76
2. Premises for donor sessions ......................................... 76
3. Equipment used at blood donation sessions .................. 77
4. Pre-donation checks and labelling ................................ 77
5. Venepuncture ............................................................ 77
   Preparation of the venepuncture site .............................. 77
   Successful venepuncture and proper mixing ................... 78
   Handling of filled containers and samples ....................... 79
6. Apheresis ................................................................. 80
   Pre-medication and apheresis ....................................... 80
   Automated apheresis .................................................. 80
   Manual apheresis ...................................................... 80
7. Repository of archive samples ...................................... 80
8. Management of adverse reactions in donors ................. 81
   Prevention of adverse reactions in donors ...................... 82
   Treatment of adverse reactions in donors ....................... 82
   Documentation of adverse reactions in donors ................. 83
   Information for a donor with adverse reactions ............... 83
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9. Donor clinic documentation</td>
<td>84</td>
</tr>
<tr>
<td>Chapter 4  Principles of blood component processing</td>
<td>85</td>
</tr>
<tr>
<td>1. Overview</td>
<td>85</td>
</tr>
<tr>
<td>2. Processing procedures</td>
<td>86</td>
</tr>
<tr>
<td>3. Choice of anti-coagulant and bag system</td>
<td>87</td>
</tr>
<tr>
<td>4. Centrifugation of blood components</td>
<td>89</td>
</tr>
<tr>
<td>5. Component separation</td>
<td>92</td>
</tr>
<tr>
<td>- Separation after the initial centrifugation</td>
<td>92</td>
</tr>
<tr>
<td>- Separation after initial filtration</td>
<td>92</td>
</tr>
<tr>
<td>- Other separation principles</td>
<td>93</td>
</tr>
<tr>
<td>6. Leucocyte depletion</td>
<td>96</td>
</tr>
<tr>
<td>7. Freezing and thawing of plasma</td>
<td>97</td>
</tr>
<tr>
<td>- Rationale</td>
<td>97</td>
</tr>
<tr>
<td>- Methods of freezing</td>
<td>98</td>
</tr>
<tr>
<td>- Methods of thawing</td>
<td>98</td>
</tr>
<tr>
<td>- Cryoprecipitation</td>
<td>99</td>
</tr>
<tr>
<td>8. Open and closed systems and sterile connection devices</td>
<td>99</td>
</tr>
<tr>
<td>9. Irradiation of blood components</td>
<td>99</td>
</tr>
<tr>
<td>10. Prevention of CMV transmission</td>
<td>100</td>
</tr>
<tr>
<td>11. Pathogen reduction technologies</td>
<td>101</td>
</tr>
<tr>
<td>12. Purity of components</td>
<td>103</td>
</tr>
<tr>
<td>13. Bacterial safety of blood components</td>
<td>103</td>
</tr>
<tr>
<td>- Overview</td>
<td>103</td>
</tr>
<tr>
<td>- Quality control for aseptic collection and processing of blood</td>
<td>104</td>
</tr>
<tr>
<td>components</td>
<td></td>
</tr>
<tr>
<td>- Release as ‘culture-negative to date’ after bacteriological testing</td>
<td>107</td>
</tr>
<tr>
<td>of all platelets</td>
<td></td>
</tr>
<tr>
<td>14. Storage of blood components</td>
<td>107</td>
</tr>
<tr>
<td>- Equipment</td>
<td>107</td>
</tr>
<tr>
<td>- Storage at + 2 to + 6 °C</td>
<td>108</td>
</tr>
<tr>
<td>- Storage of frozen plasma components</td>
<td>108</td>
</tr>
<tr>
<td>- Storage at + 20 to + 24 °C</td>
<td>108</td>
</tr>
<tr>
<td>- Aspects of red cell preservation</td>
<td>109</td>
</tr>
<tr>
<td>- Additive solutions</td>
<td>110</td>
</tr>
<tr>
<td>- Micro-aggregates in whole blood and red cell components</td>
<td>110</td>
</tr>
</tbody>
</table>
# Guide to the preparation, use and quality assurance of blood components

- Red cell preparations .................................................. 110
- Platelet preparations ................................................... 111
- Granulocyte preparations ............................................... 111
- Plasma components ....................................................... 112

15. Transportation of blood components ................................ 112
   - Transport of standard red cell components ..................... 113
   - Transport of platelet components .................................. 113
   - Transport of frozen plasma components .......................... 113

16. Component information and principles of labelling ............. 114

Chapter 5  Principles of blood component monographs .......... 115
1. Definition and properties ............................................... 116
2. Preparation ............................................................... 116
3. Requirements and quality control ................................... 116
4. Storage and transport ................................................... 117
5. Labelling ................................................................. 117
6. Warnings ................................................................. 117

Chapter 6  Principles of blood components for foetal, neonatal
and infant use .............................................................. 118
1. Overview ................................................................. 118
2. Components for intra-uterine transfusions ........................ 119
3. Components for neonatal exchange transfusion .................. 119
4. Red cells for neonatal and infant small volume transfusion ... 120
5. Fresh frozen plasma for neonatal and infant use ................. 121
6. Platelets for neonatal and infant use ............................... 121

Chapter 7  Principles of autologous transfusion .................... 123
1. Overview ................................................................. 123
2. Pre-deposit autologous transfusion .................................. 125
   - Patient selection ....................................................... 125
   - Blood collection ....................................................... 127
   - Preparation, storage and distribution of pre-deposit autologous
     components ........................................................... 127
   - Labelling ............................................................... 127
   - Storage ................................................................. 127
   - Records ............................................................... 127
## Contents

Audit .......................................................... 128

3. Red cell salvage ........................................ 128
Collection system ......................................... 128
Processing system ....................................... 129
Indications for the use of cell salvage ................. 129
Parameters for quality control ......................... 129
Precautions .................................................... 130

### Chapter 8 Principles of immunohaematology .... 131

1. Overview .................................................... 131
2. Immunohaematological testing ..................... 132
Blood group testing ....................................... 132
3. Screening and investigation of antibodies ........ 133
Pre-transfusion testing .................................... 134
4. Validation and quality assurance ................. 136
Quality control ............................................. 139
Quality control of equipment ......................... 139
Quality control of reagents .............................. 139
Quality control of techniques ......................... 139
Internal quality control .................................. 140
External quality assurance .............................. 143
Quality control of antibody quantitation ............. 144

### Chapter 9 Principles of screening for markers of infection .... 145

1. Overview .................................................... 145
2. Algorithm for infectious marker screening and
confirmatory testing ..................................... 146
3. Confirmatory testing ................................... 148
   Anti-HIV-1/2, anti-HCV and HBsAg ............... 148
   Anti-HTLV-I-II ........................................... 148
4. Nucleic acid screening ................................. 149
5. Additional serological screening .................... 149
   Syphilis screening ..................................... 149
   Anti-HBc screening .................................... 149
   CMV screening ......................................... 150
   Malaria screening ..................................... 150
Guide to the preparation, use and quality assurance of blood components

---

**Trypanosoma cruzi screening** ........................................... 150

**Chapter 10 Principles of haemovigilance** .......................... 152

1. **Overview** ................................................................. 152

2. **Prerequisites for implementation of a haemovigilance network** .................................................. 153
   - Traceability of blood components .................................. 153
   - Co-operation between blood establishments, hospital blood banks and clinical departments ............... 155

3. **Types of adverse reactions and adverse events collected in a haemovigilance network** ............................... 156
   - Adverse reactions in patients ....................................... 156
   - Adverse reactions in donors ........................................ 157
   - Adverse events .......................................................... 158
   - Device defects ......................................................... 159

4. **Tracing and recall of potentially infectious donations for HIV, HCV or HBV (look-back)** ......................... 160
   - Post-transfusion infection in a recipient reported to the blood establishment ........................................... 160
   - Post-donation information ........................................... 161
   - Recall of blood components ........................................ 161
   - Tracing of recipients of potentially infectious blood donations (look-back/review) .................................... 161

5. **Contracts between blood establishments and hospitals for haemovigilance** ............................................. 162
   - Minimum information to be captured in the initial incident report at hospital level .......................... 162

6. **Reporting haemovigilance data** ...................................... 163
   - Standardisation of reporting ...................................... 163
   - Data analysis ............................................................ 163
   - Information sent to the haemovigilance database ................. 163
   - Component information ............................................... 163
   - Information about severity ......................................... 164
   - Information about imputability .................................. 164
   - Information about the type of adverse events and reactions ................................................................. 165
Chapter 11 Principles of clinical use of blood .......... 166
1. Overview ................................................. 166
2. Elements for a quality system in clinical transfusion .... 167
   Indications for blood component transfusion and the role of
   clinical auditing .............................................. 167
   Informed consent for transfusion ......................... 168
   The transfusion request .................................... 168
   Transfusion of blood components ....................... 169
   Transfusion reporting and management of transfusion
   reactions ......................................................... 169
3. Clinical indications for blood components ................. 170
   Clinical indications of red cells ......................... 170
   Clinical indications for platelet transfusion ............ 173
   Clinical indications for fresh frozen plasma .......... 175
   Clinical use of granulocytes ............................. 178
4. The request form ........................................... 178
5. Issuing blood components .................................. 179
6. Administration of blood components ..................... 180
   Safety measures ............................................ 180
   Handling and storage of blood in the hospital ........... 181
7. Monitoring ................................................... 181
   Efficacy ....................................................... 182
8. Transfusion complications .................................. 182
9. Hospital transfusion committees ......................... 184

STANDARDS ...................................................... 185

Chapter 1 Introduction ........................................ 187

Chapter 2 Standards for selection of donors ............... 188
1. Overview .................................................... 188
2. Information to be provided to the donor ................ 188
3. Medical assessment of the donor ....................... 190
   Donor eligibility ............................................ 190
   Questionnaire and interview ............................. 191
   Donor details ............................................... 191
Guide to the preparation, use and quality assurance of blood components

38

Age of the donor .................................................. 191
Donor appearance and inspection .............................. 192
4. Donor deferral ................................................... 192
   Infectious diseases ............................................ 195
5. Specific standards for donors of different types of
   components ....................................................... 199
   Whole blood donors ........................................... 199
   Quantity of donation ......................................... 199
   Apheresis donors .............................................. 200
6. Post-donation information .................................... 203

Chapter 3  Standards for collection of blood and blood
components .......................................................... 204
1. Premises for donor sessions .................................. 204
2. Procedures and equipment used at blood donation sessions 205
3. Pre-donation checks ............................................. 205
4. Labelling .......................................................... 205
5. Venepuncture, bleeding and mixing .......................... 206
   Preparation of the venepuncture site ...................... 206
   Successful venepuncture and proper mixing .............. 207
6. Handling of filled containers and samples .................. 208
7. Special requirements for apheresis .......................... 208
   Return of red blood cells of donors undergoing manual
   apheresis .......................................................... 209
8. Repository of archive samples ................................ 209

Chapter 4  Standards for the processing, storage and
distribution of blood components ............................... 210
1. Processing ......................................................... 210
2. Component labelling and information ....................... 211
3. Release of blood components ................................ 212
4. Storage and distribution ...................................... 214
5. Irradiation of blood components ............................. 215
6. Leucocyte depletion ............................................. 216
7. Bacterial safety .................................................. 216

Chapter 5  Component monographs ................................. 217
Component monographs
Part A. Whole Blood components ........................................... 219
1. Whole Blood ...................................................................... 220
   Definition and properties ................................................. 220
   Preparation ..................................................................... 220
   Requirements and quality control ................................... 220
   Storage and transport ...................................................... 221
   Labelling ........................................................................ 221
   Warnings ........................................................................ 222
2. Whole Blood, Leucocyte-Depleted ..................................... 223
   Definition and properties ................................................. 223
   Preparation ..................................................................... 224
   Requirements and quality control ................................... 224
   Storage and transport ...................................................... 225
   Labelling ........................................................................ 225
   Warnings ........................................................................ 226

Component monographs
Part B. Red cell components ................................................. 229
1. Red Cells ........................................................................ 230
   Definition and properties ................................................. 230
   Preparation ..................................................................... 230
   Requirements and quality control ................................... 230
   Storage and transport ...................................................... 231
   Labelling ........................................................................ 231
   Warnings ........................................................................ 232
2. Red Cells, Buffy Coat Removed ........................................... 233
   Definition and properties ................................................. 233
   Preparation ..................................................................... 233
   Requirements and quality control ................................... 234
   Storage and transport ...................................................... 234
   Labelling ........................................................................ 235
   Warnings ........................................................................ 236
3. Red Cells, in Additive Solution ............................................ 237
   Definition and properties ................................................. 237
   Preparation ..................................................................... 237
Guide to the preparation, use and quality assurance of blood components

- Definition and properties ........................................ 280
- Preparation ......................................................... 280
- Requirements and quality control .............................. 280
- Storage and transport ............................................ 282
- Labelling ............................................................... 282
- Warnings .............................................................. 283

5. Platelets, Recovered, Pooled, Leucocyte-Depleted, in Additive Solution ............................................. 284
   - Definition and properties ...................................... 284
   - Preparation ......................................................... 284
   - Requirements and quality control ............................ 285
   - Storage and transport ........................................... 286
   - Labelling ............................................................... 287
   - Warnings .............................................................. 287

6. Platelets, Pooled, Pathogen-reduced .......................... 288
   - Definition and properties ...................................... 288
   - Preparation ......................................................... 289
   - Requirements and quality control ............................ 289
   - Storage and transport ........................................... 290
   - Labelling ............................................................... 291
   - Warnings .............................................................. 292

7. Platelets, Apheresis .................................................. 293
   - Definition and properties ...................................... 293
   - Preparation ......................................................... 293
   - Requirements and quality control ............................ 293
   - Storage and transport ........................................... 294
   - Labelling ............................................................... 295
   - Warnings .............................................................. 296

8. Platelets, Apheresis, Leucocyte-Depleted ....................... 297
   - Definition and properties ...................................... 297
   - Preparation ......................................................... 297
   - Requirements and quality control ............................ 297
   - Storage and transport ........................................... 298
   - Labelling ............................................................... 299
   - Warnings .............................................................. 300
9. Platelets, Apheresis, in Additive Solution ....................... 301
   Definition and properties ................................... 301
   Preparation .................................................. 301
   Requirements and quality control .......................... 301
   Storage and transport ....................................... 302
   Labelling ..................................................... 303
   Warnings ...................................................... 304
10. Platelets, Apheresis, Leucocyte-Depleted, in Additive
    Solution .................................................... 305
    Definition and properties ................................... 305
    Preparation .................................................. 305
    Requirements and quality control .......................... 306
    Storage and transport ....................................... 307
    Labelling ..................................................... 308
    Warnings ...................................................... 308
11. Platelets, Apheresis, Pathogen-reduced ......................... 309
    Definition and properties ................................... 309
    Preparation .................................................. 310
    Requirements and quality control .......................... 310
    Storage and transport ....................................... 311
    Labelling ..................................................... 312
    Warnings ...................................................... 313
12. Platelets, Cryopreserved ......................................... 314
    Definition and properties ................................... 314
    Preparation .................................................. 314
    Requirements and quality control .......................... 314
    Storage and transport ....................................... 315
    Labelling ..................................................... 315
    Warnings ...................................................... 316

Component monographs
Part D. Plasma components ........................................... 319
1. Plasma, Fresh Frozen ........................................... 320
   Definition and properties ................................... 320
   Preparation .................................................. 320
   Requirements and quality control .......................... 321
Guide to the preparation, use and quality assurance of blood components

Storage and transport ........................................ 322
Labelling ......................................................... 323
Warnings ......................................................... 323

2. Plasma, Fresh Frozen, Pathogen Reduced .................. 324
   Definition and properties .................................. 324
   Preparation .................................................. 325
   Requirements and quality control ....................... 325
   Storage and transport ..................................... 327
   Labelling ..................................................... 327
   Warnings ..................................................... 328

3. Cryoprecipitate .............................................. 329
   Definition and properties .................................. 329
   Preparation .................................................. 329
   Requirements and quality control ....................... 329
   Storage and transport ..................................... 331
   Labelling ..................................................... 332
   Warnings ..................................................... 333

4. Plasma, Fresh Frozen, Cryoprecipitate-Depleted .......... 333
   Definition and properties .................................. 333
   Preparation .................................................. 334
   Requirements and quality control ....................... 334
   Storage and transport ..................................... 334
   Labelling ..................................................... 335
   Warnings ..................................................... 335

Component monographs

Part E. White cell components ............................... 337

1. Granulocytes, Apheresis ................................. 338
   Definition and properties .................................. 338
   Preparation .................................................. 339
   Requirements and quality control ....................... 339
   Storage and transport ..................................... 340
   Labelling ..................................................... 340
   Warnings ..................................................... 341
Chapter 6  Standards for blood components for intra-uterine, neonatal and infant use ........................................... 343

Standards for blood components for intra-uterine, neonatal and infant use
Part A. Components for intra-uterine transfusions .......... 345
1. Red Cells, Leucocyte-Depleted for Intrauterine Transfusion . 346
   Definition and properties .................................... 346
   Preparation .................................................. 346
   Requirements and quality control .......................... 346
   Storage and transport .................................... 347
   Labelling ..................................................... 347
   Warnings .................................................... 347
2. Platelets, Leucocyte-Depleted for Intra-uterine Transfusion . 348
   Definition and properties .................................... 348
   Preparation .................................................. 348
   Requirements and quality control .......................... 349
   Storage and transport .................................... 349
   Labelling ..................................................... 349
   Warnings .................................................... 350

Standards for blood components for intra-uterine, neonatal and infant use
Part B. Components for neonatal exchange transfusion ...... 351
1. Whole Blood, Leucocyte-Depleted for Exchange Transfusion 352
   Definition and properties .................................... 352
   Preparation .................................................. 352
   Requirements and quality control .......................... 352
   Storage and transport .................................... 352
   Labelling ..................................................... 352
   Warnings .................................................... 353
2. Whole Blood, Leucocyte-Depleted, Plasma Reduced for
   Exchange Transfusion ..................................... 353
   Definition and properties .................................... 353
   Preparation .................................................. 353
   Requirements and quality control .......................... 354
Guide to the preparation, use and quality assurance of blood components

### 3. Red Cells, Leucocyte-Depleted, suspended in Fresh Frozen Plasma, for Exchange Transfusion

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition and properties</td>
<td>355</td>
</tr>
<tr>
<td>Preparation</td>
<td>355</td>
</tr>
<tr>
<td>Requirements and quality control</td>
<td>356</td>
</tr>
<tr>
<td>Storage and transport</td>
<td>356</td>
</tr>
<tr>
<td>Labelling</td>
<td>357</td>
</tr>
<tr>
<td>Warnings</td>
<td>357</td>
</tr>
</tbody>
</table>

### Standards of blood components for intra-uterine, neonatal and infant use

#### Part C. Components (small volume) for neonatal and infant transfusion

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Cells for Neonatal and Infant Small Volume Transfusion</td>
<td>360</td>
</tr>
<tr>
<td>Definition and properties</td>
<td>360</td>
</tr>
<tr>
<td>Preparation</td>
<td>360</td>
</tr>
<tr>
<td>Quality control</td>
<td>360</td>
</tr>
<tr>
<td>Storage and transport</td>
<td>360</td>
</tr>
<tr>
<td>Labelling</td>
<td>361</td>
</tr>
<tr>
<td>Warnings</td>
<td>361</td>
</tr>
</tbody>
</table>

### Chapter 7  Standards for autologous pre-deposit transfusion

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview</td>
<td>362</td>
</tr>
<tr>
<td>Selection of Patients for PAT and Blood Collection</td>
<td>363</td>
</tr>
<tr>
<td>Role of the physician in charge of collection</td>
<td>363</td>
</tr>
<tr>
<td>Information for donors</td>
<td>363</td>
</tr>
<tr>
<td>Contraindications or deferral criteria</td>
<td>363</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation, Storage and Distribution of Pre-deposit Autologous Blood Components</td>
<td>364</td>
</tr>
<tr>
<td>Blood typing and microbiological screening</td>
<td>364</td>
</tr>
<tr>
<td>Preparation</td>
<td>364</td>
</tr>
<tr>
<td>Labelling</td>
<td>364</td>
</tr>
<tr>
<td>Storage and handling</td>
<td>365</td>
</tr>
<tr>
<td>Warnings</td>
<td>365</td>
</tr>
</tbody>
</table>
Chapter 8  Standards for immunohaematology .................. 366
1. Overview .......................................................... 366
2. Selection and Validation of Reagents and Methods ............. 366
3. Quality Control .................................................... 367
4. Blood Group Testing of Blood Donors and Donations ........... 367
   ABO and RhD ....................................................... 368
   Additional typing ................................................. 368
   Irregular antibody testing ....................................... 368
5. Testing of Patient Samples ....................................... 368
   Blood grouping and antibody detection .......................... 369
   Compatibility testing ............................................. 369

Chapter 9  Standards for screening for infectious markers ...... 371
1. Selection and Validation of Infectious Marker Tests .............. 371
2. Mandatory Serological Screening Tests .......................... 372
3. Additional Serological Screening Tests ............................ 373
4. Management of Reactive Results in Serological Screening Tests ............................................. 373
5. Nucleic Acid Screening ............................................ 375
6. Selective Screening of Donations .................................. 375

Chapter 10 Standards for haemovigilance .......................... 377
1. Overview .......................................................... 377
2. Pre-requisites for Implementation of a Haemovigilance Network ................................................... 377
   Traceability of blood components ................................. 377
   Confidentiality of haemovigilance data .......................... 378
3. Device Defects ...................................................... 378
4. Post-transfusion Infection Reported to the Blood Establishment .................................................. 378

GOOD PRACTICE GUIDELINES ........................................ 381
   Introduction .......................................................... 381

Good practice guidelines for blood establishments and hospital blood banks required to comply with EU Directive 2005/62/EC 382
1. General principles .................................................. 382
2. Personnel and organisation ........................................... 390
3. Premises ............................................................................ 393
4. Equipment and materials .................................................... 398
5. Documentation ................................................................. 414
6. Blood collection, testing and processing ................................. 424
7. Storage and distribution ....................................................... 437
8. Contract management .......................................................... 439
9. Non-conformance ............................................................... 442
10. Self-inspection, audits and improvements ................................. 447
11. Quality monitoring and control ............................................ 447

APPENDIX 1.
KEY CRITERIA FOR DONOR ELIGIBILITY ................................. 449

APPENDIX 2.
TABLES FOR CALCULATION OF BLOOD VOLUMES ............... 467

APPENDIX 3.
DATA PROCESSING SYSTEMS .............................................. 483
1. Planning of a system ............................................................ 484
2. Defining the system ............................................................. 484
3. Implementation and validation ............................................. 485
   Functional testing of components ........................................ 486
   Data migration ................................................................. 486
   Environmental testing ....................................................... 486
   Change control ............................................................... 487
   Maintenance of the system ............................................... 487
   Quality assurance ........................................................... 488

APPENDIX 4.
STATISTICAL PROCESS CONTROL ...................................... 491
1. Introduction ................................................................. 492
2. Implementation of SPC ...................................................... 492
3. Strategy for statistical sampling .......................................... 492
   Tolerance of failure ........................................................ 493
   Confidence level ............................................................ 493
4. Frequency of control sampling ........................................... 493
   Example 1. Use of control charts .................................. 495
   Example 2. Method of scan statistics .............................. 499
   Example 3. Statistical process control for dichotomous outcomes: an approach based upon hypergeometric/binomial distributions ............................................ 502

DEFINITIONS ........................................................................ 513

ABBREVIATIONS .................................................................. 521

REFERENCES ....................................................................... 525
Recommendation No. R (95) 15

of the Committee of Ministers to member states

on the preparation, use and quality assurance of blood components

(Adopted by the Committee of Ministers on 12 October 1995 at the 545th meeting of the Ministers’ Deputies)

The Committee of Ministers, under the terms of Article 15.b of the Statute of the Council of Europe;

Considering that the aim of the Council of Europe is to achieve greater unity between its members and that this aim may be pursued, inter alia, by the adoption of common action in the health field;

Recalling its Resolution (78) 29 on harmonisation of legislations of member states relating to removal, grafting and transplantation of human substances;

Recalling also its Recommendations No. R (80) 5 concerning blood products for the treatment of haemophiliacs, No. R (81) 14 on preventing the transmission of infectious diseases in the international transfer of blood, its components and derivatives, No. R (84) 6 on
the prevention of the transmission of malaria by blood transfusion, No. R (85) 12 on the screening of blood donors for the presence of Aids markers, No. (86) 6 on guidelines for the preparation, quality control and use of fresh frozen plasma, No. R (88) 4 on the responsibilities of health authorities in the field of blood transfusion and No. R (93) 4 concerning clinical trials involving the use of components and fractionated products derived from human blood or plasma;


Taking into account Agreement No. 26 on the exchange of therapeutic substances of human origin;

Considering the importance of blood components in modern haemotherapy and the necessity to ensure their safety, efficacy and quality;

Considering that such components are of human origin and that hence specific ethical and technical principles have to be taken into account;

Considering the need for harmonisation of such principles in member states;

Considering that biotechnology does not provide substitutes for most blood products;

Convinced, therefore, of the need to provide health authorities, transfusion services as well as hospital blood banks and clinical users with a set of guidelines for the preparation, use and the quality assurance of blood components;

Aware that the Guide to the preparation, use and quality assurance of blood components published by the Council of Europe has already
become the generally accepted European standard and that it is therefore appropriate to give a legal basis to this guide;

Considering that this guide will be regularly updated by the committee of experts of the Council of Europe;

Recommends that the governments of member states take all necessary measures and steps to ensure that the preparation, use and quality control of blood components are carried out in accordance with the guidelines set out in the appendix to this recommendation.
Guide to the preparation, use and quality assurance of blood components

Appendix to Recommendation No. R (95) 15
PRINCIPLES
Chapter 1

Introduction

The Principles section of this Guide contains background information to support the Standards. It also provides information on developments that have yet to be incorporated into Standards and on technical changes in the field. This includes information on the ‘why and how’ for work in blood establishments and hospital blood banks.

In addition, several Appendices are provided at the end of this Guide. These Appendices provide detailed information on specific areas of relevance to blood establishments and hospital blood banks which are not addressed in detail elsewhere in the Guide.
Chapter 2

Principles of donor selection

1. General remarks

Principles of self-sufficiency from voluntary and non-remunerated donations have been recommended and promoted by the Council of Europe and have been defined in Article 2 of Council of Europe Recommendation No. R (95) 14 as follows:

The definition of voluntary and non-remunerated donation is:

Donation is considered voluntary and non-remunerated if the person gives blood, plasma or cellular components of his/her own free will and receives no payment for it, either in the form of cash, or in kind which could be considered a substitute for money. This would include time off work other than that reasonably needed for the donation and travel. Small tokens, refreshments and reimbursements of direct travel costs are compatible with voluntary, non-remunerated donation.

They have also been adopted by the EU in Directive 2002/98 EC, which states in the preamble (23): ‘The definition of voluntary and unpaid donation of the Council of Europe should be taken into account’, and, in Article 20 paragraph 1: ‘Member states shall take the necessary measures to encourage voluntary and unpaid blood
donations with a view to ensuring that blood and blood components are in so far as possible provided from such donations.’

Specific immunisation programmes are not considered in this document, but donors enrolled for this purpose should at least fulfil the minimum criteria outlined above (see also Annex 2, Requirements for the collection, processing and quality control of blood, blood components and plasma derivatives, WHO Technical Report Series, No. 840, 1994).

2. Overview

This chapter considers the principles for the selection of donors of whole blood and also donors of components obtained by different apheresis procedures. There are general principles which apply to all donors. Some criteria for the selection of donors vary according to the type of donation involved. There are also further requirements specific to donors of different components collected by different methods.

Selection of donors of haematopoietic progenitor cells is discussed in the Guide to the quality and safety of tissues and cells for human application (second edition, Council of Europe Publishing).

The main purpose of selecting individuals for blood and blood component donation is to determine whether the person is in good health so as to safeguard the health of both donor and recipient. All donors undergo a screening process to assess their eligibility (see Standards).

The screening process involves:

- provision of pre-donation educational material to all donors of blood or blood components;
- medical assessment of each donor.

Since blood establishments are ultimately responsible for the quality and safety of the blood and blood components collected, they are entitled to decide on the final acceptance or deferral of a donor or a prospective donor (Resolution CM/Res (2008) 5 on donor responsibility and on limitation to donation of blood and blood
components, adopted by the Committee of Ministers on 12 March 2008 at the 1021st meeting of the Ministers’ Deputies.

3. Medical assessment of the donor

In practice, a complete medical and physical examination of the donors is generally not possible. It is necessary to rely on the donors’ appearance, their answers to questions concerning their medical history, general health, and relevant risk factors (e.g. lifestyle, travel history) and on laboratory tests.

Based on this information, a decision on the eligibility of the donor will be made using accepted guidelines. Conditions that are not covered by guidelines should be referred to the physician in charge with responsibility for making the final decision.

To obtain relevant and consistent information about the donor’s medical history and general health, a standard questionnaire is to be completed at each donation. Adaptation of the questionnaire to the type of donor (first time, regular, apheresis donor, etc.) is recommended.

The key topics for donor eligibility to be covered by the questionnaire or by direct questions, the intentions of the interview questions, and examples of sample questions are included in Appendix 1.

Age of the donor

The standards set out in this Guide define age limits for donation and provide discretion to the responsible physician to accept donors outside of these limits. This medical discretion can be applied either on an individual basis for a given donor or else through a systematic approach based on an appropriate risk assessment.

Hazardous occupations

Hazardous occupations or hobbies should normally require that there is an interval of not less than 12 hours between donation and returning to the occupation or hobby. Examples of such hazardous occupations or hobbies include piloting, bus or train driving, crane
operation, climbing of ladders or scaffolding, gliding, climbing and diving.

**Donor deferral**

Considering the requirement that only healthy people are acceptable as blood donors, deferral criteria can be grouped into:

- conditions requiring permanent deferral;
- conditions requiring temporary deferral for a defined duration;
- vaccination;
- conditions requiring individual assessment;
- infectious diseases.

**Conditions requiring permanent deferral**

See Standards.

**Conditions requiring temporary deferral (suspension)**

See Standards.

**Vaccination**

See Standards.

**Conditions requiring individual assessment**

As donors may present with a variety of prior or current medical problems, only some of the more common examples are considered in Table 2-1 below.
Table 2-1. Conditions requiring individual assessment of the donor

<table>
<thead>
<tr>
<th>Condition requiring individual assessment</th>
<th>Criteria for deferral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allergy</td>
<td>Individuals with a documented history of anaphylaxis should not be accepted as donors.</td>
</tr>
<tr>
<td>Auto-immune diseases</td>
<td>If more than one organ is affected this leads to permanent deferral.</td>
</tr>
<tr>
<td>Beta-thalassaemia trait</td>
<td>Heterozygote carriers of beta-thalassaemia trait may give blood provided they are in good health and have a haemoglobin level within acceptable values.</td>
</tr>
<tr>
<td>Bronchitis</td>
<td>Persons with symptoms of severe chronic bronchitis should not be accepted as donors.</td>
</tr>
<tr>
<td>Common cold</td>
<td>Accept, if asymptomatic and feels well on the day of donation.</td>
</tr>
<tr>
<td>Hypertension(^a)</td>
<td>A person who presents with a systolic blood pressure of more than 180 mm Hg or a diastolic blood pressure of more than 100 mm Hg should not be accepted as a blood donor. A mild hypertensive, whose diastolic blood pressure is maintained at less than 100 mm Hg, may be accepted.</td>
</tr>
<tr>
<td>Pulse(^a)</td>
<td>The pulse should be regular and between 50 beats per minute (bpm) and 100 bpm. Exceptions may be made to accept donors with a lower pulse rate following individual medical review, e.g. athletes.</td>
</tr>
<tr>
<td>Jaundice and hepatitis (see Standards)</td>
<td>Hospital staff coming into direct contact with patients with hepatitis are accepted at the discretion of the physician in charge of the blood-collecting unit providing they have not suffered an inoculation injury or mucous membrane exposure, in which case they must be deferred.</td>
</tr>
<tr>
<td>Chagas disease (see Standards)</td>
<td>In some countries, donors who were born or have been transfused in areas where the disease is endemic are deferred or tested. The blood of persons who were born or have been transfused in areas where the disease is endemic should be used only for plasma fractionation products unless a validated test for infection with <em>T. cruzi</em> is negative.</td>
</tr>
</tbody>
</table>

\(^a\) Where measured.
**Post-donation information**

*See Standards.*

Systems should be in place to define the actions to be taken if a donor informs the blood establishment that he/she previously donated blood but should not have done so in the light of donor selection criteria aimed at protection of the health of recipients (e.g. in retrospect, the donor did not fulfil the criteria mentioned in the donor questionnaire).

**Infectious diseases**

Transmission of infectious agents by transfusion can be minimised by careful and appropriate use of donor questionnaires and/or laboratory testing. Donors should be questioned on their risk of exposure to infectious agents, which includes taking a travel history.

For infections in which the agent has been fully cleared from the donor’s blood on recovery, the donor should be deferred from donation until they are no longer infectious (usually 2 weeks from cessation of symptoms).

In cases of known contact with an infectious agent, the donor should be deferred for approximately twice the length of the incubation period. In case of a geographical risk of exposure to multiple infectious agents, the longest deferral period applies.

Other measures are needed for infections where there is a possibility of asymptomatic infection or existence of a carrier state. Questioning donors about symptoms in these circumstances does not always prevent transmission.

Many infections that can be transmitted by transfusion have defined geographical limits, and the risk of transfusion transmission can be minimised by temporary deferral or testing donors travelling from affected areas (see Table 2-2). Testing becomes especially relevant when deferral policies may potentially affect supply.
Table 2-2. Recommended donor deferral after exposure to infectious agents if testing is not in place

<table>
<thead>
<tr>
<th>Infectious agents</th>
<th>Incubation period (days)</th>
<th>Strategies to prevent TTI from healthy donors</th>
<th>Strategies to prevent TTI after clinical disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Nile virus</td>
<td>2-14</td>
<td>28-day deferral after leaving the risk area</td>
<td>120-day deferral after resolution of symptoms</td>
</tr>
<tr>
<td>Chikungunya virus</td>
<td>1-12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dengue fever</td>
<td>5-6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Blood services should maintain a watching brief on changes to risks of infectious diseases worldwide. Risk-benefit analyses should be carried out to determine appropriate measures to decrease the risks of infectious diseases in their own country. The risk of importation of an infectious agent through donors visiting an affected area should be balanced by considering the likelihood of this occurring, and the impact of introducing a new donor deferral ruling on blood collection. This risk will vary between countries.

New and emerging infectious agents or those that have moved to infect a new geographical area can also pose a significant challenge. The West Nile virus, dengue fever, Babesiosis, Q fever and the Chikungunya virus are examples of such viruses/diseases. In this situation, donor deferral may not be an option in the newly affected area. Donation testing is then the main tool to reduce the risk of transmission. For plasma and platelets, pathogen-reduction technology may also be considered.

Information about new and emerging infections should be communicated between countries without delay to allow blood establishments to consider their own risks and appropriate actions.

Variant Creutzfeldt-Jakob disease (vCJD) was first described in the UK in 1996. Clinical presentation differs from classical CJD in that it tends to affect a younger age group, and there is greater involvement of lymphoid tissue.
Estimating the potential size of the vCJD epidemic has been very difficult. Transfusion transmission of vCJD has been documented in animal studies and in humans.

Several measures have been taken in the UK to reduce the risk of further transmission by blood transfusion. Measures include: universal depletion of leucocytes; importation of plasma for fractionation and clinical use in children who have not been exposed to BSE through their diet; lifetime deferral of donors who have been transfused; reducing inappropriate transfusions (particularly for surgical indications). In addition, patients deemed to be ‘at risk’ because of receiving blood from an implicated donor or receiving a large amount of blood, including fractionated products, are advised not to donate blood, tissues or organs, and have special measures taken during surgery such as use of disposable or dedicated instruments.

Many countries outside the UK defer donors who have lived in the UK for a minimum defined period between 1980 and 1996; the European Medicines Agency (EMA) mandates 1 year of UK residence for donors of plasma for fractionation. In some instances the deferrals have been extended to include donors from other countries with a significant number of cases.

Endogenous risk of vCJD differs between countries. Therefore, different measures to reduce risk will be appropriate depending on each country’s own risk assessment; balancing risk with sufficiency of supply.

**History of malignancy**

Individuals with a malignant disease or a history of malignancy are usually permanently deferred (see Standards). However, there is a lack of evidence to support the theoretical concerns that cancer is transmitted via blood.

Large observational studies have provided convincing evidence that the risk of transmitting cancer via blood transfusions is undetectable or not significant.
Based on this, donors with a history of malignancy may be considered using the following criteria:

- Permanent deferral for any history of haematological malignancies (e.g. leukaemia, lymphoma, myeloma).
- Permanent deferral for any history of malignancies known to be associated with viraemic conditions (except for carcinoma in situ of the cervix, see below).
- For other cancers, the donor should have fully recovered with no expectation of recurrence (i.e. cured) and the following conditions apply:
  - for cancers with negligible metastatic potential (e.g. basal cell carcinoma and carcinoma in situ of the cervix), the donor may be accepted immediately following successful removal and cure;
  - for all other cancers, at least 5 years should have elapsed since completion of active treatment.

- No deferral is required for pre-malignant conditions.

4. Specific considerations for donors of different components

Quantity of whole blood donation

In addition to the standard volume of a whole-blood donation (see Standards), up to 35 mL of blood is collected for laboratory tests and for retention of a donation sample.

Because of the risk of adverse reactions, no more than 15 per cent of the estimated blood volume should be collected as whole blood during one blood donation. The blood volume of the donor can be calculated from their weight, height and gender using a validated formula (it is recommended to calculate the blood volume using the formula developed by the International Council for Standardisation in Haematology, ICSH). The ICSH formula is derived from a large
European study population in which measurements of red cell mass and plasma volume were carried out.¹

It is generally accepted that all men weighing ≥ 50 kg have a sufficiently large blood volume to donate a total 535 mL of blood (500 mL plus 35 mL for testing and retention of a donation sample), whilst all women weighing ≥ 50 kg have a sufficiently large blood volume to donate a total 485 mL of blood (450 mL plus 35 mL for testing and retention of a donation sample).

In case of women weighing < 65 kg and donating a total > 485 mL, the blood volume should be calculated. The calculated blood volume should exceed the minimum acceptable blood volume for the volume of blood to be collected (see Table 2-3). If the calculated blood volume is less than acceptable, a smaller volume should be collected or the donor should be deferred.

If the donation volume may exceed 15 per cent of the blood volume of the donor, blood establishments should use a blood-volume table prepared according to the ICSH formula for checking the blood volume of the donor (see examples in Appendix 2).

Table 2-3. Calculated minimum blood volume of a female donor donating 485 mL, 510 mL or 535 mL

<table>
<thead>
<tr>
<th>Volume of blood to be collected</th>
<th>Maximum percentage of blood volume collected</th>
<th>Minimum acceptable blood volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>450 mL + 35 mL</td>
<td>15%</td>
<td>3 233 mL</td>
</tr>
<tr>
<td>475 mL + 35 mL</td>
<td>15%</td>
<td>3 400 mL</td>
</tr>
<tr>
<td>500 mL + 35 mL</td>
<td>15%</td>
<td>3 567 mL</td>
</tr>
</tbody>
</table>

Frequency of whole blood donation

It is recommended that an active donor panel of sufficient size be maintained to allow donors to be bled less often than the maximum annual rates stated in Standards. Four whole blood donations for males and three donations for females should ordinarily not be exceeded per year, thereby affording the donors extra protection and giving the system flexibility to deal with large-scale emergency situations.

Laboratory examination before donation

Hb level

Haemoglobin should be measured at each donation, preferably before collection. Abnormally high and abnormally low haemoglobin values should be confirmed by a full blood count on a venous sample and, if appropriate, subsequently investigated (as should a fall in haemoglobin concentration of more than 20 g/L between two successive donations).

Iron stores

It is recognised that blood donation may result in iron deficiency in repeat blood donors. This problem may arise without it being evident through pre-donation haemoglobin measurements. This may be especially important in women of child-bearing age and in donors with inadequate dietary iron intake. Blood establishments should include appropriate measures to minimise this problem, and to protect donor health. Such measures may include:

- the provision of materials for donor education, particularly in regard to the impact of blood donation on iron stores;
- the individual tailoring of donation frequency and/or type of blood component donation based on iron status;
- the use of tests to assess iron status, such as ferritin, soluble transferrin receptor, zinc protoporphyrin and/or RBC indices;
- iron supplementation may be considered, taking into account the risk of delaying the diagnosis of unapparent underlying diseases,
such as gastric/intestinal cancer. The donor needs to be informed of the side-effects of the iron preparation.

At the same time, blood establishments should recognise that many donors currently deferred because of low haemoglobin levels are in a satisfactory state of health. Iron stores recover following an appropriate temporary deferral period. Therefore, use of appropriate measures for the prevention and management of iron deficiency in blood donors not only improves their wellbeing, but may also contribute significantly to achieving sufficiency of blood supply.

**Apheresis donors**

*General remarks*

Written informed consent should be obtained before the first apheresis procedure.

The standards require that the maximum extracorporeal volume (ECV) of 20 per cent is not exceeded. For donors weighing 50-65 kg, the total blood volume should be estimated using the approach described in Appendix 2.

The standards identify the maximum annual donation frequency, the minimum inter-donation intervals and the maximum volumes of components to be collected by apheresis.

The impact of incomplete apheresis procedures, including consideration of non-re-infusion of red cells and the amount of primary component already collected, needs to be taken into account when determining compliance with these requirements.

For apheresis procedures where cells are harvested, the haemoglobin levels defined in the standards apply.

Iron stores should be monitored in donors providing red cells by apheresis if they are donating more red cell volume/year than that allowed for whole blood donations. This is especially important for double red cell apheresis.
There is an increasing concern about long-term effects in donors in intensive apheresis programmes. This includes risks associated with citrate exposure in regular platelet apheresis donors, leading to problems with bone mineral density and diminished IgG levels after long-term intensive plasmapheresis.

Special attention should be given to the following conditions:

- abnormal bleeding episodes;
- a history suggestive of fluid retention (of special interest if steroids and/or plasma expanders are to be used);
- intake of drugs containing acetylsalicylic acid or other platelet-inhibiting components. Platelet apheresis should not be undertaken within 48 h after the last intake of acetylsalicylic acid or piroxicam;
- a history of gastric symptoms (if steroids are to be used);
- adverse reactions to previous donations.

Frequency of apheresis donation and maximal amount of collected plasma

Current recommendations are made in the absence of conclusive studies of outcomes from different regimes of volumes and frequencies of plasmapheresis. Despite some data being available from studies with several years of follow-up, further short- and long-term prospective studies are needed and should be undertaken.

The collection volume (excluding anti-coagulant) for each plasmapheresis procedure must not exceed 16 per cent of the estimated total blood volume (see Standards). The total blood volume should be calculated on the basis of gender, height and weight. Alternatively, a collection volume based on 10.5 mL per kg of body weight broadly equates to 16 per cent of estimated total blood volume. Short-term effects can be reduced by observing the maximum extracorporeal volume (ECVmax), which must never exceed 20 per cent (see Standards), with a recommended guidance value of 16 per cent.
Sampling and residual blood remaining in the plasmapheresis devices can result in a non-negligible loss of red cells, with a consequent reduction in serum iron and ferritin. This is especially important for female donors. Haemoglobin levels should be determined at each donation. The minimum value for plasmapheresis should be 120 g/L and 130 g/L for female and male donors, respectively.

The standards identify requirements for testing of donors undergoing plasmapheresis. In addition, special attention should be given to any significant fall in the results of testing, even if the results still fall within the accepted normal limits.

Additional recommendations for platelet apheresis
If undertaking high-dose platelet collection (> $5 \times 10^{11}$ platelets/unit), care should be taken to ensure that the post-donation count does not fall below $100 \times 10^9$/L.

Additional recommendations for granulocytapheresis
Clinical efficacy, indications and dosage of granulocyte transfusion have not been established. Prior to collection, the potential donor of granulocytes needs to receive medication, and sedimenting agents may be needed during the apheresis procedure. Both of these have potentially severe side-effects that need to be communicated to the donor as part of the informed consent process.

In addition to the recognised complications of routine donor apheresis, the following side-effects may occur.

- Hydroxyethyl starch (HES): acts as a volume expander. Donors who have received HES may experience headaches or peripheral oedema because of expanded circulatory volume. HES may accumulate, which can result in pruritus, and allergic reactions are possible.
- Corticosteroids: may cause, for example, hypertension, diabetes mellitus, cataracts, peptic ulcer, and psychiatric problems.
- Granulocyte colony-stimulating factor (G-CSF): the most common short-term complication following G-CSF
administration in peripheral blood stem cell (PBSC) donors is bone pain; although, on very rare occasions, splenic rupture or lung injury may occur. Concerns relating to the development of acute myeloid leukaemia (AML)/myelodysplasia (MDS) after G-CSF administration are based primarily on reports of increased rates of these disorders among women with breast cancer who received chemotherapy or patients with severe chronic neutropenia (SCN) who received G-CSF support. To date, however, registry data from Europe and the United States have not identified any increased risk of AML/MDS in over 100 000 healthy individuals who donated PBSCs and received G-CSF as pre-treatment. The median follow-up of these studies is, however, less than 5 years. Therefore, if G-CSF is given to a donor, a protocol for long-term follow-up should be in place (as advised by JACIE/FACT).¹

Additional recommendations for donors of red cells for anti-RhD immunisation

Specific protocols for donors of red cells for anti RhD immunisation should be in place and should at least include the following:

- additional testing of markers of infectious disease, such as anti-HTLV-I/II, anti-HBc and NAT tests for pro-viral HIV-DNA and HIV-RNA, antibodies against HCV-RNA, HBV-DNA, parvovirus B19DNA or parvovirus B19- antibodies, hepatitis A-RNA;

- extensive red cell phenotyping should be performed at least twice, and may be supplemented by genotyping;

- the red cells for immunisation should be stored for at least 6 months. After 6 months, all the infectious markers stated above should have been found to be negative (or indicate absence of

¹ JACIE/FACT [Internet]. International Standards for Cellular Therapy Product Collection, Processing and Administration. [available from: www.jacie.org, accessed 4 December 2014].
infection) on a new donor sample before release of the stored red cells for immunisation.

In order to manage the impact of changes in donor selection criteria and infectious marker testing that may occur over time, protocols should require:

• maintenance of retention samples from each donation suitable for future testing;
• re-qualification of past donations by assessing conformance with additional donor acceptance requirements including, where appropriate, testing of the donor and/or the retention sample sample.

Exemption of past donations from current standards is not recommended and should only be considered in exceptional circumstances after careful considerations of the risks to the immunised donors and ultimate plasma product recipients.

Designated donations

Although blood donation is voluntary, non-remunerated and anonymous, in some special circumstances it may be necessary to make use of designated donations. This should happen only for clear medical indications. Designated donors should be screened and tested like volunteer allogeneic donors.

Designated donations are those intended for named patients based on medical indications. These donations may involve family members, in which case the responsible physician should weigh up the risks and benefits for the patient. The practice of transfusing parental blood to infants is not without risk. Mothers may have antibodies to antigens that are present on the infant’s red blood cells, platelets or white blood cells. Therefore, maternal plasma should not be transfused. Fathers should not serve as cell donors to neonates because maternal antibodies to antigens inherited from the father may have been transmitted through the placenta to the foetus. In addition, due to partial histocompatibility, transfusions of cells from parental or family donors carry an increased risk of transfusion-associated graft versus
host disease, even in the immunocompetent recipient, and so such components should be irradiated. In the case of platelets, pathogen-reduction technologies for components may be used as an alternative to irradiation.

Circumstances where designated donations may be indicated include:

- for patients with rare blood types, where no compatible anonymous donations are available;
- where donor-specific transfusions are indicated for immune modulation or immunotherapy; for instance, in the preparation procedure for kidney transplants or for lymphocyte transfusions aimed at a graft-versus-leukaemia effect;
- in certain cases of allo-immune neonatal thrombocytopenia; for instance, if HPA-typed platelets are not available and intravenous immunoglobulin therapy is not sufficient.

**Directed donations**

Directed donations are those intended for named patients, where the request for the donation has been made by patients, relatives or friends. The public often believes that directed donations are safer than anonymous, voluntary, non-remunerated donations. However, this is not the case; even if directed donations are screened and tested in the same manner as voluntary non-remunerated donations, infectious disease marker rates are generally higher among directed donors.

Directed donations are not considered good practice and should be discouraged.
Chapter 3

Principles of blood collection

1. Overview

Records should be kept for each activity associated with the donation. The record should also reflect any unsuccessful donation, the rejection of a donor, adverse reactions or unexpected events. A qualified health professional should sign the donor selection records and the final assessment.

Sterile collection systems should be used in accordance with the instructions of the manufacturer. A check should be made before use to ensure that the collection system used is not damaged or contaminated and that it is appropriate for the intended collection. Defects in blood bags should be reported to the supplier and subjected to trend analysis.

The donor identification, donor selection interview and donor assessment should take place before each donation. The donor should be re-identified immediately prior to venepuncture.

2. Premises for donor sessions

When the venue of the donor session is permanent and under the control of the transfusion establishment, provision should be made for proper cleaning by, for example, the use of a non-slip, washable
floor material that is installed so as not to have inaccessible corners and by avoiding having internal window ledges, etc. If possible, air-conditioning units should be used to provide ventilation to avoid the need for open windows. Air changes, together with temperature and humidity control, should be adequate to cope with the maximum number of people likely to be in the room and with the heat output from any equipment used.

When sessions are performed by mobile teams, a realistic attitude towards environmental standards may be taken. Factors to consider should include adequate heating, lighting and ventilation, general cleanliness, provision of a secure supply of water and electricity, adequate sanitation, compliance with fire regulations, satisfactory access for unloading and loading of equipment by the mobile team, adequate space to allow free access to the bleed and rest beds.

3. **Equipment used at blood donation sessions**

It is recommended that the manufacturer’s identity and container information (catalogue number and the container number of the set), as well as the manufacturer’s lot number, should be given in eye- and machine-readable codes.

4. **Pre-donation checks and labelling**

Defects may be hidden behind the label pasted on the container. Abnormal moisture or discolouration on the surface of the bag or label after unpacking suggests leakage through a defect.

The unique identity number usually consists of a code for the responsible blood collection organisation, the year of donation and a serial number.

5. **Venepuncture**

**Preparation of the venepuncture site**

The venepuncture site should be prepared using a defined and validated disinfection procedure. The effectiveness of the disinfection
procedure should be monitored and corrective action taken where indicated.

Although it is impossible to guarantee 100 per cent sterility of the skin surface for phlebotomy, a strict, standardised procedure for the preparation of the phlebotomy area must exist (see Standards). Of particular importance is that the antiseptic solution used be allowed to dry completely before venepuncture. The time taken for this to happen will vary with the product used, but an absolute minimum of 30 s should be applied.

The prepared area must not be touched before the needle has been inserted (see Standards).

**Successful venepuncture and proper mixing**

If an anti-coagulant solution is used, the collection bag should be mixed gently immediately after collection has begun and at regular intervals thereafter during the entire collection period. The maximum collection time for acceptance of the donation for component processing should be specified and controlled. Donations that exceed the maximum time period should be recorded and discarded.

Proper mixing of the blood with the anti-coagulant is essential at all phases of the collection.

Attention should be paid to the following:

- as the blood begins to flow into the collection bag, it must immediately come into contact with the anti-coagulant and be properly mixed;

- the flow of the blood must be sufficient and uninterrupted;

- donation of a whole blood unit should ideally not last more than 10 minutes. If the duration of the collection is longer than 12 minutes, the blood should not be used for the preparation of platelets. If the duration of the collection is longer than 15 minutes, the plasma should not be used for direct transfusion or for the preparation of coagulation factors;
• in the case of apheresis, any unintended interruption of the flow occurring during the procedure should be evaluated for possible exclusion of that blood component.

**Handling of filled containers and samples**

At completion of the donation, the donation number issued should be checked on all records, blood bags and laboratory samples. Donation number labels that have not been used should be destroyed via a controlled procedure. Routine procedures to prevent misidentification should be in place.

If integral blood bag collection tubing is to be used to prepare segments for testing, it should be sealed off at the end and then filled with anti-coagulated blood as soon as possible after blood collection.

After blood collection, the blood bags should be handled, transported and placed into storage according to defined procedures.

Immediately after sealing the distal end of the collection bag, the contents of the bag line should be completely discharged into the bag.

The process should minimise the possibility of errors in labelling of blood containers and blood samples. It is recommended that each donor bed should have individual facilities for the handling of samples during donation and labelling.

Laboratory test samples should be taken at the time of donation. Procedures should be designed to minimise the risk of bacterial contamination of the collected blood or deterioration of the sample, and to prevent potential misidentification.

The test samples should be taken directly from the bleed line or from a sample pouch (deviation bag) of the collection system.

If samples are taken at the end of donation, this must be done immediately.

The blood bag and corresponding samples must not be removed from the donor’s bedside until correct labelling has been checked and verified.
After collection, blood bags should be placed promptly into controlled-temperature storage and transported to the processing site under temperature conditions appropriate for the component that is to be prepared. There should be validation data to demonstrate that the storage and transport conditions used after collection ensure maintenance of the blood within the specified temperature range.

6. Apheresis

Pre-medication and apheresis
With the exception of granulocyte donors, pre-medication of donors for the purpose of increasing component yield is not recommended. Caution is recommended regarding pre-treatment of donors with corticosteroids and G-CSF.

Automated apheresis
It is recommended to exercise caution to prevent any misconnection of the different components of the apheresis set; in particular, confusion between anti-coagulant and saline, which could result in serious adverse reaction in donors (deaths from citrate overload have been reported).

Manual apheresis
Manual apheresis is no longer recommended.

7. Repository of archive samples
Retention of donor samples for a period of time may provide useful information. Provision of such systems is contingent on the availability of adequate resources.

If archive samples from the donations are kept, then procedures must be in place prescribing their use and final disposal (see Standards).
8. Management of adverse reactions in donors

Special attention should be given to all donors in whom an adverse reaction in relation to blood donation has been identified.

In the case of an adverse reaction, the donor should be referred as soon as possible to the responsible healthcare worker/physician in charge.

The source of the adverse reaction should be identified and corrective and preventive measures considered.

All adverse reactions, including the treatment and preventive actions taken, should be documented in the donor’s records and those of the quality system.

Severe adverse reactions in donors should be reported to the nationally established haemovigilance system (see Chapter 10, Principles of haemovigilance; and Chapter 10, Standards of haemovigilance).

### Table 3-1. Examples of adverse reactions related to blood collection

<table>
<thead>
<tr>
<th>Local reactions related to needle insertion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel injuries</td>
</tr>
<tr>
<td>Haematomas</td>
</tr>
<tr>
<td>Arterial puncture</td>
</tr>
<tr>
<td>Thrombophlebitis</td>
</tr>
<tr>
<td>Nerve injuries</td>
</tr>
<tr>
<td>Injury of nerve</td>
</tr>
<tr>
<td>Injury of nerve by haematoma</td>
</tr>
<tr>
<td>Other complications</td>
</tr>
<tr>
<td>Tendon injury</td>
</tr>
<tr>
<td>Allergic reaction (local)</td>
</tr>
<tr>
<td>Infection (local)</td>
</tr>
<tr>
<td>General reactions</td>
</tr>
<tr>
<td>Vasovagal reaction</td>
</tr>
<tr>
<td>Immediate type</td>
</tr>
<tr>
<td>Delayed type</td>
</tr>
</tbody>
</table>
## Rare, significant complications

<table>
<thead>
<tr>
<th>Related to vessel injury</th>
<th>Pseudoaneurysm in the brachial artery</th>
<th>Arteriovenous fistulae</th>
<th>Compartment syndrome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidents</td>
<td>Accidents or injuries related to vasovagal syncope</td>
<td>Other kinds of accidents</td>
<td></td>
</tr>
<tr>
<td>Cardiovascular reactions</td>
<td>Angina pectoris</td>
<td>Myocardial infarction</td>
<td>Cerebral ischaemia</td>
</tr>
<tr>
<td>Related to apheresis procedures</td>
<td>Citrate toxicity</td>
<td>Systemic allergic reaction</td>
<td>Anaphylaxis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Haemolysis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Air embolism</td>
</tr>
</tbody>
</table>

## Prevention of adverse reactions in donors

Prospective donors must be informed of the possible adverse reactions of blood donation and how they can be prevented.

Training of the personnel collecting blood should include preventing and recognising the (early) signs of adverse reactions and their rapid treatment.

The physician in charge is responsible for the medical supervision of blood collection, and each session must be staffed with a qualified healthcare professional.

## Treatment of adverse reactions in donors

The treatment of adverse reactions related to blood donation must be described in standard operating procedures.

Staff must be properly and regularly trained to be attentive for the early signs of an adverse reaction and be able to respond immediately with the appropriate action.
In each collection facility, a specific space should be reserved for dealing with donors who have an adverse reaction.

The donor should be observed until fully recovered and, in the event of a serious adverse reaction, the blood establishment must remain in contact with the donor until the complication has disappeared or the donor is in a stable condition.

**Documentation of adverse reactions in donors**

The treatment and outcome of all adverse reactions related to blood donation, at any stage of the procedure, must be fully documented.

The medical supervisor must be immediately informed about all serious adverse reactions.

Data should be collected and analysed in order to initiate corrective actions that could prevent or reduce the frequency or minimise the severity of adverse reactions in the future.

Serious adverse reactions must also be reported to the appropriate national authority.

**Information for a donor with adverse reactions**

When an adverse reaction occurs, the donor must be informed about the reaction, its treatment and the expected outcome. The donor should be given the opportunity to contact the on-call physician of the blood establishment at any time.

The collection staff should instruct the donor in post-collection care and they should keep the donor under observation until he/she is released.

In particular, a donor who has experienced vasovagal reactions should be informed about the risk of delayed fainting. The donor should not drive a vehicle or resume work or any hazardous occupation or hobby in the ensuing 12 hours if delayed fainting could put the donor or other persons at risk.
9. Donor clinic documentation

Full records should be maintained at blood donation sessions to cover the following parameters:

- the blood component(s) collected, the date, donation number, identity and medical history of the donor;
- the date, donation number, identity and medical history of the donor for each unsuccessful donation, together with reasons for the failure of the donation;
- recording of rejected donors following assessment, together with the reasons for their rejection;
- full details of any adverse reactions in a donor at any stage of the procedure;
- in the case of apheresis, the volumes of blood collected, blood processed, and replacement solution and anti-coagulant used.

As far as possible, the records of blood donation sessions should allow blood transfusion staff to identify each important phase associated with the donation. These records should be used for the regular compilation of statistics, which should be studied by the individual with ultimate responsibility for the blood donation session, who can take appropriate actions as deemed necessary.
Chapter 4

Principles of blood component processing

1. Overview
In the past, transfusion therapy was largely dependent on the use of whole blood. While whole blood may still be used in certain limited circumstances, the main thrust of modern transfusion therapy is to use the specific component that is clinically indicated. Components are those therapeutic constituents of blood that can be prepared by centrifugation, filtration and freezing using conventional blood bank methodologies.

Transfusions are used mainly for the following purposes:

- to maintain oxygen/carbon dioxide transport;
- to correct or avoid bleeding and coagulation disorders.

Clearly, whole blood is not necessarily suitable for all these purposes, unless the patient requiring treatment has multiple deficiencies. Even then, frequent storage defects in whole blood make it unsuitable. Patients should only be given the component needed to correct their specific deficiency. This avoids unnecessary and possibly harmful infusions of surplus constituents. The change from collecting blood in glass bottles to multiple plastic bag systems has greatly facilitated the
preparation of high-quality components. Storage considerations are a major reason for promoting the use of individual blood components. Optimal conditions and, consequently, shelf-lives vary for different components. Red cells maintain optimal functional capability when they are refrigerated. The quality of plasma constituents is best maintained in the frozen state while platelet storage is optimal at room temperature (20-24 °C) with continuous agitation. Thus, only the storage requirements of red cells are fulfilled if whole blood is refrigerated, with a consequent loss of therapeutic effectiveness of most of the other constituents.

Component therapy also offers logistic, ethical and economic advantages. The majority of patients requiring transfusions do not need the plasma in a whole blood unit. Production of plasma-derived products can thus be facilitated by the use of red cells rather than whole blood. Leucocyte depletion may further improve the quality of blood components.

2. Processing procedures

Processing procedures should detail the specifications for materials, since these influence the quality of the final blood component. In particular, specifications should be in place for blood and blood components (intermediate and final components), starting materials, additive solutions, primary packaging materials (bags) and equipment.

Premises used for the processing of blood components should be maintained in a clean and hygienic condition. The bacterial load on critical equipment, surfaces, and the environment of the processing areas should be monitored.

Sterile connecting devices should be used in accordance with a validated procedure. The resulting joint between devices should be checked for satisfactory alignment and its integrity should be validated. If validated and properly used, connections achieved using sterile connecting devices can be regarded as closed system processing.
There should be a system of administrative and physical quarantine for blood and blood components to ensure that they cannot be released until all mandatory requirements have been satisfied.

Blood components may be prepared during collection using apheresis technology. Plasma, leucocytes, platelets and red cell concentrates may be obtained in this way. Alternatively, whole blood may be collected in the traditional manner, with individual components extracted using post-donation processing of whole blood.

Time limits should be defined for the processing of blood components. Due to the potential deterioration of activity and functionality of labile blood components, the conditions of storage and time before processing are vital to preparation of high-quality blood components. Delays in preparation or unsuitable storage conditions may affect the quality of the final components adversely.

3. **Choice of anti-coagulant and bag system**

Whole blood is collected into a bag containing an anti-coagulant solution. The solution contains citrate and cell nutrients such as glucose and adenine. The first centrifugation steps remove more than half of these nutrients from the residual red cells. Thus, it may be more logical to provide the proper nutrients for the cells using a re-suspension medium instead of incorporating them in the initial anti-coagulant solution.

Plastic ware used for blood collection, apheresis and component preparation should comply with the requirements of the relevant monographs of the European Pharmacopoeia with regard to haemocompatibility, in addition to its suitability for achieving the respective technological goal. Polyvinylchloride (PVC) has been found to be satisfactory for red blood cell storage. Biocompatibility of any plasticisers used must be ensured. Storage of platelets at +20-24 °C necessitates use of a plastic with increased oxygen permeability. This feature has been achieved by plastic materials of alternative physical and/or chemical characteristics. Leaching of plasticisers into blood/blood component should not pose undue risk to the recipient. Any
possible leaching of adhesives from labels or other device components should be kept within acceptable safety limits. Care should be taken to minimise the levels of residual toxic substances after sterilisation (e.g. ethylene oxide).

Whenever use of new plastics is being considered, an adequate study of component preparation and/or storage should be conducted. The following parameters could be useful:

- **red blood cells**: glucose, pH, haematocrit, haemolysis, ATP, lactate, extracellular potassium and 2, 3-bisphosphoglycerate;
- **platelets**: pH, pO$_2$, pCO$_2$, bicarbonate ion, glucose, lactate accumulation, ATP, P-selectin, LDH release, beta thromboglobulin release, response from hypotonic shock and swirling phenomenon, morphology score and extent of shape change;
- **plasma**: Factor VIII and signs of coagulation activation (e.g. thrombin–anti-thrombin complexes).

These studies are normally carried out by the manufacturer before introduction of the new plastics and the results should be made available to the transfusion services.

The suitability of new plastics can be determined by the evaluation of post-transfusion *in vivo* recovery and survival of autologous red cells after 24 hours and by the assessment of platelet recovery, survival and corrected count increments (CCI).

In order to maintain a closed system throughout the separation procedure, a multiple bag configuration (either ready-made or sterile-docked) should be used. The design and arrangement of the packaging system should permit sterile preparation of the desired component.

Although use of closed systems is recommended for all steps in component processing, open systems may sometimes be necessary due to local constraints. If open systems are employed, they should be carried out in an environment designed specifically to minimise the risk of bacterial contamination, and careful attention should be given to use of aseptic procedures. Red cells prepared in open systems
should be transfused within 24 hours of processing. Platelets prepared in open systems should be transfused within 6 hours of processing.

4. **Centrifugation of blood components**

The sedimentation behaviour of blood cells is determined primarily by their size as well as the difference of their density from that of the surrounding fluid (see Table 4-1 below). Other factors are the viscosity of the medium and flexibility of the cells (which is temperature-dependent). The optimal temperature for centrifugation with respect to these factors is +20 °C or higher.

**Table 4-1. Volume and density of principal blood constituents**

<table>
<thead>
<tr>
<th></th>
<th>Mean density (g/mL)</th>
<th>Mean corpuscle volume (10^{-15} L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma</td>
<td>1.026</td>
<td></td>
</tr>
<tr>
<td>Platelets</td>
<td>1.058</td>
<td>9</td>
</tr>
<tr>
<td>Monocytes</td>
<td>1.062</td>
<td>470</td>
</tr>
<tr>
<td>Lymphocytes</td>
<td>1.070</td>
<td>230</td>
</tr>
<tr>
<td>Neutrophils</td>
<td>1.082</td>
<td>450</td>
</tr>
<tr>
<td>Red cells</td>
<td>1.100</td>
<td>87</td>
</tr>
</tbody>
</table>

In the first phase of centrifugation, the surrounding fluid is a mixture of plasma and anti-coagulant solution. Leucocytes and red cells centrifuge out more rapidly than platelets as they both have a bigger volume than platelets. Depending on the time and speed of centrifugation, most of the leucocytes and red cells settle in the lower half of the bag and the upper half contains platelet-rich plasma. More prolonged centrifugation results also in platelet sedimentation, driven by a force proportional to the square of the number of rotations per minute and the distance of each cell to the centre of the rotor, whereas the leucocytes (now surrounded by a fluid of higher density, i.e. the
red cell mass) move upwards. At the end of centrifugation, cell-free plasma occupies the upper part of the bag and red cells are at the bottom.

Platelets accumulate on top of the red cell layer, while the majority of leucocytes are to be found immediately below the platelets in the top 10 mL of the red cell mass. Haematopoietic progenitor cells have similar characteristics to normal mononuclear blood cells. However, this component may be contaminated with immature or malignant cells from different haematopoietic lineages, which commonly have larger sizes and lower densities than their mature counterparts.

The conditions of centrifugation, such as g-force, acceleration, time, deceleration, etc., determine the composition of the desired component. For example, if platelet-rich plasma is desired, centrifugation should stop prior to the phase where platelet sedimentation commences. A low centrifugation speed allows for some variation in centrifugation time. If cell-free plasma is required, fast centrifugation for an adequate time allows separation into cell-poor plasma and densely packed cells. It is important that the optimal conditions for good separation be carefully standardised for each centrifuge. A number of options exist for the selection of a procedure for centrifugation for the preparation of components from whole blood.

Table 4-2 below outlines five different methods of performing the first step in the separation of whole blood as well as the approximate composition of the resulting initial components. The choice of the initial separation step strongly influences the choice of methods for further processing of the initial fractions. This leads to a system of interdependent preparation procedures for blood components and reference should always be made to the initial separation step.
Table 4-2. Five different methods of initial separation of whole blood and the approximate composition of the fractions obtained (figures refer to a standard donation of 450 mL ± 10 per cent, with 60-70 mL of anti-coagulant)

<table>
<thead>
<tr>
<th>Method</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial filtration</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>Centrifugation speed</td>
<td>low</td>
<td>low</td>
<td>high</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>Separation into</td>
<td>plasma + buffy coat + red cells</td>
<td>plasma + buffy coat + red cells</td>
<td>plasma + buffy coat + red cells</td>
<td>plasma + red cells</td>
<td>plasma + red cells, leucocyte-depleted</td>
</tr>
</tbody>
</table>

**Resulting crude fractions**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Plasma volume</td>
<td>200-280 mL</td>
<td>200-280 mL</td>
<td>270-320 mL</td>
<td>270-330 mL</td>
<td>240-290 mL</td>
</tr>
<tr>
<td>Platelets</td>
<td>70-80%</td>
<td>70-80%</td>
<td>10-20%</td>
<td>10-20%</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Leucocytes</td>
<td>5-10%</td>
<td>5-10%</td>
<td>2-5%</td>
<td>2-5%</td>
<td>&lt; 0.01%</td>
</tr>
</tbody>
</table>

**Red cells**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Haematocrit</td>
<td>0.75-0.80</td>
<td>0.65-0.75</td>
<td>0.85-0.90</td>
<td>0.80-0.90</td>
<td>0.80-0.90</td>
</tr>
<tr>
<td>Platelets</td>
<td>5-15%</td>
<td>20-30%</td>
<td>10-20%</td>
<td>80-90%</td>
<td>&lt; 1%</td>
</tr>
<tr>
<td>Leucocytes</td>
<td>25-45%</td>
<td>90-95%</td>
<td>25-45%</td>
<td>95-98%</td>
<td>&lt; 0.01%</td>
</tr>
</tbody>
</table>

**Buffy coat**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Haematocrit</td>
<td>0.50-0.70</td>
<td>0.40-0.60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red cells</td>
<td>10-15%</td>
<td>10-15%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platelets</td>
<td>10-25%</td>
<td>80-90%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leucocytes</td>
<td>60-70%</td>
<td>50-70%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subscripted note: Where initial filtration is not used, centrifugation is the first step.
5. **Component separation**

**Separation after the initial centrifugation**

After centrifugation, the bag system should be carefully removed from the centrifuge. The primary bag should then be placed into a plasma extraction system and the layers transferred, one by one, into satellite packs within the closed system.

The choice to be made is whether or not the buffy coat is to be separated from the sedimented cells. The advantage of separation of the buffy coat is that red cells are relatively leucocyte-poor, which prevents formation of aggregates during storage. The red cells can be re-suspended into a solution designed to offer optimal conditions for red cell storage, e.g. saline-adenine-glucose-mannitol (SAGM). The re-suspension can still be done within the closed system. Plasma, after separation, can be frozen and stored as fresh frozen plasma to be used as such or as a starting material for other products, such as medicinal products derived from human plasma.

Table 4-2 provides an estimation of the results that can be obtained using initial centrifugation (4 options) or initial filtration (1 option).

Depending on the choice of technique for component preparation:

- methods I and II are followed by re-centrifugation of the platelet-rich plasma for the preparation of cell-free plasma and platelet concentrate;
- method III is followed by the preparation of platelet concentrate from the buffy coat.

**Separation after initial filtration**

Whole blood may be filtered for leucocyte depletion prior to high-speed centrifugation. This procedure enables separation into almost cell-free plasma and leucocyte-depleted (and platelet-depleted) red cells.
Other separation principles

Zonal centrifugation

Sedimentation of blood cells can be achieved when a centrifugal force is exerted on flowing blood more or less perpendicularly to the direction of the blood flow. The efficiency of the separation depends on the ratio between the centrifugal force and the flow velocity. At a high ratio, the plasma obtained is platelet-poor and, at a lower ratio, platelet-rich plasma can be obtained.

A number of apheresis devices are available in which this principle is applied for the production of cell-poor plasma or platelet-rich plasma.

A further application of zonal centrifugation is the removal of plasma proteins from a blood cell suspension. A unit of blood cells is introduced into the centrifuge bowl. Then, a flow of washing fluid is maintained until the protein concentration in the effluent is reduced sufficiently. Centrifugation is discontinued and the ‘washed’ blood cell suspension can be harvested.

The same principle is also used for both the addition and the removal of cryoprotectant before freezing and after thawing of cryopreserved blood cell suspensions.

Buoyant density centrifugation

Buoyant density centrifugation of blood, bone marrow or buffy coat cells on top of a layer with a density of 1.077 g/mL leads to a layer of mononuclear cells floating on the interface and a pellet of red cells and granulocytes that have penetrated through the separating medium according to the density of the cells involved.

Buoyant density separation is generally applicable for separations based on density differences between cells, e.g. for the separation of cells complexed with red cells and to separate rosetted from non-rosetted cells.
Counter-current centrifugation (elutriation)

Cells that are simultaneously subjected to a liquid flow and a centrifugal force in opposite directions tend to be separated according to their size. This property has been applied in cell separators to collect apheresis platelet concentrates with reduced leucocyte content which, for some devices, may reach the specification of leucocyte depletion (i.e. < 10^6 leucocytes per unit).

Using specific centrifuges, counter-current centrifugation is also used to separate sub-populations of mononuclear cells obtained from blood or bone marrow.

Filtration

At present, two major types of filtration are available for blood component preparation:

- the separation of plasma from blood by tangential filtration;
- the removal of leucocytes from cell suspensions by depth-filtration or surface filtration.

Tangential filtration

When blood flows along a membrane with a pore size allowing free passage of plasma proteins but not of blood cells, cell-free plasma may be obtained by filtration.

Plasmapheresis devices have been developed in which a pumping system takes blood from the donor’s vein, mixes it at a constant ratio with an anti-coagulant solution and then passes it over a plasma-permeable membrane (flat membrane or hollow fibre system). Two pressures are exerted on the blood: one parallel to the membrane, keeping the blood flowing along the membrane, and the other perpendicular to the membrane, the actual filtration pressure. This system prevents accumulation of cells on the membrane while plasma is removed from the blood (the haematocrit in the system may increase from 0.40 to 0.75). In some devices, the velocity of the flow parallel to the membrane can be increased by an additional vortex action or by movement of the membrane.
When a specified extra-corporeal cell volume has been reached, the cells are re-infused back to the donor, and the next cycle starts until the required volume of cell-free plasma has been obtained.

**Depth and surface filtration**

Owing to the specific properties of platelets and granulocytes, as well as the low flexibility of lymphocytes, these cells are trapped more easily in a filter bed of fibres than red cells. Four mechanisms of trapping are used for leucocyte depletion of red cell concentrates:

- the activation of platelets leading to the attachment of these cells to the fibres in the top of the filter, followed by the interaction of the attached platelets and granulocytes;
- the activation of granulocytes by another type of fibre leading to attachment of these cells in the middle part of the filter;
- the obstruction of the lymphocytes in the pores and fork junctions of the finest fibre material in the bottom layers of the filter. Blow-moulded mats of fibrous material with different pore sizes and fibre thicknesses can be used to produce leucocyte depletion filters for red cell concentrates;
- surface treatment of the filter material allows the production of filters that reduce contamination by leucocytes in platelet concentrates by sieving and may prevent activation of platelets.

Filters used for leucocyte removal from red cells or platelets show considerable variations in efficacy and capacity. Besides filter properties, the final result of filtration is influenced by several process parameters (e.g. flow rate, temperature, priming and rinsing) and properties of the component to be filtered (e.g. storage history of the component, number of leucocytes and number of platelets). When a standardised filtration procedure is established, limits must be set for all the variables affecting the efficacy of filtration. The SOPs should be fully validated under the process conditions to be used.
Washing of cellular components

This technique is occasionally used when there is a requirement for cellular blood components with a very low level of plasma protein.

6. Leucocyte depletion

The introduction of any leucocyte depletion process, either by a filtration or special centrifugation technique, needs careful validation. An appropriate method should be used for counting leucocytes after leucocyte depletion. This method should be validated.

The validation should be carried out by the blood establishment using the manufacturer’s instructions against the requirements for leucocyte depletion and other quality aspects of the components, including plasma for fractionation.

To enable a comparison of the filters that can be used for leucocyte depletion and to facilitate selection between them, manufacturers should report data on their system performances under defined conditions. Manufacturers should also provide performance data to the blood establishment on variations between different filter types or modifications and between batches.

Mathematical models have been developed to calculate the sample size necessary to validate and control the leucocyte depletion process.

After full validation of the process, tools such as statistical process controls could be used to detect any on-going changes in the process and/or the procedures.

Particular problems may arise with donations from donors with red cell abnormalities (e.g. sickle-cell traits) where adequate leucocyte depletion may not be achieved and more detailed quality control procedures are necessary (e.g. leucocyte counting of every donation). The quality of the red cells collected after slow filtration processes needs further investigation.
7. Freezing and thawing of plasma

Rationale

Freezing is a critical step in the preservation of some plasma proteins, including coagulation factors (in particular Factor VIII). During freezing, pure ice is formed and the plasma solutes are concentrated in the remaining water. Each solute forms crystals when the solubility of the solutes is exceeded, but this may be influenced by the anticoagulants used.

Ice formation depends on the rate of heat extraction, whereas the diffusion rates of the solutes determine their displacement. At slow freezing rates, the diffusion of solutes is better adapted to the rate of ice formation and so solutes are increasingly concentrated in the middle of a plasma unit.

Since all solutes are displaced simultaneously, the Factor VIII molecules are exposed to a high concentration of salts for a prolonged period of time and are thus inactivated. At a high freezing rate, ice formation overtakes solute displacement. Hence, small clusters of solidified solute are trapped homogeneously in the ice without prolonged contact between the highly concentrated salts and Factor VIII.

To achieve the highest yield of Factor VIII, plasma should be frozen to −25 °C or lower.

A reduction in Factor VIII content occurs during freezing when the solidification of plasma takes more than one hour. This can be monitored by measuring the total protein content of a core sample of the frozen plasma; the protein concentration should be identical to the total protein content of plasma before freezing. Heat extraction of 38 kcal per hour per unit of plasma is an optimal freezing rate, and can be monitored by use of thermocouples.

To incorporate these methods effectively into a coherent daily routine, the staff of the blood establishment must be familiar with the rationale behind the method, as well as its potential limitations and pitfalls.
Methods of freezing

If freezing plasma, the rate of cooling should be as rapid as possible and, optimally, should bring the core temperature down to \(-25 \, ^\circ\text{C}\) or below within 60 minutes.

Experience has shown that without the use of a snap-freezer, it takes several hours to reach this temperature. This time can be reduced, for example, by placing plasma batches in a regular configuration to maximise exposure to the freezing process (e.g. bags laid flat or, if vertical, in formers) and immersed in an environment at a very low temperature. If a liquid environment is used, it should have been demonstrated that the container cannot be penetrated by the solvent (see Standards, Chapter 5, Component Monographs, and the relevant European Pharmacopoeia monographs for the required storage conditions of individual blood components for further fractionation and manufacturing of medicinal products derived from human plasma).

Methods of thawing

Frozen units should be handled with care since the bags may be brittle. The integrity of the pack should be verified before and after thawing to exclude any defects and leakages. Leaky containers must be discarded. The product should be thawed immediately after removal from storage in an appropriately controlled environment at \(+37 \, ^\circ\text{C}\) and according to a validated procedure. After thawing of frozen plasma, the content should be inspected to ensure that no insoluble cryoprecipitate is visible.

The product should not be used if insoluble material is present. To preserve labile factors, plasma should be used as soon as possible after thawing. It should not be refrozen.

Thawing of the plasma is an inevitable part of some current viral inactivation processes, after which the products may be refrozen. In order to preserve viable components, the final component should be used immediately following thawing for clinical use and not further refrozen.
Cryoprecipitation
The isolation of some plasma proteins, most importantly Factor VIII, vWF, fibronectin and fibrinogen, can be achieved by making use of their reduced solubility at low temperatures. In practice, this is done by freezing units of plasma, thawing and then centrifuging them at low temperature.

Details regarding the freezing, thawing, and centrifugation conditions required for cryoprecipitate production are given in Standards, Chapter 5, Component monographs.

8. Open and closed systems and sterile connection devices
It is recommended that any new developments in component preparation involving an open system should be subjected to intensive testing during the developmental phase to ensure maintenance of sterility.

Blood components prepared by an open system should be used as quickly as possible.

Components prepared in systems using fully validated sterile connecting devices may be stored as if prepared in a closed system. Monitoring should be carried out by pressure testing of all connections and regular traction tests.

9. Irradiation of blood components
Viable lymphocytes in blood components can cause fatal transfusion-associated graft versus host disease, particularly in severely immune-compromised patients, e.g. patients undergoing haematopoietic transplantation, children with inherited cellular immunodeficiency syndromes and some low birth weight neonates. Other clinical settings with an increased risk of this rare complication include intra-uterine transfusion, transfusion between family members and transfusion of HLA-matched components.
Lymphocytes can be rendered non-viable by exposure to irradiation. Irradiation at doses specified in the Standards does not cause significant harm to other blood cells. Therefore, an irradiated component can be given safely to all patients. However, the *in vitro* quality of irradiated red cells deteriorates faster during storage than the quality of non-irradiated red cell components. Therefore, irradiation leads to a reduced shelf-life of red cell components (see Standards).

10. **Prevention of CMV transmission**

Cytomegalovirus (CMV) is a common infectious agent that can be transmitted via the transfusion of blood components. The risk of disease transmission is highest with fresh components containing mono- and poly-morphonuclear leucocytes. CMV infection is often asymptomatic in healthy persons. Antibodies usually appear 4 to 8 weeks after infection and can be demonstrated in standard screening tests. Since the infection is common, the test has to be repeated on each donation from a previously sero-negative donor.

Infection caused by this virus is usually not clinically significant in immuno-competent recipients, but can cause severe, even fatal, disease in certain patients not previously exposed to the virus such as:

- transplant recipients;
- patients with severe immuno-deficiency;
- foetuses (intra-uterine transfusion);
- anti-CMV-negative pregnant women;
- low-weight premature infants and neonates.

These patients should receive components selected or processed to minimise the risk of CMV infectivity. The use of components from anti-CMV-negative donors or leucocyte-depleted components significantly reduces the risk of CMV transmission and CMV disease in immuno-compromised patients. However, neither method nor a combination of them can completely prevent transmission due to occasional cases of CMV viraemia in the early stage of acute infection.
There is no consensus on the requirement for CMV screening in blood services that undertake universal leucocyte depletion of blood components. Some services (especially in areas that have a high seroprevalence of CMV) have ceased antibody screening, but others believe that the combination of antibody screening and leucocyte depletion may confer additional safety.

11. Pathogen reduction technologies

The aim of pathogen reduction technologies (PRT) is to remove or inactivate bacteria and/or other pathogens (viruses, parasites) using physical and/or chemical methods. So far, it has not been possible to treat whole blood donations, so blood must be separated into its component parts before use of PRT.

Systems for PRT of plasma components have been available and used routinely in Europe for many years. There are currently no licensed systems for PRT of red cells, but such systems are currently under development.

Several devices are CE-marked for PRT of platelets. These involve the addition of a photo-sensitising chemical to platelets in combination with exposure to UV light. An alternative system is being developed, which is based on exposure of platelets to UV light alone and does not require the addition of any chemicals.

Currently available systems have been demonstrated to inactivate a wide range of viruses, bacteria, parasites and leucocytes. They do not reduce infectivity associated with prion proteins and, hence, vCJD risk.

With regard to the efficacy of PRT of platelets, there is some loss of platelets in the process. However, this can be compensated for by an increase in collection volume for apheresis platelets or an increase in the number of buffy coats used in pooled platelets. Most clinical studies have demonstrated a reduced corrected count increment compared to untreated control platelets, and one study found an increase in bleeding risk associated with this phenomenon. Other studies have not shown a significant effect on clinical bleeding
parameters. Other potential risks include toxicity and neo-antigen formation; neither has been observed in haemovigilance studies of short duration, but longer-term surveillance studies will be required to confirm the absence of long-term toxicity. One study has shown that PRT of platelets can be implemented in routine practice without impacting on utilisation of platelets or red blood cells or with a reduction of acute transfusion reactions. PRT of platelets potentially allows the extension of the shelf-life of platelets to 7 days, with the consequent benefit in reducing platelet wastage. A further advantage of some PRT is inactivation of lymphocytes, which obviates the need for irradiation of platelets.

A symposium was held under the aegis of the EDQM/Council of Europe on implementation of PRT for blood components on 2-3 September 2010. A consensus on implementation did not emerge. It was noted that countries have adopted different positions with regard to the implementation of PRT depending on differences in the risk of pathogens. An executive summary including recommendations has been published online.1 Several blood establishments in Europe have now implemented PRT of platelets, and others are actively considering it. The value and cost-effectiveness of implementation of these technologies should be assessed in conjunction with current and alternative methods for risk reduction (see section 13, Bacterial safety of blood components).

When using PRT, blood establishments should introduce quality-control measures to monitor the effectiveness of the process and, if applicable, removal of active substances and/or their metabolites. A possible assay for demonstrating pathogen reduction might be a PCR assay of mitochondrial DNA that targets the regions of 16S rDNA, cytochrome c oxidase I and cytochrome c oxidase III. Amplicon sizes around 1 000 base pairs are inhibited by PR procedures, while sizes less than 300 base pairs are not and this can, therefore, be used as an internal control.

12. **Purity of components**

Since blood components are used to correct a known deficit, each preparation must be subjected to strict quality control. The aim is to produce ‘pure’ components, but a very high degree of purity can be difficult and expensive to obtain and might not even be necessary in all instances. However, it is absolutely necessary to declare the quality and to be able to make different types of preparations in order to give the clinicians a reasonable choice for patients with different transfusion demands.

For example, a red cell concentrate can be produced with varying concentrations of contaminating leucocytes and platelets. A buffy coat-depleted preparation (in which most of the leucocytes and platelets have been removed) is useful for most recipients because formation of micro-aggregates during storage is inhibited. If the prospective patient has antibodies against leucocyte antigens or if it can be foreseen that he/she will need a very large number of transfusions, leucocyte depletion must be much more efficient.

In order to institute an adequate scheme of component therapy, all components must be carefully defined and the minimum requirements clearly established. Clinical users should be informed of the properties of all components.

13. **Bacterial safety of blood components**

**Overview**

Although blood collection and processing procedures are intended to produce non-infectious blood components, bacterial contamination may still occur. Bacterial quality control testing in all blood components may be appropriate. However, for collection of whole blood, bacterial cultures of platelet components provide the best indication of the overall rate of contamination provided that the sample for culture is obtained in a suitable sample volume and at a suitable time after collection. Surveillance studies have found rates of contamination as high as 0.4 per cent in single donor platelets,
although rates at or below 0.2 per cent are more often reported. The causes of bacterial contamination include occult bacteraemia in the donor, inadequate or contaminated skin preparation at the phlebotomy site, coring of a skin plug by the phlebotomy needle and breaches of the closed system from equipment defects or mishandling. Platelet components are more likely than other blood components to be associated with sepsis due to their storage at room temperature, which facilitates bacterial growth.

A variety of procedures may be used to obtain a valid platelet sample for bacterial culture. Aseptic techniques are required in order to minimise the risk of false positive cultures due to contamination at the time of sampling or upon inoculation in culture. Additionally, it is prudent to retain a sample that can be used for repeat culture to validate a positive result. Large volume samples removed from a multiple-unit pooled platelet component or single donor apheresis platelets can be cultured any time post-collection. However, small volume samples (e.g. 2-5 mL removed from a single whole blood unit) should be taken for culture after a 24 to 48 hour delay post-collection. Delayed sampling of a small volume permits bacterial growth to a level that subsequent assays can detect reliably, thereby overcoming sampling errors at low contamination levels.

PRT may offer an alternative approach to assuring the bacterial safety of blood components. Currently, systems are available for platelets, but not for red cells.

**Quality control for aseptic collection and processing of blood components**

The goal of quality-control testing for bacterial contamination should be to assure that the collection and processing procedures for blood conform to current standards. Statistically defined sampling of platelets for culture (or testing of nucleic acids) by a validated method provides a reliable indication of the rate of contamination for all blood components. Quality-control testing may be of value in long-
term process controls if it is validated and conducted according to an appropriate statistical plan. Based on these considerations, one possible approach for monitoring sterility is as follows:

- As a quality control for aseptic collection of blood components, blood establishments should determine the rate of bacterial contamination in platelets at least every year by culturing 1 500 or more units (about 30 units per week or 5 per cent of units released after 48 hours of collection, whichever is larger). Standard statistical methods should be used to identify significant deviations from a baseline contamination rate not to exceed 0.2 per cent. The chosen method should be based on a predetermined level of confidence to exclude a maximum tolerated rate of contamination and an action limit should be established;
- All instances of a positive culture should be investigated promptly to identify a correctable cause;
- Whenever the observed rate of bacterial contamination exceeds the defined action limit, a comprehensive investigation into potential causes of contamination should be undertaken and all collection and processing procedures should be re-validated.

**Example**

A blood facility wishes to establish surveillance to detect bacterial contamination rates significantly in excess of 0.2 per cent. Table 4-3, which has been derived from binomial statistics, can be used to determine the power to detect contamination rates.
Table 4-3. Examples from power calculations from binomial statistics to detect bacterial contamination rates

<table>
<thead>
<tr>
<th>Candidate action limit</th>
<th>Confidence in positive result</th>
<th>Power to detect the actual contamination rate at</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of positive units/ No. of sampled units</td>
<td>0.4%</td>
<td>0.6%</td>
</tr>
<tr>
<td>≥ 3 per 400</td>
<td>95.3%</td>
<td>22%</td>
</tr>
<tr>
<td>≥ 5 per 800</td>
<td>97.6%</td>
<td>22%</td>
</tr>
<tr>
<td>≥ 7 per 1 600</td>
<td>95.5%</td>
<td>46%</td>
</tr>
</tbody>
</table>

A blood establishment collects 12 units of platelets per day, 5 days per week. Cultures of units released after 48 hours, plus out-dated units, number 30 units per week, which are processed as 6 weekly cultures of 5 unit pools. An action limit is set to re-validate the collection procedures if the observed contamination rate exceeds 0.42 per cent for yearly samples of 1 560 units. The action limit is established based on an expected contamination rate of 0.2 per cent, a sample size of 1 560, and a cut-off determined as baseline plus 2-sigma variation. For this scheme, the likelihood of rejecting a conforming process is 4.5 per cent (once every 22 years). The confidence levels (i.e. power) to exclude actual contamination rates of 1%, 0.8% and 0.6% are 99.6%, 97% and 84%, respectively.

Over a one-year period, 7 positive platelet pools are identified, traceable to 7 individual units. The individual cases are investigated, but no clearly attributable cause is identified. The observed contamination rate of 7/1 560 = 0.45 per cent exceeds the action level. Confidence that the actual contamination rate exceeds 0.2 per cent is greater than 95 per cent. An intensive review is conducted and all collection and processing procedures are re-validated.
Release as ‘culture-negative to date’ after bacteriological testing of all platelets

Routine pre-release bacteriological testing of all platelets to establish a criterion for issuance of platelets as ‘culture-negative to date’ obviates recommendations in ‘Quality control of aseptic collection and processing of blood components’. Sampling of platelets for the purpose of establishing a release criterion based on a negative result of bacterial cultures requires that the integrity of the closed system should be maintained. This is because platelets may continue to be stored for variable periods after sampling and before use. Suitable methods of sampling in this case include the use of integral satellite containers or the stripping, refilling and then pinching off of duplicate pigtails. Sampling may also be done into collection containers via the use of sterile connecting devices.

14. Storage of blood components

Storage conditions for blood components are designed to preserve optimal viability and functionality during the entire storage period. The risk of bacterial contamination decreases substantially if only closed separation and storage systems are used.

Equipment

Blood components are stored at +20-24 °C, at +2-6 °C or at different temperatures below 0 °C. Whatever type of storage device is chosen, the following points should be considered before purchase:

- refrigerators and freezers must have surplus capacity. The space should be easy to inspect;
- the operation must be reliable and temperature distribution must be uniform within the unit;
- the equipment must have temperature recording and alarm devices;
• the equipment should be easy to clean and should withstand strong detergents. It should also conform to local safety requirements.

Storage at + 2 to + 6 °C

The space for each of the component types should be clearly indicated. The temperature within the storage device should be continuously recorded. The sensor of the temperature monitoring-device can be placed within a blood bag filled with 10% glycerol solution to a volume equivalent to the smallest volume of the stored component. Other systems might also be used. This container should be placed in the upper part of the refrigerated space. In large refrigerated rooms, two such sensors should be used.

The alarm system should preferably have both acoustic and optical signals and should be regularly tested.

Refrigerators for blood components should ideally be connected to a reserve power unit, as well as to the main supply.

There should be a system in place to maintain and control the storage of blood components throughout their shelf-life, including any transportation that may be required. Autologous blood and blood components should be stored separately. Temperature and hygienic conditions should be continuously monitored. Warning systems should be used where applicable.

Storage of frozen plasma components

Freezers with automatic defrosting should be avoided, unless it can be guaranteed that the low temperature is maintained during defrosting.

Freezers should ideally be connected to a reserve power source, as well as to the main supply.

Storage at + 20 to + 24 °C

Platelets are stored at + 20-24 °C. A closed device that permits temperature control is recommended. If such a device is unavailable,
the storage location chosen should be capable of maintaining the required constant temperature.

Platelets should be stored in agitators that:

- enable satisfactory mixing in the bag, as well as gas exchange through the wall of the bag;
- avoid folding of the bags;
- have a set speed to avoid foaming.

**Aspects of red cell preservation**

The anti-coagulant solutions used in blood collection have been developed to prevent coagulation and to permit storage of red cells for a certain period of time. Designed originally for storage of whole blood, they have also been used in blood from which components are prepared. All of the solutions contain sodium citrate, citric acid and glucose, and some of them may also contain adenine, guanosine and phosphate.

Citrate binds calcium and prevents clotting of the blood. Glucose is used by red cells during storage. Each glucose molecule gives two molecules of adenosine triphosphate (ATP), which is formed by phosphorylation of adenosine diphosphate (ADP). ATP is an energy-rich molecule used to support the energy-demanding functions of red cells, such as membrane flexibility and certain transport functions in the cell membrane. During energy-consuming operations, ATP reverts back to ADP. Citric acid is added to anti-coagulants to obtain a concentration of hydrogen ions that is suitably high at the beginning of storage at +4 °C. Without the addition of citric acid, blood is too alkaline at storage temperature.

Acidity increases during storage, which reduces glycolysis. Conversely, the content of adenosine nucleotides (ATP, ADP, AMP) decreases during storage. By adding adenine, which is the main component of adenosine nucleotides, red cells can synthesise new AMP, ADP and ATP and compensate for (or reduce) this decrease. When red cell concentrates are prepared, a considerable part of the glucose and...
adenine is removed with the plasma. If not compensated for in other ways (e.g. by adding a larger amount than normal of adenine and glucose in the anti-coagulant or by separate addition of a suspension/preservative medium), sufficient viability of the red cells can only be maintained if the cells are not over-concentrated. Therefore, normal CPD adenine red cell concentrate should have an average haematocrit above 0.70. This also keeps the viscosity sufficiently low to permit transfusion of the concentrate without pre-administrative dilution.

**Additive solutions**

An additive solution should allow maintenance of red cell viability even if more than 90 per cent of the plasma is removed. The use of glucose and adenine is necessary for the maintenance of red blood cell post-transfusion viability. Phosphate may be used to enhance glycolysis and other substances (e.g. mannitol, citrate) may be used to prevent in vitro haemolysis. Sodium chloride or di-sodium phosphate may be used to give the additive solution a suitable osmotic strength.

**Micro-aggregates in whole blood and red cell components**

Platelets and leucocytes rapidly lose their viability at + 4 °C. They form micro-aggregates that are present in considerable amounts even after 3-4 days of storage of whole blood and, even more so, in concentrates of red cells. Micro-aggregates can pass through the filters of ordinary blood transfusion sets. Micro-aggregates can cause decreased lung function by blocking lung capillaries and this may be of clinical importance in massive transfusions. Removal of platelets during component preparation reduces micro-aggregate formation. Likewise, leucocyte depletion by buffy-coat removal also reduces the frequency of febrile transfusion reactions, and helps to achieve high-grade depletion of leucocytes if leucocyte-removal filters are used for this purpose.

**Red cell preparations**

The maximum duration of storage (expiry date) should be noted on each container. This duration may vary with the type of preparation
(concentration of cells, formula of anti-coagulant, use of additive solution) and should ensure a mean 24-hour post-transfusion survival of no less than 75 per cent of transfused red cells.

Red cells may be stored in a fluid state at a controlled temperature of +2–6 °C. The performance of the storage refrigerator must be controlled very carefully.

Frozen red cells should be prepared and reconstituted according to an approved protocol, be stored at <–60 °C, and produce satisfactory post-transfusion survival figures.

**Platelet preparations**

Platelets must be stored under conditions that guarantee that their viability and haemostatic activities are optimally preserved (see Standards).

Plastic bags intended for platelet storage should be sufficiently permeable to gases to guarantee oxygen availability to platelets and diffusion of carbon dioxide. The amount of oxygen required is dependent on the number of platelets and their concentration in the component. Lack of oxygen increases anaerobic glycolysis and lactic acid production. The quality of platelets is preserved if the pH remains consistently above 6.4 throughout the storage period.

Agitation of platelets during storage should be sufficient to guarantee oxygen availability but as gentle as possible to prevent induction of activation and storage lesions. The storage temperature should be +20-24 °C. Platelets undergo membrane phase transition, and cold activation (below +20 °C) means that the discoid structure of platelets gradually converts to a sphere.

**Granulocyte preparations**

Typically, granulocyte suspensions are prepared for a specific patient and administered immediately.
Plasma components

Recommended storage conditions for fresh frozen plasma and cryoprecipitate and for cryoprecipitate-depleted plasma are given in Table 4-4 below.

<table>
<thead>
<tr>
<th>Blood component</th>
<th>Length of storage and temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh frozen plasma, cryoprecipitate</td>
<td>36 months at or below –25 °C</td>
</tr>
<tr>
<td>Cryoprecipitate-depleted plasma</td>
<td>3 months at –18 °C to –25 °C</td>
</tr>
</tbody>
</table>

For plasma intended for fractionation, refer to the appropriate European Pharmacopoeia monograph.

The recommended temperature ranges are based upon practical refrigeration conditions.

15. Transportation of blood components

Blood components should be transported by a system that has been validated to maintain the integrity of the component over the proposed maximum time and extremes of ambient temperature of transport. It is recommended that some form of temperature indicator be used to monitor the temperature in transit. Also, the temperature on receipt can be monitored as follows:

- take two bags from the container;
- place a thermometer between the bags and fix them together with rubber bands;
- quickly place them back into the container and close the lid;
- read the temperature after 5 minutes.

Alternatively, an electronic sensing device may be used to take immediate measurements from the surface of a pack.

On receipt, if not intended for immediate transfusion, the product should be transferred to storage under the recommended conditions.
Transport of standard red cell components
Red cell components should be kept between +2 and +6 °C. The temperature of red cell bags should not go below +1 °C nor exceed +10 °C. A maximum transit time of 24 hours at temperatures not above 10°C is recommended. Otherwise, transport conditions must be validated to ensure maintenance of the quality of red blood cells.

Transport of platelet components
Platelet components are usually not agitated during transport and, therefore, oxygen delivery to platelets is reduced. Agitation of platelets can be interrupted (simulated shipping conditions) for up to 30 hours for one to three periods without a major impact on the in vitro quality of the platelets at the end of a storage time of 5-7 days. The pH of the platelet components is better preserved when agitation is interrupted for several short periods compared to one long period.
Platelet components should be transported in an insulated container with temperature stabilising elements that ensure transport temperature is maintained as close as possible to the recommended storage temperature. Transport conditions should be chosen to maintain component quality and must be validated for this purpose. It is recommended not to exceed 24 hours if transported without agitation. On receipt, unless intended for immediate therapeutic use, platelet components should be transferred to storage under the recommended conditions (including further agitation).
The impact of transport conditions on the quality of platelet components should be validated by quality control tests, e.g. swirling tests and pH measurements of components at the end of the storage period.

Transport of frozen plasma components
Frozen plasma components should be transported in the frozen state as close as possible to the recommended storage temperature.
16. **Component information and principles of labelling**

Immediately before use, all containers should be labelled with relevant information pertaining to their identity. The type of label to be used as well as the labelling methodology should be established in written procedures. Where possible, critical information should be provided in machine-readable format to eliminate transcription errors.

The blood establishment responsible for the processing of the blood component should supply the person(s) using the blood component with information on its use, composition and any special conditions that do not appear on the label.

Brief information about the various blood components should be made available to clinicians with regard to composition, indications, and storage and transfusion practices. This includes the proviso that the blood must not be used for transfusion if there is abnormal haemolysis or any other deterioration, and that all blood components must be administered through a 150–200-µm filter (if not stated otherwise). This information should be presented to clinicians in a booklet and/or in an information leaflet on blood components.

The labelling of blood components should comply with the relevant national legislation and international agreements. Each single blood container must be uniquely identified by the identity number and the component description, preferably in eye- and machine-readable codes. The identity number must allow full traceability to the donor and data on the collection, testing, processing, storage, release, distribution and transfusion of the blood component.

The label on the component that is ready for distribution should contain the information (in eye-readable format) necessary for safe transfusion. That is: unique identity number (preferably consisting of a code for the blood-collection organisation, the year of donation, and a serial number); ABO and RhD blood group; name of the blood component; essential information about the properties and handling of the blood component; expiry date (see also labelling requirements in Chapter 5, Component Monographs).
Chapter 5

Principles of blood component monographs

Monographs with detailed information on the different categories of blood components are given in the Standards section, Chapter 5, Component monographs.

- Part A – Whole blood components, page 219
- Part B – Red cell components, page 229
- Part C – Platelet components, page 265
- Part D – Plasma components, page 319
- Part E – White cell components, page 337

The blood components described in these monographs are to be regarded as standard blood components across Europe. However, some components are in use only in a few countries. Based on future consensus, the number of variant components may be reduced.

The component monographs have a standardised structure, which encompasses the headings as listed hereafter..
1. **Definition and properties**
Here, information is given about the component, including its origin, the active constituents and contaminating cells (if appropriate).

2. **Preparation**
Here, a short description is given about the method(s) of preparation. It differentiates between primary and secondary processing. Primary processing results in different blood components, each of which is described in Chapter 5 of the Standards section. Secondary processing leads to variant preparations, which are very similar to the primary component and do not differ in handling, release and application aspects. More detailed information about preparation processes is described in Chapter 4 of the Principles Section.

3. **Requirements and quality control**
Typical component-specific handling and testing parameters for quality control are given in tables, which are formatted as follows:

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
</table>

If appropriate, the requirements may be met by performing the test on the donation sample that was taken as part of the donor screening process in place of individual component testing.

The monographs provide advice on frequency of control. An alternative approach to identify the number of units to be tested is Statistical Process Control (SPC) (see Appendix 4).

Quality control may be carried out either as a separate quality control procedure for the given component or as a routine part of the issuance and transfusion of these components. Detailed information on the preparation processes are given in Chapter 4, Principles of blood component processing.
4. **Storage and transport**

Typical mandatory storage and transport conditions for the respective blood components are given. Detailed and descriptive information about the processes of storage and transport are given in Chapter 4, Principles of blood component processing.

5. **Labelling**

The labelling should comply with the relevant national legislation and international agreements. The given information should be shown on the label or contained in the component information leaflet.

6. **Warnings**

Typical warnings and side-effects are described that should be communicated to the physician (in written form, such as in a component information leaflet).
Chapter 6

Principles of blood components for foetal, neonatal and infant use

1. Overview

Specially designed blood components are required for intra-uterine and infant transfusions. The following factors must be considered when transfusing neonates: (1) smaller blood volume, (2) reduced metabolic capacity, (3) higher haematocrit and (4) an immature immunological system. All these aspects are particularly important in foetal transfusions and for small premature infants.

There is a significant risk of GvHD and CMV transmission when a foetus or small infant is transfused. These patients should receive cellular components selected or processed to minimise the risk of CMV transmission.

The rate of transfusion should be controlled to avoid excessive fluctuations in blood volume.

Consideration should be given to producing red cell components for these patients from donors who have screened negative for haemoglobin S.
There are specific national regulations or guidelines for pre-transfusion blood grouping and compatibility testing of neonates.

2. **Components for intra-uterine transfusions**

   All components for intra-uterine transfusion (IUT) must be irradiated. To minimise the effect of potassium load, red cells for IUT must be used within five days of donation and within 24 hours of irradiation.

   **Indications for use:**
   - Intra-uterine red cell transfusions are performed to treat severe foetal anaemia.
   - Intra-uterine platelets are administered for the correction of severe thrombocytopenia, which may be due to ante-natal HPA allo-immunisation.

3. **Components for neonatal exchange transfusion**

   Exchange transfusion is a special type of massive transfusion. The components used must be fresh enough so that metabolic and haemostatic disturbances can be minimised.

   A number of components can be utilised for exchange transfusion, including:
   - whole blood (LD);
   - whole blood (LD and plasma-reduced);
   - red cells (LD and re-suspended in fresh frozen plasma).

   ABO and Rh groups, as well as other red cell antigens to which the mother has become sensitised, have to be taken into account when selecting blood for exchange transfusion.

   Whole blood and red cell components for exchange transfusion should be irradiated, unless compelling clinical circumstances indicate that a delay would compromise the clinical outcome. Irradiation is essential if the infant has had a previous IUT.
To minimise the effect of potassium load, components of whole blood and red cells must be used within five days of donation and within 24 hours of irradiation. For reconstituted components, the shelf-life is 24 hours.

Indications for use:

• Exchange transfusions of neonates;
• These components are also suitable for large volume (massive) transfusion of neonates and small infants;
• If the platelet count of the infant undergoing/following exchange or other massive transfusion is very low, specific platelet transfusion should be given.

4. Red cells for neonatal and infant small volume transfusion

Pre-term infants are amongst the most intensively transfused of all hospital patients and have the greatest potential for long-term survival. Therefore, minimising the number of donor exposures is a central aim in designating proper components and guiding transfusion practice.

It is good practice to divide a component unit into several sub-batches and to dedicate all the satellite units from a donation to a single patient. Fresh blood and red cells are used in IUT and exchange transfusions. Hence, it is often thought that fresh blood is necessary for all neonatal transfusions. There is no scientific or clinical evidence to support this concept in the case of small volume, top-up transfusions, provided that transfusion rates are carefully controlled.

The component may be irradiated where clinically indicated. If the component is irradiated, it must be used within 48 hours.

Indications for use:

• anaemia of premature infants;
• to replace the blood loss due to investigative sampling;
• suitable for surgical replacement in infants and children.
5. **Fresh frozen plasma for neonatal and infant use**

In order to reduce donor exposure, a fresh frozen plasma (FFP) unit can be divided into approximately equal volumes in satellite packs, prior to freezing, by using a closed or functionally closed system. Three to four such bags can be dedicated to one patient.

ABO blood group-compatible plasma should be used. National requirements may require the use of plasma only from AB RhD-negative and -positive donors.

**Indications for use:**
- FFP may be used in coagulation defects, particularly in those clinical situations in which a multiple coagulation deficit exists and only where no suitable viral-inactivated alternative is available;
- congenital deficiency of single clotting factors where no virally inactivated concentrate exists.

**Contraindications:**
- FFP should not be used simply to correct a volume deficit in babies in the absence of a coagulation defect nor as a source of immunoglobulins;
- FFP should not be used where a suitable virally inactivated clotting factor concentrate is available;
- FFP should not be used in a patient with intolerance to plasma proteins.

6. **Platelets for neonatal and infant use**

When preparing platelets for infants, every effort should be made to minimise donor exposure.

Apheresis-derived platelets offer the greatest potential to reduce donor exposure and can be divided into satellite packs by using a closed system as for FFP.
The clinical situation of a small child may necessitate the use of volume-reduced platelets; volume reduction to around 25 mL causes about a 10 per cent loss of platelets. Platelets after volume reduction should be used as soon as possible.

The platelet component must be used within 24 hours of any washing procedure and within 6 hours of any concentration process. The platelet component should be irradiated where clinically indicated.

Indications for use:

- Severe neonatal thrombocytopenia (of any cause).
Chapter 7

Principles of autologous transfusion

1. Overview

Several techniques of autologous transfusion, including pre-deposit autologous collection and intraoperative or postoperative red cell salvage, may be useful in surgery. These techniques have been designed to avoid the risks of the allo-immune complications of blood transfusion, and to reduce the risk of transfusion-associated infections. Each technique has its own separate risks that are also presented and discussed. The choice of different techniques (including allogeneic transfusion) should be balanced for the patient’s benefit.

Pre-deposit autologous transfusion (PAT) comprises the collection, processing and storage of autologous blood components in the weeks preceding surgery for reinfusion in the perioperative period. In selected conditions, red cell or platelet components can be collected using a cell separator. The equivalent of 2 units of red cells or up to 3 standard adult doses of platelets can be collected in a single procedure. The incidence of severe adverse reactions and severe adverse events associated with the collection of whole blood has been shown to be significantly increased in autologous blood donors compared with allogeneic blood donors.
The principle of pre-deposit autologous collection and transfusion was popular in the 1990s among surgeons and patients because it was seen primarily as a means to reduce the risk of transfusion-transmitted infections. Since then, however, questions have been raised as to its benefits and its use remains controversial.

The frequency of some adverse effects of transfusion, such as bacterial contamination or administrative errors, is not reduced by PAT, and the latter may be increased. However, PAT may be the only option for a patient with an antibody for which compatible blood is difficult to find.

Some other disadvantages are that patients may be rendered anaemic prior to surgery, thus leading to increased transfusion requirements, blood wastage is increased (it is estimated that only 50 per cent of autologous blood is used) and cost-effectiveness is low. In some circumstances, autologous blood may be inappropriately transfused, even if transfusion is not indicated. In addition, where efforts have been made to reduce the use of blood in surgery by improved pre-operative assessment and intra-operative management, the benefit of PAT has been reduced further.

Pre-deposit autologous blood components obtained from PAT must be collected, prepared and stored in the same conditions as for allogeneic donations. For these reasons, PAT must be collected by or under the control of blood establishments or in authorised clinical departments that are subject to the same rules and controls as blood establishments (see Standards).

Acute normovolemic haemodilution is the collection of blood immediately before surgery, with blood volume compensation (leading to a haematocrit below 0.32), with subsequent re-infusion during or after surgery.

Red cell salvage during surgery is another means of autologous transfusion. Blood collected from the operation site may be given back to the patient either after a simple filtration or a washing procedure. These techniques do not allow storage of the collected blood. They are
usually performed under the responsibility of anaesthesiologists and/or surgeons.

2. **Pre-deposit autologous transfusion**

**Patient selection**

*Role of the physician in charge of the patient*

In elective surgery, in which blood transfusion is expected, the physician in charge of the patient (usually the anaesthesiologist or surgeon) may prescribe preoperative collections.

The prescription should indicate:

- the diagnosis;
- the type and number of components required;
- the date and location of scheduled surgery.

The patient should be informed of the respective risks and constraints of autologous and allogeneic transfusion, and that allogeneic transfusion may also have to be used if necessary.

**Indications**

Autologous transfusion should only be considered if there is a clear reason for preferring PAT to allogeneic blood, and there is a strong likelihood that blood will be used.

Special consideration should be given to the use of PAT in exceptional circumstances, such as patients with rare blood groups where allogeneic blood is likely to be difficult to obtain.

**Contraindications**

Appropriate autologous pre-deposit collection may be carried out safely in elderly patients. However, more careful consideration may need to be given in the case of a patient aged more than 70 years.
Haemoglobin levels should be measured before each collection. Autologous pre-deposit collection should not be done in patients with a haemoglobin concentration below 100 g/L.

In patients with a haemoglobin concentration between 100 and 110 g/L, autologous pre-deposit collection may be discussed according to the number of scheduled collections and aetiology of anaemia.

The presence of cardiac disease is a relative contraindication, and the assessment of a cardiologist may be required. Patients with unstable angina, severe aortic stenosis or uncontrolled hypertension should not be considered.

**Pre-deposit autologous transfusion in children**

Pre-deposit autologous collection may be considered in children undergoing harvesting of bone marrow and in exceptional cases whereby suitable allogeneic blood is not available for elective surgery. The child should understand the nature of the procedure and be willing to co-operate.

Children under 10 kg should not be included in an autologous pre-deposit collection programme and PAT programme. For children between 10 and 20 kg, the use of volume compensation solutions is usually needed.

The maximum volume that can be drawn at each collection is 10 mL/kg or 12 per cent of the estimated blood volume.

The volume of anti-coagulant in the pack should be adjusted as required to maintain an appropriate ratio of blood to anti-coagulant. Paediatric packs of 200 mL or 250 mL (available with small gauge needles) should be used wherever possible.

Adverse reactions related to blood collection, such as haemodynamic disturbances, occur significantly more often in children. Volume replacement with crystalloid solutions reduces the rate of these adverse reactions.
Blood collection

Surgical admission and the day of the surgical procedure should be guaranteed. Sufficient time to enable optimal collection of blood should be allowed before surgery, but should not exceed the storage time of the collected blood component.

Sufficient time should be given from the date and time of the final blood collection prior to surgery for the patient to make a full circulatory and volaemic recovery. This should be at least 72 hours (preferably 7 days).

Iron and/or erythropoietin should be considered to supplement the patient’s haemoglobin in conjunction with PAT.

For patients undergoing double-unit red cell apheresis, shorter collection intervals can be accepted at the discretion of the physician responsible for blood collection.

Preparation, storage and distribution of pre-deposit autologous components

See Standards.

Labelling

See Standards.

Storage

See Standards.

Records

Blood establishments and hospitals should both maintain the following records for every patient included in a pre-deposit autologous transfusion programme:

- the date and type of surgery;
- the name of the anaesthesiologist or the surgeon;
- the time of transfusion, specifying whether blood was used during surgery or post-operatively;
- the actual use of the prepared pre-operative autologous blood components;
- the concurrent use of peri-operative autologous transfusion techniques;
- the technique used and volume of autologous blood re-infused;
- the use of allogeneic blood components;
- the occurrence of any adverse reactions.

Audit
Blood establishments should audit the use of PAT, where it is provided on a regular basis.

3. Red cell salvage
Cell salvage (CS) is the process of collecting a patient’s blood during surgery for transfusion back into the patient. It is also known as ‘autotransfusion’ and covers a range of techniques that scavenge blood from operative fields or wound sites and re-infuse the blood back into the patient. CS can be performed during intraoperative and/or postoperative periods. The aim of CS is to reduce or eliminate the need for allogeneic blood transfusion. At least one allogeneic packed red cell should be saved. The blood salvage system can, in general, be broken down into a collection and a processing systems.

Collection system
The collection system consists of:
- the suction line and suction tip used in the surgical field;
- suction;
- an anticoagulant;
- collection reservoir.

During collection of red blood cells, an appropriate anticoagulant is added to salvaged blood. Then, anticoagulated blood is filtered and collected in a reservoir. When a sufficient amount of blood has been
collected (approximately the equivalent of one packed red blood cell should be the result at the end of the entire process), separation of blood by centrifugation and washing of red blood cells follows.

**Processing system**

Various separation devices use centrifuge bowls for stepwise processing or a disc-shaped separation chamber enabling continuous processing of salvaged red cells. The washing procedure removes (to a large extent) free haemoglobin, plasma, platelets, white blood cells, and anticoagulant. Remaining red blood cells are then resuspended in normal (0.9%) saline. The resulting haematocrit should be 0.60 and 0.80. Small washing volumes, fast washing rates, and half-full bowls should be avoided. Salvaged red cells should be transfused immediately or at least within 6 h. Blood filters and standard blood-administration filters are required. Some manufacturers recommend microaggregate or leucodepletion filters to remove bacteria, cancer cells or amniotic-fluid contaminants depending on the different clinical settings.

**Indications for the use of cell salvage**

- patients undergoing cardiothoracic, vascular, transplant and major orthopaedic surgery;
- anticipated blood loss of 1000 mL or of 20% estimated blood volume;
- patients with low haemoglobin levels or at an increased risk of bleeding;
- patients with multiple antibodies or rare blood types;
- patients with objections to receiving allogeneic blood.

**Parameters for quality control**

Parameters for quality control of the component should be:

- volume;
- haematocrit;
• haemolysis at the end of the process;
• protein content of the supernatant.

Precautions
Some substances should not be aspirated with blood: antibiotics not licensed for intravenous use; iodine; hydrogen peroxide; alcohol; topical clotting factors; orthopaedic cement; sterile water.

Careful use of a large-bore suction tip under low vacuum pressure can reduce the risk of shear-induced haemolysis.

Colorectal surgery: Salvaged blood can (under special preventive measures) be gained during colorectal surgery or other types of surgery if the blood has come into contact with bacteria. Use of leucodepletion filters and washing of salvaged blood reduces the risk of microbial contamination because these methods also help to minimise the risk of activation of coagulation factors or influx of cytokines and other biologically active substances. As an additional precaution, broad-spectrum antibiotics should be administered to the patient.

Haemorrhage in cancer patients: Although the passing of blood through a leucodepletion filter reduces significantly the number of retransfused tumour cells, the salvaged cells should be irradiated.

Obstetric haemorrhage: Use of leucodepletion filters in obstetric haemorrhage provides a significant reduction in contamination of cells from amniotic fluid. This is also true for caesarean section. There is also concern regarding reinfusion of foetal red cells from the operative field. If the mother is RhD-negative and the foetus RhD-positive, the extent of maternal exposure should be determined as soon as possible, and a suitable dose of human anti-D immunoglobulin should be administered.
Chapter 8

Principles of immunohaematology

1. Overview

The aim of any blood transfusion laboratory is to perform the correct test on the correct sample and to obtain accurate results to ensure that a compatible blood component is issued to the right patient. It is essential to obtain accurate results for tests such as ABO/RhD typing and antibody screening on the donor and patient, as well as compatibility testing.

Errors at any stage of the performance of such tests can lead to incompatible or inappropriate blood being transfused, with significant adverse health effects for patients. These errors can be due to technical failures in testing or inadequate procedures leading to misidentification of samples from donors or patients, transcription errors, or misinterpretation of results. Haemovigilance data indicate that, in some cases, a combination of factors contribute to error, with the original error being perpetuated or compounded by the lack of adequate procedural controls within the laboratory or at the bedside.

The implementation of a quality management system helps to reduce the number of technical, and more often procedural, errors made in laboratories. These include quality assurance measures such as the use of standard operating procedures, staff training, periodic assessment
of the technical competence of staff, documentation and validation of techniques, reagents and equipment, procedures that monitor day-to-day reproducibility of test results and methods to detect errors in analytical procedures.

2. Immunohaematological testing

Immunohaematological testing includes blood group testing, antibody screening, antibody identification (if applicable) and pre-transfusion testing (including compatibility testing). All tests could be manual or automated.

Blood group testing

Serological testing

Serological blood group testing includes ABO RhD typing and additional phenotyping. This is currently the standard procedure used in most transfusion laboratories.

Molecular testing

Molecular testing is becoming increasingly available and used as a supplemental technique to serological testing. In time, molecular testing may replace the need for routine serological testing. Current indications for molecular typing include situations: in which serological testing of blood donors and patients renders unclear results; if there is a suspicion of weak antigens or variants (within ABO, RHD, RHCE, JK, FY); if serological reagents directed to specific antigens do not exist or are not readily available.

Increased utilisation and access to this technology will support further indications:

- Multi-transfused patients that cannot be typed with serological techniques who may benefit from matched erythrocyte transfusions, for example, patients with sickle cell anaemia, thalassaemia and others who depend on treatment by chronic transfusion;
• Patients that cannot be typed with indirect agglutination techniques because of positive direct agglutination tests (DAT pos);
• Patients that may be expected to present with unusual and unexpected phenotypes/genotypes;
• Blood donors with unusual phenotypes in serological typing;
• Donors of panel cells if extended typing is needed or if heterozygosity or homozygosity needs to be established;
• Foetal RHD, RHCE, KEL, FY, JK or other clinically significant antigen typing (in samples of maternal blood, amniocentesis or chorionic villi) in cases of maternal immunisation against the corresponding antigens.

Testing can be undertaken on samples from blood, amniocentesis, biopsy of chorionic villi, and plasma.

Methods include polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP), sequence-specific priming (PCR-SSP), allele-specific PCR (AS-PCR), allelic discrimination (AD) and real-time PCR. Commercial reagents and kits are available for these techniques. Micro-array and mass spectrometry-based techniques are also available.

Molecular investigations may be carried out at regional, national or international laboratories. Before ordering such typing, information on how to handle and ship samples, material or prepared DNA should be requested.

3. **Screening and investigation of antibodies**

In addition to routine antibody screening, donors may be investigated for high titres of anti-A and/or anti-B to avoid transfusing plasma-containing blood components (FFP, platelets in plasma) with a high titre of clinically significant antibodies.

For pre-transfusion testing of patients, see type and screen below. Screening and investigation of antibodies may also be used in
pregnant women to evaluate the risk of haemolytic disease of the foetus and newborn.

**Pre-transfusion testing**

The purpose of pre-transfusion testing is to select compatible blood components that will survive normally in the circulation, and to avoid clinically significant haemolysis of red blood cells during or after transfusion.

ABO/RhD typing for donor and recipient is the most important test and is the basis of pre-transfusion testing.

Antibody screening is performed to detect clinically significant non-ABO red cell antibodies. Positive results of screening tests should be investigated fully to identify antibody specificity. If appropriate, red cell components lacking antigens should be selected for transfusion.

A compatibility test should be undertaken before issuing red cell components for transfusion. This process may involve serological testing or may be achieved with electronic release of the component using a type and screen procedure. The most appropriate method for compatibility testing will be determined by the results of screening of blood groups and antibodies on the current sample as well as results of previous testing and clinical urgency of the transfusion.

**Serological compatibility testing**

The principle of serological compatibility testing is to test donor red cells with the recipient’s plasma/serum. This process must be undertaken in patients with clinically significant red cell antibodies, and is usually performed using an indirect anti-globulin test.

An immediate spin crossmatch can also be undertaken immediately before issue of the red cell component but is effective only for excluding ABO incompatibility.
Electronic issue using a type and screen procedure

Electronic issue (EI) using a type and screen procedure is usually employed only if a test for clinically significant antibodies is negative and there is no history of antibodies being detected.

The overall process for determining eligibility for EI must be controlled. Supplementary checks which should be manually performed, (e.g. review of the clinical details on the request form) must not be forgotten. It should be not be possible to issue ABO-incompatible red cells. The computer system should have a record of the history of transfusion and antibodies of the patient as well as serological status of the current sample.

The following process criteria should be met:

- Entry of the testing and results of the blood group and antibody screen are fully automated;
- Samples and reagents are registered and identified within the analyser via barcodes;
- Results are transmitted electronically from the analyser to the computer;
- The computer controls the suitability of patients and their samples for EI;
- The computer enables permanent exclusions of patients from EI in the presence of antibodies of likely clinical significance;
- The computer enables temporary exclusions of patients from EI (e.g. limited period of exclusion after transplantation of solid organs);
- Stock entry of unique donation number, component code, blood group and expiry date from the unit’s label is by barcode reader or other electronic means.

The following criteria for patient and sample should be met:

- Interpretation of blood group in the current sample is identical to the historical record;
• No manual amendments have been made to automated results;
• The current antibody screen is negative;
• Results of the patient’s group and antibody screen are complete and fully authorised in the computer;
• The patient does not have a previously known antibody of likely clinical significance;
• The current sample meets the requirements for timing and storage.

4. **Validation and quality assurance**

The Council of Europe has issued requirements for blood grouping and anti-globulin reagents (European Agreement on the Exchanges of Blood-Grouping Reagents, European Treaty Series, No. 39). Summarised requirements are included in Tables 1 and 2 of this chapter.

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reagent red cells</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appearance</td>
<td>No haemolysis or turbidity in the supernatant (determined by visual inspection)</td>
<td>Each lot</td>
</tr>
<tr>
<td>Reactivity and specificity</td>
<td>Clear-cut reactions with selected reagents against declared RBC antigens</td>
<td>Each lot</td>
</tr>
<tr>
<td><strong>ABO-typing reagents</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appearance</td>
<td>No precipitate, particles or gel-formation (determined by visual inspection)</td>
<td>Each new lot</td>
</tr>
<tr>
<td>Parameter to be checked</td>
<td>Requirements</td>
<td>Frequency of control</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Reactivity and specificity</td>
<td>No immune haemolysis, rouleaux formation or prozone phenomenon, clear-cut reactions, with RBC presenting weakened expression of the corresponding antigen(s) and no false reactions (see also quality control of ABO- and Rh-typing)</td>
<td>Each new lot</td>
</tr>
<tr>
<td>Potency</td>
<td>Undiluted reagent should give a 3 to 4 plus reaction in a saline tube test using a 3 per cent RBC suspension at room temperature, for polyclonal reagents, titres should be of 128 for anti-A, anti-B and anti-AB with A1 and B cells, and 64 with A2 and A2B cells</td>
<td>Each new lot</td>
</tr>
</tbody>
</table>

**Rh-typing reagents**

| Appearance | No precipitate, particles or gel-formation (determined by visual inspection) | Each lot |
| Reactivity and specificity | As for ABO-typing reagents | Each new lot |
| Potency | Undiluted serum to give a 3 to 4 plus reaction in the designated test for each serum and a titre of 32 for anti-RhD and of 16 for anti-C, anti-E, anti-c, anti-e and anti-CDE using appropriate heterozygous red blood cells | Each new lot |

**Anti-globulin serum**

<p>| Appearance | No precipitate, particles or gel-formation (determined by visual inspection) | Each lot |</p>
<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactivity and specificity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a</td>
<td>No haemolytic activity and no agglutination of RBC of any ABO group after incubation with compatible serum</td>
<td>Each lot</td>
</tr>
<tr>
<td>b</td>
<td>Agglutination of RBC sensitised with anti-RhD serum containing not more than 10 nanograms/mL antibody activity (0.05 IU/mL antibody activity)</td>
<td>Each lot</td>
</tr>
<tr>
<td>c</td>
<td>Agglutination of RBC sensitised with a complement-binding allo-antibody (eg anti-Jka) to a higher titre in the presence than in the absence of complement or agglutination of RBC coated with C3b and C3d</td>
<td>Each new lot</td>
</tr>
</tbody>
</table>

**Albumin**

| Appearance | No precipitate, particles or gel-formation (determined by visual inspection)                                                                                                                                           | Each lot             |
| Reactivity | No agglutination of unsensitised RBC, no haemolytic activity and no prozone or ‘tailing’ phenomena                                                                                                                     | Each lot             |

**Protease**

| Appearance | No precipitate, particles or gel-formation (determined by visual inspection)                                                                                                                                           | Each lot             |
| Reactivity | No agglutination or haemolysis using compatible AB-serum                                                                                                                                                    | Each lot             |
|            | Agglutination of RBC, sensitised with a weak IgG anti-RhD                                                                                                                                                         |                      |
|            | No agglutination of unsensitised RBC and no haemolytic activity                                                                                                                                                | Each new lot         |

**Saline**

| Appearance | No precipitate, particles or gel-formation (determined by visual inspection)                                                                                                                                           | Each day             |
| NaCl content | 0.154 mol/L (= 9 g/L)                                                                                                                                        | Each new lot         |
Quality control procedures in blood group serology can be divided into controls for equipment, reagents and techniques. This classification is considered to provide clarity, in spite of partial overlap, especially between controls for reagents and techniques.

**Quality control of equipment**
Equipment used in transfusion serology (in particular centrifuges, and automatic cell washers, water baths, incubators, refrigerators and freezers) should undergo regular quality controls. Equipment for automated blood grouping should also be systematically controlled according to the manufacturer’s instructions.

**Quality control of reagents**
Quality control procedures recommended in this section may be applied to the reagents used for manual and automated techniques. However, reagents for blood grouping machines may have special quality requirements and more detailed controls, which are typically supplied by the manufacturers of the equipment.

**Quality control of techniques**
Provided that the quality of equipment and reagents fulfil the requirements, false results are due to the technique itself, either...
because of inadequacy of the method or, more often, because of operational errors as a consequence of inaccurate performance or incorrect interpretations.

**Internal quality control**

The quality control procedures recommended in this section are focused on techniques, but they can also disclose poor quality of equipment and/or reagents.

### Table 2. Validation of techniques

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Minimal requirements for testing</th>
<th>Control samples</th>
<th>Frequency of control</th>
</tr>
</thead>
</table>
| 1. ABO-grouping         | Test twice using two different reagents. Use of two different reagents: 
  a monoclonal anti-A and anti-B from different clones; human antisera anti-A, anti-B and anti-A,B from different batches. 
  b One blood sample of each of the following types: O, A1, B. | One blood sample of each of the following types: O, A1, B. | Each test series or at least once a day provided the same reagents are used throughout. |
| 2. ABO reverse-grouping | Use of A and B cells. | | Each test series or at least once a day provided the same reagents are used throughout. |

*a* If reverse grouping is undertaken, the two tests may be carried out using the same reagents.

*b* If ABO and RhD blood groups are already known, a single test is sufficient.
<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Minimal requirements for testing</th>
<th>Control samples</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. RhD-grouping</td>
<td>Test twice using two anti-RhD reagents from different clones or batches. For donors, it must be ascertained that the system recognises weak D antigens and the most important variants (notably D variants, category VI) as RhD positive.</td>
<td>One RhD-pos, one RhD-neg sample.</td>
<td>Each test series or at least once a day provided the same reagents are used throughout.</td>
</tr>
<tr>
<td>5. Anti-globulin testing tube technique</td>
<td>Wash the cells at least three times before anti-globulin is added.</td>
<td>Negative tests validated by addition of sensitised blood cells to give a positive result.</td>
<td>Each negative test.</td>
</tr>
</tbody>
</table>

a If reverse grouping is undertaken, the two tests may be carried out using the same reagents.
b If ABO and RhD blood groups are already known, a single test is sufficient.
<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Minimal requirements for testing</th>
<th>Control samples</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>6. Testing for high-titre anti-A and anti-B (in donors)</td>
<td>Use of A1- and B-RBC. Titration in saline or in anti-globulin test with plasma (serum) diluted 1:50.</td>
<td>Serum samples with an amount of immune anti-A and immune anti-B, respectively, above and below the accepted saline agglutination titre of anti-A and/or anti-B. Using the anti-globulin test, one control sample should give a positive result and the other a negative result.</td>
<td>Each test series.</td>
</tr>
<tr>
<td>7. Testing for irregular allo-antibodies (in donors)</td>
<td>Use of anti-globulin test or other tests with the same sensitivity.</td>
<td>Serum samples with known RBC- allo-antibodies.</td>
<td>Occasional input by the supervisor of the laboratory and participation in external proficiency testing exercises.</td>
</tr>
<tr>
<td>8. Testing for irregular allo-antibodies (in patients)</td>
<td>Use of at least the indirect anti-globulin test or manual/automated testing with equivalent sensitivity and homozygous RBC for the main clinically-important antigens.</td>
<td>As for 7.</td>
<td>As for 7.</td>
</tr>
<tr>
<td>9. Compatibility testing (including ABO- and D-typing in donor and recipient RBC and test for irregular antibodies in patient serum)</td>
<td>Use of at least the indirect anti-globulin test or manual/automated testing with equivalent sensitivity.</td>
<td>As for 7.</td>
<td>As for 7.</td>
</tr>
</tbody>
</table>

a If reverse grouping is undertaken, the two tests may be carried out using the same reagents.

b If ABO and RhD blood groups are already known, a single test is sufficient.
### Parameter to be checked  
Minimal requirements for testing  
Control samples  
Frequency of control

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Minimal requirements for testing</th>
<th>Control samples</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Type and screen</td>
<td>Typing: as for 1, 2, 3 and 4 above, with at least the anti-globulin test against a panel of cells chosen to express homozygosity for important antigens.</td>
<td>As for 7.</td>
<td>Each test series, but at least daily.</td>
</tr>
</tbody>
</table>

*a* If reverse grouping is undertaken, the two tests may be carried out using the same reagents.  
*b* If ABO and RhD blood groups are already known, a single test is sufficient.

### External quality assurance

In external quality assurance, blood samples for proficiency tests coded as ‘normal’ and ‘problem’ are distributed from a national or regional reference laboratory to the participants, at least twice a year. The exercise can be limited to compatibility testing, since ABO-grouping, Rh-typing and Rh-phenotyping, as well as allo-antibody detection, are automatically included. The proficiency test panel may consist of four to six blood samples and the participants are asked to test each RBC sample against each serum (or plasma) for compatibility. The test panel should be composed in such a way that compatible as well as incompatible combinations occur. A titration of one or two of the detected antibodies may also be requested as part of the proficiency test.

In the reference centre, the results are collated and accuracy scores are determined. The results should be communicated to all participating laboratories (in coded or uncoded form, according to local agreements) in order to enable each laboratory to compare its own quality standards with those of a large number of other laboratories, including the reference centre.

If no proficiency programme is available in a particular geographical area, the laboratory should arrange mutual proficiency testing with another laboratory. Although such external quality control is not as
informative as participation in a comprehensive proficiency-testing programme, it is a valuable addition to the internal quality control procedure.

**Quality control of antibody quantitation**

For practical purposes, RBC antibody quantitation is confined to the quantitation of anti-RhD. It is recommended that quantitation of anti-RhD be carried out by automated techniques rather than by manual titration. In that case, test serum is assigned an anti-RhD value that is expressed in international units per millilitre after comparison with a curve derived from standard sera. All sera should be tested in duplicate as a minimum, and all national and in-house standards should be calibrated against the international standard for anti-RhD. Records should be kept of the data derived from processing the standard sera; these figures should show no more variance than 2 standard deviations. If an automated technique is not available, manual titration by the anti-globulin test is recommended.
Chapter 9

Principles of screening for markers of infection

1. Overview

Quality assurance for screening donations for infectious markers is particularly important and implies both general and specific approaches.

Only tests that have been licensed or evaluated and considered suitable by the relevant Regulatory authorities can be used. In the EU, these tests are considered as in vitro diagnostic devices and must be CE marked. EU Directive 98/79/EC classifies the HIV, HTLV, hepatitis B and C screening tests in list A, Appendix II. The manufacturer must have a full quality system, certified by an authorised body, and must submit batch release certificates containing all the control results for each lot.

In addition, proper validation demonstrates control, generates useful knowledge of the test and establishes future requirements for internal quality control, external quality assurance, calibration and maintenance of equipment and training of personnel, etc.

There must be special emphasis on training of staff, assessment of staff competency, maintenance and calibration of equipment, as well as the
monitoring of the storage conditions of test materials and reagents, together with documentation of all of these actions.

Current tests for the screening of donations are based on the detection of relevant antigens and/or antibody and gene sequences.

It is further recommended that the tests include an external weak positive control in order to allow for statistical process controls.

Ideally, confirmatory tests should be as sensitive as, and more specific than, those used for screening. However, some screening tests are more sensitive than the available confirmatory tests. It is recommended that algorithms be developed nationally to enable consistent resolution of problems associated with discordant or unconfirmed results.

2. **Algorithm for infectious marker screening and confirmatory testing**

Figure 9-1 shows a widely used algorithm for infectious marker screening and confirmatory testing.

![Figure 9-1. Algorithm for infectious marker screening and confirmatory testing](image-url)
Repeatedly reactive screening test of a donor previously screening test repeatedly reactive\(^c\)

**Discard donation**

Sample(s) of donation to confirmatory lab

**Block in-house products of donor**

**Confirmatory test results\(^d\)**

- **Positive\(^b\)**
  - Confirm results and donor identity on a new sample
  - Notify and defer donor

- **Negative\(^b\)**
  - Notify and defer donor

- **Indeterminate\(^b\)**
  - Arrange retesting after max window-period if indicated by confirmatory lab\(^b,d\)

---

\(a\) For example, a repeatedly reactive serological screening test or a positive NAT on a single donation. Confirmatory testing is performed by a certified or accredited medical microbiology reference laboratory, which is responsible for results and may use tests at its discretion. The confirmatory laboratory should be kept informed about the type of screening test used by the blood establishment, and is contracted to use tests at least as sensitive as the screening test and, if feasible, based on other principles.

\(b\) The confirmatory laboratory is contracted to provide overall confirmatory test results or interpretations as follows: ‘positive’, which means infected; ‘negative’, which means not infected; or ‘indeterminate’, which means a diagnosis cannot be established (may include a demand for follow-up testing). If a confirmatory test(s) is less sensitive than the screening assay, the conclusion of confirmatory testing should read ‘uncertain’ (unless positive).

\(c\) The blood establishment keeps a donor record allowing longitudinal recording of confirmatory laboratory test results as: screening test positive; confirmatory lab positive; negative; or indeterminate.

\(d\) The confirmatory laboratory is contracted to keep longitudinal records of the unique donor ID, linked to laboratory test results.

\(e\) Refer donor to a medical doctor (general practitioner or specialist). Inform plasma fractionation centre(s) if plasma from earlier donation(s) has been issued. Inform hospital(s) to allow look back if component(s) from earlier donation(s) have been issued.

The specific approach to the quality of the screening process must rely on the following categories of measures:

- internal day-to-day quality control covering both reagents and techniques. Batch pre-acceptance testing (BPAT) of new manufacturer’s lots of kits should be performed as an additional measure of quality assurance;

- external quality checks. In particular, confirmation of screen reactivity should be carried out by an appropriate and certified reference laboratory;

- occasional internal exercises using a panel of sera that have been established by comparison with available standards;
• external proficiency exercises involving the testing of a panel of sera circulated to laboratories by an approved reference institution;
• collection of representative data may be useful to monitor test performances.

It is recommended that repeatedly reactive rates and confirmed positive results of screening for infectious markers and epidemiological data be collected and monitored at least on a national level. This will allow international comparisons to be made.

It should be noted that following hepatitis B immunisation, a transient positive HBsAg result may be obtained.

3. Confirmatory testing

Anti-HIV-1/2, anti-HCV and HBsAg
The approaches currently used to confirm HIV or HCV infection consist of the use of a nationally established algorithm, which may include alternative enzyme-linked immuno-sorbent assay (ELISA), western blot or recombinant immuno-blots. Tests for antigens and the use of nucleic acid amplification techniques (NAT) may be of value in the interpretation of uncertain antibody test results. The positive confirmatory test should be repeated on an additional sample taken as soon as possible and not later than 4 weeks after the first sample.

Confirmation of HBsAg reactivity should include specific neutralisation. The stage of infection of the donor may be determined by anti-HBc (total and IgM-specific) and HBe antigen/antibody (HBeAg/anti-HBe).

Anti-HTLV-I-II
The approach to anti-HTLV-I-II confirmation testing is similar to that of HIV and involves nationally established algorithms as well as specific assays including immuno-blotting and NAT. Sensitive tests for genome detection (including typing) may be helpful in defining the infection status of the donor. NAT detection of chromosomal
integrated proviral HTLV (e.g. in whole blood or PBMCs) may be more sensitive compared with plasma test material.

4. Nucleic acid screening
The Committee for Medicinal Products for Human Use (CHMP) has recommended a strategy of pre-testing by manufacturers of mini-pools (of donations or of samples representative of donations) for HCV in order to avoid the loss of a complete manufacturing pool and to facilitate trace back to the donor in the event of a positive test result. In order to achieve a sensitivity that detects 5 000 IU/mL of HCV RNA for donations tested in mini-pools of, for example, 100, 50 IU/mL should be detected with 95 per cent confidence by the NAT assay. Validated enrichment steps like centrifugation may counteract the dilution effect of mini-pools. Each assay run should include an external run control (usually at 3 times the 95 per cent detection limit). This reagent must be reactive in every run. The external run control may be omitted if the test is licensed (CE marked) with other procedures that ensure robustness.

5. Additional serological screening

Syphilis screening
There is on-going discussion over the need to test blood donors for syphilis, but the test may be used as an indicator of risk behaviours for sexually transmitted diseases and is still required by most European countries. Most blood establishments use a test employing a variant of the Treponema pallidum particle agglutination assay (TPPA) or an ELISA test. Reactive syphilis screening results should ideally be confirmed by TPPA, a fluorescent treponemal antibody test (FTA) or an immunoblot test.

Anti-HBc screening
Donors or donations may be tested by an approved test that will detect antibodies to hepatitis B core antigen (anti-HBc). The approach
to deferral or re-entry of an anti-HBc positive donor should be established in an algorithm.

Re-entry into the donor base of an anti-HBc positive donor and the subsequent release of his/her donations should only be considered when the donor has been shown to have anti-HBs with a titre of at least 100 IU/L and each subsequent donation should test negative for both HBsAg and HBV DNA using approved assays.

**CMV screening**

Testing for CMV antibodies is most commonly performed using ELISA or the latex particle agglutination test. The screening of donations for anti-CMV negativity enables the establishment of a panel of anti-CMV negative components for dedicated use in highly susceptible patients.

**Malaria screening**

At present, only a few reliable and robust malaria antibody tests are commercially available. Any malarial antibody-testing requirement necessitates integration within local approaches to the taking of donor histories. If malaria antibody testing is used to determine donor acceptance or rejection, the test employed should be shown to detect antibodies to the malaria types that are likely to pose a risk of transfusion transmission. Currently, NAT for malaria cannot be recommended for use in screening of blood donor because it may fail to detect the small number of parasites in a blood donation that can infect a transfusion recipient. Confirmation of reactivity in malaria antibody tests should be performed by a competent and certified reference laboratory that can define the malaria status of the donor. Users need to be aware that assays may depend on the detection of heterotypic antibodies. Users must ensure that the assay detects antibodies to the Plasmodium species prevalent in their donor panel.

**Trypanosoma cruzi screening**

Donors who were born or have been transfused in areas where trypanosomiasis is endemic can be selected to be tested for antibodies
against *T. cruzi*. Plasma for fractionation is exempt from this test procedure.
Chapter 10

Principles of haemovigilance

1. Overview

Haemovigilance is defined as the use of organised surveillance procedures related to serious adverse events or serious adverse reactions either in donors or in recipients as well as the epidemiological follow-up of infectious disease markers in donors.

The ultimate goal of haemovigilance is to prevent the recurrence of adverse events and reactions. For that purpose, results of data analyses should be fed back to their providers periodically and communicated to the Competent Authority (or Regulatory Authority) indicating (if possible) preventive or corrective measures to be adopted.

Haemovigilance should also incorporate an early alert/warning system. Haemovigilance provides useful information on morbidity arising from donations and transfusions of blood, and gives guidance on corrective measures to prevent recurrence of certain incidents. Moreover, haemovigilance is considered to be a part of total healthcare vigilance (along with pharmacovigilance and vigilance on medical devices).

The information provided by haemovigilance contributes to improving the safety of blood collection and transfusion by:
Chapter 10  Principles of haemovigilance

- providing the medical community with a reliable source of information about adverse events and reactions associated with blood collection and transfusion;
- indicating corrective measures required to prevent the recurrence of some incidents or mistakes in the transfusion process;
- warning hospitals and blood establishments about adverse events and reactions that could involve more individuals than a single recipient, including:
  - those related to the transmission of infectious diseases;
  - those related to blood bags, solutions or blood processing.

2. Prerequisites for implementation of a haemovigilance network

Haemovigilance should be a responsibility of the national Competent Authority (or Regulatory Authority) for blood safety. Haemovigilance networks should embody operational linkages between clinical departments, hospital blood banks, blood establishments and national authorities.

Traceability of blood components

Traceability, which is a prerequisite for haemovigilance, may be defined as the ability to trace in all directions each individual unit of blood or the blood components derived from it from the donor to its final destination, whether this is a patient, a manufacturer of medicinal products or its disposal.

The essential element for traceability is a unique identification numeric or alphanumeric code for each donation, with a subsidiary code for each component prepared from that donation (Recommendation No. R (96) 11 of the Council of Europe on documentation and record-keeping to guarantee the traceability of blood and blood components especially in hospital). This unique identifier must be linked to data that identifies both the donor and the
recipient. In this way, all patients transfused with a particular donor’s blood (or all donors who donated the blood components that a patient received) may be traced.

Traceability is essential for:

- tracing, retrospectively, a possibly infectious donor in case of transmission of an infectious agent to a recipient;
- tracing, retrospectively, a possibly infected recipient in case of infectivity of a donor;
- tracing recipients in case of systemic problems that put recipients at risk of serious adverse reactions or events.

Traceability can provide information on the total number of:

- patients that have been transfused;
- blood units or components that have been issued or used;
- blood donors that have provided the transfused blood units or components.

Without this information, it is difficult to calculate the incidence of adverse events and reactions and, thus, to estimate risk. The number of adverse events and adverse reactions over a given time period may help to identify critical issues within the various processes of collection, preparation and/or transfusion.

Information systems should be available to facilitate rapid traceability by using patients, blood components and donors as data-access keys. To ensure the reliability of the database, confirmation is needed that the blood component was transfused to the designated patient for whom it was issued. Without this, proving the link between donor and patient requires verification in the patient’s notes that the blood component was appropriately transfused. The document confirming the transfusion should also include information on the existence or non-existence of immediate adverse events or reactions.

The following accurate data should be made available:
• personal data uniquely identifying the donor and providing a means to contact him/her;
• the blood establishment in which the blood or blood component collection has been carried out;
• the date of donation;
• the blood components produced and additional component information, if appropriate;
• the blood establishment or hospital blood bank to which the blood component has been distributed, if different from the production facility;
• the hospital and the ward to which the blood component has been issued for transfusion;
• the date and time of issue;
• the final fate of the unit; either the identity of the patient who received it or other use (e.g. quality assurance, reagents, discards, etc.);
• the date and starting time of transfusion.

In case of blood components that have not been issued for transfusion, data should be available to identify the facility where the units have been used or disposed of.

Co-operation between blood establishments, hospital blood banks and clinical departments

The responsibility of reporting adverse events and reactions does not imply a responsibility for individual patient care.

Reporting and analysis of adverse events and reactions associated with transfusion requires close co-operation between the clinical department where transfusion took place, the hospital blood bank that issued the transfused blood component and the blood establishment that collected and distributed the blood unit (if different from the hospital blood bank).
This co-operation is essential to ensure a complete investigation of any adverse event or reaction, including uneventful transfusion errors. In the blood establishment and/or the hospital blood bank, the physician involved may be the person responsible for blood component delivery, or a physician may be specifically in charge of haemovigilance. Similarly, in clinical departments, the responsible person can be the physician in charge of the patient or another physician specifically in charge of haemovigilance.

In case of serious adverse reactions in blood recipients, which may be related to the transfused blood components, notification should be sent as soon as possible to the blood establishment where the components were collected.

Prompt reporting enables the blood establishment to take action to block blood components from related donors, donations or production methods.

Serious adverse reactions include: acute haemolytic transfusion reactions, sepsis due to bacterial contamination, delayed haemolysis, transfusion-related acute lung injury, transfusion-associated GvHD, transfusion-transmitted infectious diseases, anaphylaxis, transfusion-associated circulatory overload, hypocalcaemia, hypothermia, post-transfusion purpura.

3. Types of adverse reactions and adverse events collected in a haemovigilance network

Adverse reactions in patients

Adverse reactions associated with transfusion of blood components are the primary scope of a haemovigilance system, which should collect reports concerning patients of events such as:

- immediate adverse reactions during transfusion, such as: haemolysis; non-haemolytic febrile transfusion reaction; rash; erythema; urticarial; anaphylactic shock; bacterial contamination;
• TRALI, transfusion-associated circulatory overload (TACO) and GvHD;
• delayed adverse reactions after transfusion, such as haemolysis, post-transfusion purpura, iron overload, etc.;
• bacterial, viral, parasitical or TSE transmission;
• occurrence of allo-immunisation against red cell, HLA or platelet antigens.

The rules for reporting may differ according to the type and severity of adverse reaction. In case of minor reactions (such as non-haemolytic febrile transfusion reaction, rash, erythema and urticaria), individual reports should only be sent by the clinical departments to the blood bank. Then, depending on the organisation of the haemovigilance network, the blood bank may send periodic reports to its associated blood establishment or to the Competent Authority (Regulatory Authority) describing the incidence of such events.

This applies to any event that may involve several individuals and to serious hazards. Moreover, in case of viral transmission, the extent of required investigations should be clearly defined.

**Adverse reactions in donors**

See also Chapter 3, Principles of blood collection.

Adverse reactions in donors are defined as an unintended response associated with the collection of blood or blood components.

Adverse reactions in a donor should be fully documented in donor records and serious adverse reactions should also be documented in the records of the quality system.

Haemovigilance for donors may:

• facilitate the creation of a list of adverse events and reactions in relation to blood collection;
• allow analysis of data and enhance safety of blood collection by implementing corrective actions to prevent recurrences of incidents;
• allow analysis of data and improve transfusion safety depending on donor selection (frequency and causes of blood donation exclusion) and epidemiological follow-up of the donor population (confirmed positive donors in infectious marker screening);

• allow tracing of donors in case of an emerging threat to the safety of blood components (such as a new disease endemic situation).

Adverse events related to blood donation can occur in several fields:

• donor selection: the donor does not fulfil the local medical selection criteria, but has been given clearance for donating blood (with a possible consequence for his/her health or quality of blood components), e.g. insufficient haemoglobin level before donation, insufficient weight, etc.;

• blood collection: inappropriate procedure, e.g. excessive blood loss during blood or blood component donation, inadequate volume of anti-coagulant used for apheresis procedures;

• donor suitability: post-donation information may have consequences for the safety of donated blood components.

Both adverse events and reactions in donors may also have consequences for the quality of the donated blood components.

Data concerning adverse reactions and adverse events in donors should be collected and evaluated within blood establishments and, if appropriate, should be reported at least annually to the national haemovigilance system. Information on adverse events and adverse reactions in donors should be considered to be part of the haemovigilance system.

**Adverse events**

An adverse event is defined as any untoward occurrence associated with the collecting, testing, processing, storage and distribution of blood and blood components that might lead to an adverse reaction in blood recipients or blood donors.
Serious adverse events are those that might have led to death or life-threatening, disabling or incapacitating conditions for patients or donors (but did not), or which might have resulted in prolonged hospitalisation or morbidity (but did not). Examples of such serious adverse events are: failures to detect an infectious agent; errors in ABO typing; incorrect labelling of blood samples or blood components from donors. For instance, if components were not transfused or an incorrect or inappropriate component was administered due to incorrect identification of the recipient, Directive EC 2002/98 requires that these events must be notified to the Competent Authority.

‘Near-miss’ events are a subgroup of adverse events. A near-miss event is defined as any error which, if undetected, could result in determination of a wrong blood group or failure to detect a red cell antibody or the issuance, collection or administration of an incorrect, inappropriate or unsuitable component, but where the mistake was recognised before transfusion took place.

Adverse events include incorrect, inappropriate or unsuitable blood component transfusions that did not lead to harm to the recipient (but could have). For example, administration of a mis-matched ABO-compatible component or failure to give irradiated components when prescribed.

Notification of adverse events which are transfusion errors that do not cause an adverse reaction may help to identify weaknesses in the clinical transfusion process and thereby reduce risk. The haemovigilance system should inform relevant staff of the importance of reporting of adverse events. The haemovigilance system should provide a system for reporting near misses with anonymisation to protect individuals from blame and to stimulate voluntary reporting. Information technology systems may facilitate reporting and analysis of haemovigilance data.

**Device defects**

Reporting of device defects can be viewed as part of haemovigilance (see Standards).
4. **Tracing and recall of potentially infectious donations for HIV, HCV or HBV (look-back)**

**Post-transfusion infection in a recipient reported to the blood establishment**

Hospitals must inform the blood establishment whenever a recipient of blood components develops laboratory test results and/or disease symptoms indicating that a blood component may have transmitted an infectious agent (see **Standards**).

It is important that the blood establishment is informed without delay by the hospital so as to allow further action on implicated donations and donors and in order to prevent harm to other recipients.

Test results from donations of implicated donors may be re-analysed, or additional or confirmatory tests on archived or freshly obtained samples from the implicated donors may be performed with the aim of excluding infection by HIV, HCV or HBV in the donor(s). If such analyses reasonably exclude infection, such donor(s) may be re-released for future donations and (temporarily) blocked components derived from their donations may be re-released.

Where feasible and appropriate, the blood establishment should (temporarily) defer all implicated donors from further donations and retrieve (temporarily) or quarantine all in-date components for transfusion collected from the implicated donors.

If an implicated donor is found with a confirmed positive test for infection by HIV, HCV or HBV, the blood establishment should act accordingly with regard to deferral of the donor and initiate a look-back procedure on previous potentially infectious donations and inform the hospital(s) concerned.

The incident should be reported to the national haemovigilance system and/or Competent Authorities (or Regulatory Authorities).
Post-donation information

The blood establishment should (temporarily) block all in-house components from the donor and retrieve all in-date components. The relevant plasma fractionation institute must be notified.

The blood establishment should perform a risk analysis to assess whether the incident indicates a potentially infectious blood component destined for recipient(s). Test results from donations of the implicated donors may be re-analysed, or additional or confirmatory tests on archived or freshly obtained samples from the donor may be performed.

If a confirmed HBV, HCV or HIV infection is shown in the donor, the blood establishment should defer the donor and undertake a look-back procedure on previous potentially infectious donations.

Recall of blood components

In case of a quality deviation (e.g. for HBV, HCV or HIV), the blood establishment must retrieve all in-date blood components distributed to the hospital(s) as a precautionary measure. This procedure may be a temporary measure and implies that certain retrieved blood components may be re-released after appropriate risk analyses and/or additional testing. The measure is taken in order to prevent harm to potential recipients. The relevant plasma fractionation institute must also be notified.

Tracing of recipients of potentially infectious blood donations (look-back/review)

Blood establishments should initiate a look-back procedure that is aimed at tracing recipients of blood components from a potentially infectious blood donation and notifying these recipient(s), via their treating physicians, whenever a blood donation may have taken place within the window period of a (repeat) donor with a confirmed HIV, HBV or HCV infection.
Implicated donations include those within a timeframe equal to the maximum test-specific window period of the infection preceding the last negative screening test result in the donor.

The blood establishment should inform the hospital in writing about the incident and advise the hospital to trace the recipient(s) of the implicated blood component(s) and inform the treating physician about the potentially infectious transfusion. The relevant plasma fractionation institute must also be notified.

It is the responsibility of the treating physician to inform the recipient about a potentially infectious transfusion, unless there are medical arguments not to do so. If the recipient is tested in order to establish or to exclude infection, the blood establishment should be informed by the hospital about such test results. If testing of the recipient is not performed, the blood establishment should also be informed of this by the hospital.

If the recipient is confirmed to be positive for the infection, the incident must be reported to a national haemovigilance system and/or to the Competent Authorities.

Consistent with the recommendations of the national health authority, blood establishments should consider the need to trace and notify blood component recipients and/or their physicians in cases where a blood donor subsequently is diagnosed with vCJD infection.

5. Contracts between blood establishments and hospitals for haemovigilance

In those situations in which blood collection and processing is carried out in facilities located outside of hospitals, the look-back, trace-back and recall procedures may be described in the contract(s) between the blood establishment and the hospital(s).

Minimum information to be captured in the initial incident report at hospital level

Information about transfused patients must be managed according to the confidentiality requirements/legislation of individual countries.
Reported patient identifiers should include at least date of birth, gender and a unique case number. Any clinical signs observed should be documented in a standardised fashion, either specific for a given adverse event or reaction or the same format for every untoward effect. The clinical outcome of all adverse reactions should be stated.

6. Reporting haemovigilance data

Standardisation of reporting

Reports of adverse events and reactions should be made in the same way in all the institutions that participate in the haemovigilance network. This strategy implies not only use of common report forms, but also a common training programme that ensures a similar method of interpretation for a given incident as well as a common and agreed definition of the different types of adverse events and adverse reactions among all participants. In this respect, the persons specifically in charge of haemovigilance may contribute to the standardisation of both reports and definitions.

In practice, standardisation of reporting requires an active training policy initiated inside the network.

Data analysis

All the reports should be carefully analysed before inclusion in the haemovigilance database, which can be exploited at different levels: institutional, regional, national or international. Whatever the magnitude of the network, an individual institution should have permanent and full access to its own data.

Information sent to the haemovigilance database

Information about transfused patients must be managed according to the confidentiality requirements/legislation of individual countries.

Component information

This information should include a detailed description of the component involved:
• unit number and appropriate codes for components;
• description of the component, including:
  – the type of component, i.e. red cell, platelet or plasma;
  – the type of preparation, i.e. from whole blood or from apheresis;
  – other characteristics, i.e. leucocyte-depleted, irradiated, plasma-reduced, etc.;
  – conditions and duration of storage prior to transfusion.

**Information about severity**

Severity should be graded. A suggested scale is as follows:

<table>
<thead>
<tr>
<th>Severity scale</th>
<th>Information about imputability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 No clinical signs</td>
<td>When there is conclusive evidence beyond reasonable doubt for attributing the adverse reaction to alternative causes.</td>
</tr>
<tr>
<td>1 Immediate signs without vital risk and full resolution</td>
<td></td>
</tr>
<tr>
<td>2 Immediate signs with vital risk</td>
<td></td>
</tr>
<tr>
<td>3 Long-term morbidity</td>
<td></td>
</tr>
<tr>
<td>4 Death</td>
<td></td>
</tr>
</tbody>
</table>

The possible relationship between the observed adverse reaction and the transfusion of blood components given (imputability) should be identified. A scale, required in the EU, is as follows (Directive 2005/61/EC):
## Imputability scale

<table>
<thead>
<tr>
<th>Imputability scale</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Unlikely: When the evidence is clearly in favour of attributing the adverse reaction to causes other than the blood or blood components.</td>
</tr>
<tr>
<td>N/A</td>
<td>Not assessable: When there is insufficient data for causality assessment.</td>
</tr>
<tr>
<td>1</td>
<td>Possible: When the evidence is indeterminate for attributing the adverse reaction either to the blood or blood component or to alternative causes.</td>
</tr>
<tr>
<td>2</td>
<td>Likely, probable: When the evidence is clearly in favour of attributing the adverse reaction to the blood or blood component.</td>
</tr>
<tr>
<td>3</td>
<td>Certain: When there is conclusive evidence beyond reasonable doubt for attributing the adverse reaction to the blood or blood component.</td>
</tr>
</tbody>
</table>

### Information about the type of adverse events and reactions

Report forms should enable differentiation between adverse reactions in patients and donors, as well as from adverse events.

Report forms should include a brief summary that describes the event, as well as the corrective actions taken.

In order to provide an evaluation of the incidence of untoward effects, each participating institution should provide the number of blood components used per year and the number of patients transfused, together with details of all reported events.

Additional information about the current guidelines and procedures in regard to the use of blood components is useful in comparing the results from different institutions or even different countries.
Chapter 11

Principles of clinical use of blood

1. Overview

The clinical transfusion process is the ‘transfusion of the right unit of blood to the right patient at the right time, and in the right condition and according to appropriate guidelines’. It is a chain of inter-related events beginning with an appropriate decision that the patient needs transfusion of a blood component and ending with assessment of the clinical outcome of the transfusion. Safety of transfusion of blood components is underpinned by several key measures:

- the decision to transfuse;
- completion of the transfusion request form;
- correct identification of the patient and obtaining a pre-transfusion sample;
- testing within the laboratory;
- selection and issue of appropriate blood components;
- administration of the component to the patient with appropriate monitoring.
2. Elements for a quality system in clinical transfusion

A quality system in the clinical use of human blood and blood products is a complex process that involves different health professionals. Overall responsibility for the process lies with the physician in charge of the transfusion department within the hospital. Structures and individuals that contribute to the governance of the process include hospital management, the Hospital Transfusion Committee (HTC), the hospital blood bank and the blood establishment responsible for distribution of components to the hospital, and all hospital staff involved in the transfusion chain.

Elements of the system include:

- adoption and regular updating of clear guidelines for appropriate use of blood and blood components;
- adoption of SOPs for the implementation and surveillance of appropriate blood utilisation;
- thorough dissemination of guidelines and SOPs;
- appropriate selection of suitable blood component for each clinical condition;
- safe issue and handling of therapeutic components;
- ensuring correct patient identification throughout the transfusion process;
- safe transfusion of the patient, e.g. adoption of safety measures;
- recognition, management and prevention of adverse effects of transfusion;
- constant monitoring of quality and revision of the processes, results, and blood components of transfusion medicine activities.

Indications for blood component transfusion and the role of clinical auditing

Appropriate evidence-based guidelines that are updated regularly should be available to prescribing physicians. They should represent
a rational model for the prescription of transfusion therapy. The guidelines should contain detailed instructions on appropriate use of blood components for each clinical condition. They should also include guidance on the dosage and indications for special requirements (e.g. irradiated, washed).

The HTC should adopt procedures for regular transfusion auditing. Transfusion audit reports should be made available to appropriate prescribing physicians. The medical staff of the blood establishment and hospital blood bank is responsible for providing transfusion medicine clinical support and advice on all aspects of the process.

**Informed consent for transfusion**

Informed consent for transfusion is recommended and, indeed, mandatory in many countries. This is the responsibility of the prescribing physician. Information in written form should be available in each hospital ward and should include appropriate information on the risks and benefits of transfusion therapy and its alternatives.

The indication for transfusion and informed consent of the patient should be documented in the clinical record.

**The transfusion request**

Transfusion requests must include an appropriate clinical indication (following HTC guidelines) and should be made on standard forms. These forms should be completed under the direct clinical and legal responsibility of the prescribing doctor (or nurses, if such procedures are approved) and they should include information justifying the clinical request for blood transfusion.

A procedure for auditing transfusion requests should be in place in order to identify non-conformity and to facilitate interventions to improve compliance and, where appropriate, to update the guidelines.

Where appropriate, the request form should be accompanied by correct blood samples for pre-transfusion testing. Procedures must be in place to ensure that samples have been drawn from the correct patient.
Detailed instructions on the completion of the request form and taking of pre-transfusion samples should be available.

**Transfusion of blood components**

Incorrect blood component transfusions account for a significant proportion of the reported serious adverse reactions in transfusion. Appropriate standard operating procedures for blood transfusion therapy should be adopted, including:

- education and training of health personnel about symptoms and signs of transfusion reactions;
- the requirement for proper patient identification and confirmation that the component is intended for this patient, the blood group of the patient and component and expiry date of the unit;
- visual inspection of the blood component unit to identify leakage, evidence of bacterial infection and other abnormalities;
- proper handling of the units in the ward;
- instructions for administration of the blood component and monitoring of the patient prior to and during the transfusion;
- maximum time allowed for the transfusion of individual components;
- correct use of infusion devices (filters, heating devices, pressure bags).

**Transfusion reporting and management of transfusion reactions**

A procedure should be in place to document that the transfusion has taken place and that any evidence of adverse transfusion reactions are reported to the hospital blood bank and, where appropriate, the blood establishment.
3. Clinical indications for blood components

Clinical indications of red cells

The aim of red cell transfusion is to achieve sufficient oxygen delivery to organs and tissues. Insufficient oxygen transportation may result from acute, intermittent or chronic blood loss, conditions affecting the production of red cells and/or haemoglobin or conditions affecting the cardiovascular and respiratory systems.

There is no general agreement at which point transfusion should be given or on the optimal targets (haemoglobin, red cell counts) to be achieved. Furthermore, the haemoglobin level necessary for maintaining sufficient oxygenation of organs and tissues varies considerably among patients and in different clinical situations.

Clinically useful criteria are needed to assist clinicians in evaluating signs, symptoms and co-existing conditions. The decision on transfusion for each patient should take into account the patient’s haemoglobin concentration, capacity to compensate for anaemia and co-morbidities. Haemoglobin concentration alone is not an adequate measurement of oxygen supply. In addition, if the patient is hypovolaemic, the haemoglobin level does not correctly reflect the red cell mass in the patient and it may be necessary to deviate from the recommendations below.

In a healthy person at rest and not bleeding, a haemoglobin concentration of 70-80 g/L is normally sufficient to maintain tissue oxygenation. This is partly a result of the improved micro-circulation due to decreased blood viscosity. Therefore, in this setting, red cell transfusion is not normally required unless the haemoglobin falls below this level. However, if compensation mechanisms are insufficient to adequately increase cardiac output, for example due to impaired heart and/or pulmonary function or septicaemia, a higher level (e.g. 90-100 g/L) may be appropriate.
Acute blood loss

Initial measures in the management of acute blood loss aim to arrest the bleeding by treating any traumatic, surgical or obstetric source and maintaining blood flow through critical organs. If oxygenation of organs and tissues is judged to be critically impaired, red cells may need to be transfused in order to improve tissue oxygenation. The need for transfusion of red cells should be assessed individually and be based on clinical signs and critical evaluation of the results of laboratory tests. Haemoglobin and haematocrit levels should be measured frequently, but in the knowledge that they may be a poor indicator of blood loss in the acute situation.

‘Massive transfusion’ can be defined as replacement of the patient’s total blood volume with donor blood in less than 24 hours, replacement of 50 per cent of the blood volume within 3 hours, or transfusion to compensate for blood loss exceeding 150 mL per minute. Early recognition of the volumes of blood loss and effective action are necessary to prevent shock and its consequences. Effective communication between clinicians, diagnostic laboratories and blood banks is critical and a massive transfusion procedure/protocol (MTP) is highly recommended. Correction of bleeding in this setting requires judicious use of blood component therapy (red cells, platelets, FFP, cryoprecipitate), fibrinogen concentrate, and pharmacological agents such as tranexamic acid.

Chronic anaemia

Treatment of chronic anaemia due to iron, folate and vitamin B12 deficiency should primarily be directed to correcting the cause of the anaemia. Transfusion of red cells is rarely needed.

When measures to correct the cause of the anemia are ineffective, red cell transfusion may be considered. The decision to transfuse should be based on the clinical condition of the patient, taking into account the haemoglobin level, the duration of anaemia and the presence of conditions affecting oxygen delivery such as impaired pulmonary function, cardiac disease or cardiovascular disease. In chronic disease
such as uraemia and in malignant diseases, increasing anaemia is significantly related to increasing fatigue, which has a significant adverse impact on patients’ functional abilities and quality of life.

Transfusion therapy in chronic anaemia, such as that associated with malignancy, usually aims to maintain the haemoglobin level between 80 and 100 g/L, whilst >100 g/L may be appropriate for some patients to avoid angina or heart failure. The need for transfusion must be individually assessed and should take into account that different patients need different transfusion support in order to maintain an acceptable social situation and physical performance, as well as to experience a satisfactory quality of life. Regular transfusion therapy, whilst effective, has several drawbacks. The effect is short-lived and there is a risk of iron overload, with consequent organ damage.

Erythropoiesis-stimulating agents (ESA) treatment, aimed at maintaining a haemoglobin level of up to 120 g/L, is usually effective in the treatment of anaemia in renal failure patients, but not all patients respond to this treatment. ESA should be used with caution in cases of malignancy. ESA use is contraindicated in some cancers, whereas in other types of cancer it may be ineffective. More widespread use of ESA in the treatment of chronic anaemia will depend on its cost, effectiveness and safety.

In people with thalassaemia and presenting with chronic, severe and life-threatening haemolytic anaemia, transfusion therapy involves regular blood transfusions throughout life that are usually administered every 2 to 5 weeks, which are targeted at maintaining the pre-transfusion haemoglobin level above 90-105 g/L. This moderate transfusion regimen has been shown to promote normal growth, to allow normal physical activities, to adequately suppress bone marrow hyperactivity in most patients and to minimise iron accumulation. Higher target pre-transfusion haemoglobin levels (i.e. 110-120 g/L) may be more appropriate for patients with heart disease or other medical conditions and for those patients in whom adequate suppression of bone marrow activity is not achieved at the lower recommended haemoglobin levels.
In sickle cell disease, the indications for transfusion therapy with red blood cells are anaemia and vascular occlusion. Chronic transfusion has also been shown to be effective in prevention of recurrent ischemic events (particularly thrombotic stroke). Transfusion therapy is not normally indicated in patients with haemoglobin values greater than 70 g/L. In the presence of vascular occlusion, the aim of transfusion therapy is to prevent or stop intra-vascular sickling by dilution or replacement of the pathological circulating RBCs with normal RBCs. Sickle cell patients must be transfused with red blood cells lacking haemoglobin S. It is unlikely that these patients will develop vaso-occlusive episodes when the percentage of haemoglobin S is below 30-40%. Red cell exchange may be required for major elective surgery, ocular surgery and to prevent or treat acute vaso-occlusive episodes.

**Acute auto-immune haemolytic anaemia**

Transfusion should normally be avoided in this setting, but may be necessary in life-threatening situations, despite serological incompatibility.

**Clinical indications for platelet transfusion**

The aim of platelet transfusion is to prevent and treat haemorrhage in patients with thrombocytopenia or with platelet functional defects. The decision to transfuse platelet components should be based on the platelet count, clinical status of the patient, and clinical setting.

**Thrombocytopenia**

The cause of the thrombocytopenia should normally be established before a decision about the use of platelet transfusion is made. Platelet transfusions are not indicated in all causes of thrombocytopenia and may be contraindicated in certain conditions.

**Thrombocytopenia caused by primary or secondary bone marrow failure**

Therapeutic platelet transfusions are indicated for patients with active bleeding associated with thrombocytopenia. Prophylactic platelet
transfusions are used when the platelet count is less than $5-10 \times 10^9/L$ and in the absence of bleeding or another platelet-consuming factor. The presence of fever, local injuries, coagulation disorders and/or other untoward symptoms may require prophylactic transfusions to maintain platelet counts $> 15-20 \times 10^9/L$.

In chronic failure of platelet production due to aplastic anaemia or myelodysplasia, long-term prophylactic transfusions are best avoided because of the risk of HLA/HPA allo-immunisation and platelet refractoriness. Many patients remain free of serious bleeding despite platelet counts of $5-10 \times 10^9/L$. If platelet transfusions are needed, the interval between transfusions must be individually assessed.

**Thrombocytopaenia and surgery or invasive procedures**

Platelet transfusion should be considered to maintain a platelet count above $50 \times 10^9/L$ in patients who are to undergo either a major invasive procedure or in situations where direct haemostasis is not accessible (e.g. liver or trans-bronchial biopsies).

Higher platelet levels ($> 100 \times 10^9/L$) may be required in clinical settings involving critical bleeding risks (e.g. neurosurgical and intra-ocular procedures).

**Platelet function defects**

Patients with platelet function disorders rarely need platelet transfusions. The cause of impaired function (e.g. medication impairing platelet function) should be identified and corrected, if possible, prior to surgery or before invasive procedures.

Platelet transfusion should be considered in patients with disorders of platelet function when the patient requires an invasive procedure and there is a high risk of bleeding. In this setting, the platelet count is not a reliable indicator of bleeding risk, so platelet transfusion should be continued until the risk of bleeding has ceased. Transfusion might also be indicated in spontaneous bleeding that is not responsive to simple topical treatment or other measures.
**Massive transfusion, cardio-pulmonary bypass and disseminated intra-vascular coagulation**

In these settings, platelet counts and coagulation studies should be performed prior to the transfusion to guide subsequent therapy. During surgery on patients with quantitative or qualitative platelet defects, the adequacy of haemostasis should be evaluated by an assessment of microvascular bleeding.

The underlying disease of a disseminated intravascular coagulation status should preferably be treated before the administration of platelets.

**Other thrombocytopenias**

Auto-immune thrombocytopenia – platelet transfusions are only indicated in life-threatening bleeding.

Thrombotic thrombocytopenic purpura – platelet transfusion should be avoided.

Neonatal allo-immune thrombocytopenia – this is a situation that may require urgent platelet transfusion. In Europe, allo-immune thrombocytopenia is commonly due to anti-HPA-1a (or anti-HPA-5b) antibodies. Hence, neonates with allo-immune thrombocytopenia should receive apheresis platelets that are antigen-negative for the corresponding antibody. When these are not available from donors, maternal platelets that have been washed to remove the antibodies and then re-suspended in AB plasma or additive solution may be acceptable, but they must be irradiated prior to transfusion.

In emergency settings (severe bleeding), if compatible platelets are not available, transfusion of non-typed platelets should be considered.

**Clinical indications for fresh frozen plasma**

The aim of FFP transfusion is to correct coagulation disorders in a bleeding patient with a deficiency of multiple coagulation factors.

FFP has very limited indications. It can be used in situations in which multiple coagulation factor deficiencies exist or in a deficiency of a
single coagulation factor if no suitable pathogen-reduced coagulation factor concentrate is available.

The clinical effects of FFP transfusions are often difficult to assess. Clinical response may indicate effectiveness of the FFP transfusion, especially in bleeding patients. When FFP is transfused to correct abnormal levels of haemostatic variables, the effect should be monitored to assist the decision-making process for further treatment. Monitoring clinical signs and haemostatic variables will help to assess the adequacy of support and to guide the selection of components, but should not delay the initial issuance of FFP.

*Surgical bleeding and massive transfusion*

Massive transfusion can be defined as the replacement of the patient’s total blood volume with donor blood in less than 24 hours, replacement of 50 per cent of the blood volume within 3 hours or transfusion to compensate for a blood loss exceeding 150 mL per minute.

There is considerable debate on the appropriate mix of blood components used in the early management of patients with massive blood loss. Observational studies have suggested that an initial FFP:RBC ratio of 1:1.5 is associated with reduced mortality. Such transfusion protocols should be supplemented by observations of clinical signs and timely coagulation tests. FFP should be used to maintain prothrombin time and activated partial thromboplastin time ratios at around 1.5 times normal or less and to maintain fibrinogen above 1.0 g/L.

*Complex haemostasis deficiencies and disseminated intra-vascular coagulation (DIC)*

Activation of coagulation and fibrinolytic systems consumes coagulation proteins and inhibitors, fibrinogen and platelets. Clinical presentation can range from major bleeding (with or without thrombotic complications) to a compensated state diagnosed only on laboratory testing.
Acute DIC is most likely to occur when the coagulation (and fibrinolytic) system is massively activated by underlying disease and the natural inhibitors cannot balance this massive activation. The underlying cause of the acute DIC must be treated. Supportive treatment with FFP, platelets and fibrinogen concentrate or cryoprecipitate may be required if the patient is bleeding.

An initial dose of 15 mL/kg of FFP is recommended; although there is some evidence that a dose of 30 mL/kg produces more complete correction of coagulation factor levels.

**Liver disease**

The bleeding tendency is due to the reduction of clotting factor synthesis, dysfibrinogenemia, thrombocytopenia and increased fibrinolysis. If there is active bleeding, supportive treatment with FFP may be needed. The response to FFP is unpredictable in terms of correcting abnormal test results before invasive procedures in patients with liver disease. The routine use of FFP in this situation has, therefore, been questioned. If FFP is given, repeat coagulation tests should be performed and further therapy should be determined based on the results of these tests.

**Single coagulation factor deficiencies**

FFP may be used only when no coagulation factor concentrate suitable for treatment of the specific coagulation factor deficiency is available. Today, this applies mainly to the rare, inherited, coagulation factor V deficiency.

**Thrombotic thrombocytopenic purpura (TTP)**

Accumulation of ultra-high-molecular-weight multimers of von Willebrand factor (HMW-vWF) due to a deficiency of a metalloproteinase enzyme (ADAMTS13) results in the activation and consumption of platelets. Plasma exchange with replacement with FFP and/or fresh frozen plasma – cryoprecipitate depleted (FFP-CD) should be performed as soon as possible, preferably within 24 hours.
after onset of disease symptoms. Daily plasma exchange should continue until at least 2 days after remission.

**Clinical use of granulocytes**

The aim of granulocyte transfusion is to improve the clinical status of infected and severely neutropenic patients that are unresponsive to appropriate antibiotic therapy. There is limited evidence from clinical trials for the use of granulocytes. Hence, their use is largely empirical (see ‘important notice’ in the monograph Granulocytes, Apheresis).

Granulocyte transfusion should only be used in:

- severely neutropenic patients that meet all the following criteria:
  - neutrophil count less than $0.5 \times 10^9/L$, due to congenital or acquired bone marrow failure;
  - fever for more than 24-48 hours, proven or highly probable fungal or bacterial infection, unresponsive to appropriate anti-fungal and antibiotic therapy;
  - expectation of neutrophil recovery number and function or if a bone marrow transplantation is planned;

- patients with severe granulocyte dysfunction (congenital or acquired), regardless of the granulocyte count, with either a proven or strongly suspected life-threatening fungal or bacterial infection, and who are unresponsive to at least 48 hours of appropriate anti-bacterial or anti-fungal therapy.

The component may be indicated in neonates with fulminant sepsis and relative neutropenia $< 3 \times 10^9/L$ in the first week of life or $< 1 \times 10^9/L$ after the first week of life.

Prophylactic granulocyte transfusions are not recommended.

**4. The request form**

The request form should be completed after the decision to transfuse has been made and the patient has consented.
Patient identification: family name and given name and date of birth are minimal requirements for identification, but these should be supplemented by a unique identity hospital number. In newborn infants, the gender and the number on the identification wristband should also be noted. If it is not possible to establish a patient’s identity, a unique series of numbers may be used on wristbands and attached to the patient according to specified rules.

The following should be indicated on the request form: the diagnosis; clinical and laboratory results-based reasons justifying prescription of blood transfusion; number of units; type(s) of blood component(s) and associated special requirements; date and location of the transfusion; urgency of the transfusion.

Special transfusion requirements, e.g. irradiation or washing, should be documented on the request form.

The patient should be positively identified and, if possible, the patient should be asked to give his/her details whilst they are conscious.

The request should be sent with the patient’s blood sample. If blood is required urgently, a specific communication can be sent to the blood bank.

5. **Issuing blood components**

Before issuing a blood component, the laboratory should check that the: correct component has been selected; special requirements have been fulfilled: component remains in-date. A check should be made of the integrity of the unit. A compatibility label should be attached to the component indicating the patient identifiers obtained from the sample and/or request form.

Each type of blood component should be transported according to the appropriate and validated transport systems (see Chapter 4).

The blood component should not remain out of controlled storage for more than 30 minutes if it is to be returned to storage and not transfused. Transfusion should be completed within 4 hours of removal from controlled storage.
6. **Administration of blood components**

**Safety measures**

Patient identity should be confirmed at the bedside by asking the patient to state his/her name and date of birth and by verifying these or other identification details, e.g. patient wrist-band, attached according to well-specified rules.

Blood components must be administered using an approved blood administration set that incorporates an integral mesh filter (usually 170-200 microns) to filter out large clots and aggregates and ensure an effective flow rate. This set must be used in accordance with manufacturer recommendations. It is recommended that no transfusion sets are used for more than 6 hours. A check should be carried out to ensure that there is no visible deterioration of the blood component (with particular emphasis on discolouration and leakage).

Confirmation of compatibility between patient and blood unit must be carried out by:

- checking the written prescription (including special requirements);
- comparing the identity information received from the patient with data on the certificate of compatibility testing (if used) from the laboratory;
- checking the certificate of the patient’s blood group against the blood group on the blood unit label;
- checking if the identification number of blood units on the laboratory’s certificate matches the identification numbers on the blood unit labels;
- checking that the expiry date of the blood unit has not been passed.

To ensure traceability, all blood components administered should be recorded in the clinical patient record, including the component identification number and the start and end times of the transfusion.
Handling and storage of blood in the hospital
Before transfusion, the quality and safety of blood components must be maintained in the hospital or clinic by handling and storage according to current rules or recommendations of the blood establishment that distributed the component(s). To avoid compromising clinical effectiveness and safety, blood components should be transfused within the time limits required by the current rules or local procedures.

Relevant staff should be properly trained in the principles and practice of handling different types of blood components and written SOPs should be readily available for consultation.

Warming of blood
Hypothermia induced by rapid/massive transfusion (more than 50 mL/kg/hour in adults and 15 mL/kg/hour in children) increases the risks of organ failure and coagulopathy. If warming of blood is indicated, only validated and regularly controlled warming devices should be used in accordance with manufacturer instructions.

Handling of frozen units
Frozen units have to be handled with great care since the containers may be brittle and may easily crack at low temperatures.

Air embolism
During blood transfusion, air embolism is possible under some circumstances if the operator is not sufficiently careful and skilled.

7. Monitoring
Observation of the patient during and after transfusion is essential. Vital signs such as blood pressure, pulse and temperature should be measured before starting the transfusion, and ideally at intervals during and after the transfusion. Observation during the first 15 minutes of the transfusion is especially important to facilitate early detection of signs of serious acute reactions.
The time when transfusion is started, interrupted and stopped should be clearly reported in patient records, as well as vital signs or any other symptoms that could indicate a transfusion reaction.

Confirmation of transfusion should be sent back to the hospital blood bank.

Any adverse reaction or event related to the transfusion should be investigated, recorded and notified to the haemovigilance system.

Surveillance procedures should be described in SOPs and personnel should be trained.

**Efficacy**

An assessment of the effectiveness of the transfusion should be performed (by post-transfusion increment rates or improvements in patient symptoms and clinical signs) and documented in a clinical record, identifying whether the desired effect was obtained and the likely need for further transfusion.

### 8. Transfusion complications

Transfusion complications include both adverse events and adverse reactions associated with transfusions. These are described in Chapter 10, Principles of haemovigilance.

Each transfusion of blood components is a separate event. Complications may occur during the transfusion, shortly after, or after a delay of hours, days or months. Therefore, careful documentation of the transfusion as well as recording and reporting of transfusion complications is essential.

In the event of a suspected immediate transfusion reaction, the transfusion should be stopped and the line should be maintained with normal saline. A clerical check of the documentation associated with the transfusion should be undertaken, including an identification check of the recipient and blood component and that the ABO and RhD blood group of the component is compatible with the patient’s blood group.
New samples should be taken from the patient and the transfusion packs and, together with a transfusion reaction report, these should be sent to the hospital blood bank for further investigation. In order to assist laboratory investigations of suspected reactions, transfusion packs should not be discarded for at least 24 hours after commencement of the transfusion.

When clinical symptoms and signs suggest the possibility of bacterial infection, blood culture should be obtained from the patient as well as bacterial culture from the blood component bag. Care should be taken not to contaminate the content of the bag after disconnecting from the patient.

In the event of repeated, febrile non-haemolytic transfusion reactions, the use of leucocyte- or buffy coat-depleted blood for subsequent transfusions is recommended.

Long-term complications may also occur. These mainly comprise immunological complications (e.g. allo-immunisation, graft-versus-host disease) and disease transmission.

Haemosiderosis is a particularly serious complication of chronic red cell transfusion affecting patients suffering from transfusion-dependent conditions. Unless patients undergo iron-chelation therapy to control iron overload in the liver and heart, this complication may lead to severe organ impairment and death before the third decade of life. This phenomenon is another reason for maintaining haemoglobin levels at the lowest acceptable level during transfusion. In children, this scenario is a particularly serious complication, and use of iron-reducing/chelating agents should be considered.

There should be co-operation between the responsible physician and the hospital blood banks/blood establishment to facilitate investigation of possible transfusion-transmitted infections and to provide medical follow-up of recipients in cases where a donor is subsequently found to have sero-converted or to have become antigen- or NAT-positive for a disease marker.
Appropriate follow-up and patient counselling is also necessary when significant allo-immunisation against transfused cells may have taken place.

9. **Hospital transfusion committees**

Establishment of hospital transfusion committees (HTCs) is to be encouraged.

A hospital blood transfusion committee should include representatives of the hospital blood bank, the blood establishment and the main clinical units with significant transfusion activity. It is recommended that physicians, nurses and administrative personnel be represented on these committees.

The main goals of HTCs are:

- to define blood transfusion policies adapted to local clinical activities;
- to perform regular evaluation of blood transfusion practices;
- to analyse adverse events and adverse reactions related to blood transfusion;
- to take any corrective and preventive measures if necessary;
- to ensure that all staff involved in transfusion practice receive adequate training.

Audit systems for the clinical use of components further enhance the efficacy and safety of transfusion practices.
STANDARDS
Chapter 1

Introduction

The Standards section of this Guide contains minimum standards for blood establishments and hospital blood banks that are required to comply with European Union (EU) Directive 2005/62/EC. The Standards are aligned closely with European Commission Directives, and include blood component monographs that mirror the structure used in the European Pharmacopoeia. This section states what must be done.

*Elements of the Standards that are transcribed from EU Directives are legally binding on blood establishments and hospital blood banks within the EU. These are highlighted within this section of this Guide. The specific numbering used in Directive 2005/62/EC is to assist in cross-referencing of EU requirements. They may also be of benefit to Council of Europe member states outside the EU and to other organisations involved in transfusion activities outside Europe.*
Chapter 2

Standards for selection of donors

1. Overview
Measures must be taken to promote the collection of blood and blood components from voluntary non-remunerated donations according to the principles set out in the Convention for the Protection of Human Rights and Dignity of the Human Being with Regard to the Application of Biology and Medicine (Convention on Human Rights and Biomedicine, ETS No. 164) and its Additional Protocol concerning Transplantation of Organs and Tissues of Human Origin (ETS No. 186).

Blood establishments are ultimately responsible for the quality and safety of the blood and blood components collected, and must be entitled to decide on the final acceptance or deferral of a donor or a prospective donor, taking into account Resolution CM/Res (2008) 5 on donor responsibility and on the limitations to donation of blood and blood components.

2. Information to be provided to the donor
The following information must be provided to prospective donors of blood or blood components:
Chapter 2 Standards for selection of donors

- Accurate educational materials that are understandable for members of the general public about the: essential nature of blood; blood-donation procedure; components derived from whole blood and apheresis donations; important benefits to patients;

- For both allogeneic and autologous donations, the reasons for requiring a medical assessment, health and medical history, the testing of donations and the significance of ‘informed consent’:
  - For allogeneic donations, self-deferral, and temporary and permanent deferral, and the reasons why individuals must not donate blood or blood components if there could be a risk for the recipient or the donor;
  - For autologous donations, the possibility of deferral and the reasons why the donation procedure cannot take place in the presence of a health risk to the individual, whether as a donor or recipient of the autologous blood or blood components;

- Information on the protection of personal data: no unauthorised disclosure of the identity of the donor, of information concerning the donor’s health or of the results of the tests performed;

- The reasons why individuals must not make donations that may be detrimental to their health;

- Specific information on the nature of the procedures involved in the allogeneic or autologous donation process and their respective associated risks. For autologous donations, the possibility that the autologous blood and blood components may not suffice for the intended transfusion requirements;

- All blood donors must be provided with accurate and updated information on HIV/AIDS and hepatitis transmission and be given the opportunity for self-exclusion so that those persons who have unsafe sex practices or other risk behaviours exposing them to potential infectious sources refrain from donating;

- Information on the option for donors to change their mind about donating before proceeding further, or the option to withdraw or
self-defer at any time during the donation process without undue embarrassment or discomfort;

- The reasons why it is important that donors inform the blood establishment of any subsequent event that may render any prior donation unsuitable for transfusion;

- Information on the responsibility of the blood establishment to inform the donor, through an appropriate mechanism, if test results show any abnormality of significance to the donor’s health;

- Information why unused autologous blood and blood components are discarded and not transfused to other patients;

- Information that test results detecting markers for viruses, such as HIV, HBV, HCV or other relevant blood-transmissible microbiologic agents, will result in donor deferral and destruction of the collected unit and, when required by law, that the results will be reported to health authorities;

- Information on the opportunity for donors to ask questions at any time.

This information provides the basis for informed consent from the donor that must be obtained before proceeding to donation.

3. **Medical assessment of the donor**

**Donor eligibility**

Procedures for safe donor identification, the suitability interview and eligibility assessment must be implemented and maintained. They must take place before each donation and comply with the requirements set out in Annex II and Annex III to Directive 2004/33/EC (Directive 2005/62/EC Annex 6.1.1).

All donors must undergo a screening process to assess their suitability. Only healthy individuals with an appropriate medical history can be accepted as donors of blood or blood components.

The donor must be properly identified.
The selection process must include assessment of each donor carried out by a suitably qualified individual who has been trained to use accepted guidelines and who works under the direction of a physician. This assessment involves an interview, a questionnaire and further direct questions, if necessary.

**Questionnaire and interview**

The questionnaire must be designed to elicit information relevant to the health and lifestyle of the donor. It must be designed to be understandable by the donor and given to all donors each time they attend. On completion, it must be signed by the donor.

A confidential interview must be conducted by specifically trained staff to ask further direct questions to supplement the information in the questionnaire. The person who carries out the assessment must certify that the relevant questions have been asked.

---

The donor interview must be conducted in such a way as to ensure confidentiality (Directive 2005/62/EC Annex 6.1.2).

The donor suitability records and final assessment must be signed by a qualified health professional (Directive 2005/62/EC Annex 6.1.3).

---

**Donor details**

There must be secure, unique donor identification, contact details and robust mechanisms linking the donors to each of their donations.

**Age of the donor**

The age limits for donation are a minimum of 18 years and maximum of 65 years.

Where allowed by national legislation, blood donation may be considered from donors aged 17.

Donation by first-time donors above the age of 60 years is at the discretion of the responsible physician.

Donation by regular donors over 65 years is at the discretion of the responsible physician. Permission to continue donating after the age
of 65 years can be given annually by the responsible physician either individually to each donor or based on a medical risk assessment for a given donor population.

**Donor appearance and inspection**

Special note must be taken in case of plethora, poor physique, debilitation, under-nutrition, anaemia, jaundice, cyanosis, dyspnoea, mental instability and intoxication from alcohol or drugs.

**4. Donor deferral**

Deferred donors must be given a clear explanation of the reasons for deferral.

Tables 2-1, 2-2 and 2-3 list conditions for deferral. Specific conditions for infectious diseases are listed.

### Table 2-1. Conditions leading to permanent deferral

<table>
<thead>
<tr>
<th>Condition</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer/ malignant diseases</td>
<td>Individuals with a malignant disease, or a history of such, are usually permanently deferred. The physician in charge may make exceptions to this rule in selected cases (see Principles).</td>
</tr>
<tr>
<td>Creutzfeldt-Jakob disease</td>
<td>All individuals who have in the past been treated with extracts derived from human pituitary glands, have been recipients of dura mater or corneal grafts or who have been told of a family risk of Creutzfeldt-Jakob disease or any other transmissible spongiform encephalopathy.</td>
</tr>
<tr>
<td>Diabetes</td>
<td>If insulin therapy is required, rDNA insulin is used.</td>
</tr>
<tr>
<td>Drugs</td>
<td>Any history of injectable drug abuse.</td>
</tr>
<tr>
<td>Heart and blood vessel disease</td>
<td>Persons with a history of heart disease, especially coronary disease, angina pectoris, severe cardiac arrhythmia, a history of cerebrovascular diseases, arterial thrombosis or recurrent venous thrombosis (see also Principles Chapter 2).</td>
</tr>
</tbody>
</table>

---

* A family history of CJD carries a presumption of family risk unless it is determined that: (a) the affected family member had vCJD, not CJD; or (b) the affected family member did not have a genetic relationship to the donor; or (c) the cause of CJD in the affected family member was iatrogenic; or (d) the donor was tested and is known to have a normal genetic polymorphism for PrPC.

* Deferral requirements may be waived by the blood establishment if the donation is used exclusively for plasma for fractionation.
Infectious conditions

Certain infectious states and diseases necessitate permanent deferral:

a) Carriers of HIV 1/2, HTLV I/II, HBV and HCV
b) Babesiosis

c) Leishmaniasis (Kala-Azar) visceral leishmaniasis

d) Chronic Q fever

e) Trypanosomiasis cruzi (Chagas disease)

(see also Chapters 2 and 9 Infectious diseases)
f) Persons whose sexual behaviour puts them at high risk of acquiring severe infectious diseases that can be transmitted by blood.

Xenotransplantation

All recipients.

---

A family history of CJD carries a presumption of family risk unless it is determined that: (a) the affected family member had vCJD, not CJD; or (b) the affected family member did not have a genetic relationship to the donor; or (c) the cause of CJD in the affected family member was iatrogenic; or (d) the donor was tested and is known to have a normal genetic polymorphism for PrPc.

Deferral requirements may be waived by the blood establishment if the donation is used exclusively for plasma for fractionation.

---

### Table 2-2. Conditions leading to temporary deferral (suspension)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Deferral period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endoscopy with biopsy using flexible instruments, inoculation injury,</td>
<td>6 months (or 4 months, provided a NAT test for hepatitis C is negative).</td>
</tr>
<tr>
<td>acupuncture, tattooing or body piercing, mucosal splashes with blood,</td>
<td></td>
</tr>
<tr>
<td>tissue or cell transplant of human origin</td>
<td></td>
</tr>
<tr>
<td>Transfusion of blood components</td>
<td>6 months or for 4 months provided a NAT test for hepatitis C is negative.</td>
</tr>
<tr>
<td></td>
<td>Injection of red cells as part of an approved immunisation programme will need</td>
</tr>
<tr>
<td></td>
<td>clinical assessment.</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>3 years off treatment and without an attack.</td>
</tr>
<tr>
<td>Fever above 38 °C, flu-like illness</td>
<td>2 weeks following cessation of symptoms.</td>
</tr>
</tbody>
</table>

*a* Exceptions can be made according to national risk assessments.
<table>
<thead>
<tr>
<th>Condition</th>
<th>Deferral period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidney disease</td>
<td>Acute glomerulonephritis: 5 years deferral period following complete recovery.</td>
</tr>
<tr>
<td>Medication</td>
<td>The taking of a medication may indicate an underlying disease which may disqualify the donor. It is recommended that a list of commonly used drugs, with rules for acceptability of donors, approved by the medical staff of the transfusion centre, be made available. Donors treated with prescribed drugs, particularly those with proven teratogenic effect, should be deferred for a period consistent with the pharmacokinetic properties of the drug.</td>
</tr>
<tr>
<td>Osteomyelitis</td>
<td>2 years after having been declared cured.</td>
</tr>
<tr>
<td>Pregnancy</td>
<td>6 months after delivery or termination, except in exceptional circumstances and at the discretion of a physician.</td>
</tr>
<tr>
<td>Rheumatic fever</td>
<td>2 years following attack with no evidence of chronic heart disease. The latter complication is a cause for permanent deferral.</td>
</tr>
<tr>
<td>Surgery</td>
<td>After surgery, patients should not donate until they have recovered fully and are fit to be donors (typically about 6 months).</td>
</tr>
<tr>
<td>Tooth extraction</td>
<td>If no complications, 1 week (because of possible risk of transient bacteraemia).</td>
</tr>
<tr>
<td>Tropical infections</td>
<td>6 months following return from tropical areas and then only if they have not suffered an unexplained fever or illness (see Chapters 2 and 9, Infectious diseases).</td>
</tr>
</tbody>
</table>

*a Exceptions can be made according to national risk assessments.*
Table 2-3. Vaccinations

<table>
<thead>
<tr>
<th>Inoculations, vaccinations</th>
<th>Deferral period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vaccines with attenuated bacteria and viruses: BCG, yellow fever, rubella, measles, poliomyelitis (oral), mumps, live attenuated typhoid fever vaccinia, live attenuated cholera vaccine</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Vaccinia for smallpox at 8 weeks</td>
<td></td>
</tr>
<tr>
<td>Vaccines with killed bacteria: cholera, typhoid, capsular polysaccharide typhoid fever vaccine</td>
<td>Accept, if well</td>
</tr>
<tr>
<td>Vaccines with inactivated viruses: poliomyelitis (injection), influenza</td>
<td>Accept, if well</td>
</tr>
<tr>
<td>Toxoids: diphtheria, tetanus</td>
<td>Accept, if well</td>
</tr>
<tr>
<td>Other vaccines: hepatitis A and B vaccine, hepatitis B vaccine, rabies, tick-borne encephalitis</td>
<td>Accept, if well and no exposure is reported</td>
</tr>
<tr>
<td>1 week in order to prevent vaccine-related positivity in HBs-antigen result.</td>
<td>Accept, if well</td>
</tr>
<tr>
<td>One year if post-exposure</td>
<td></td>
</tr>
</tbody>
</table>

Infectious diseases

HIV/AIDS

Persons whose sexual behavior puts them at a high risk of acquiring severe infectious diseases that can be transmitted by blood must be deferred permanently.

Current sexual partners of people with HIV must be deferred. Previous sexual partners of people with HIV are acceptable 12 months after the last sexual contact.

Brucellosis (confirmed)

Deferral for at least two years following full recovery.
The deferral period does not apply when the donation is used exclusively for plasma fractionation.

**Chagas disease**

Individuals with Chagas disease or who have had Chagas disease must be permanently deferred.

The blood of persons who were born or have been transfused in areas where the disease is endemic should be used only for the production of plasma that is used exclusively for fractionation into plasma derivatives, unless a validated test for infection with T. cruzi is negative.

**Jaundice and hepatitis**

Individuals with a history of jaundice or hepatitis may, at the discretion of the appropriate Competent Authority, be accepted as blood donors provided a CE-marked test for HBsAg and anti-HCV is negative.

Persons who have been in close household contact with an individual infected by the hepatitis-B virus (acute or chronic) must be deferred for 6 months (4 months if appropriate testing has been performed) from the time of contact unless demonstrated to be immune.

Current sexual partners of people with HBV must be deferred, unless demonstrated to be immune.

Previous sexual partners of people with HBV are acceptable after 6 months since the last sexual contact. This can be reduced to 4 months if HBV NAT and anti-HBc are performed and both test results are negative.

**Malaria**

Since questioning a donor as to the country(s) in which he/she was born, brought up or has visited is essential for effective detection,

---

1 Tests and deferral periods may be waived by the blood establishment if the donation is used exclusively for plasma fractionation.
every blood establishment must have a current map or list of the endemic zones and time-frames in the countries concerned.

Persons who have lived in a malaria-endemic area for a continuous period of 6 months or more at any time in their life

These persons may become asymptomatic carriers of the malaria parasite. Therefore, the following rules must apply to these individuals after each return from a malaria area:

- May be accepted as blood donors if the result of a validated immunological test for antibodies to the malaria parasite, performed at least 4 months after the last visit to a malaria area, is negative;
- If the test is repeatedly reactive, the donor must be deferred and may be re-evaluated after a suitable period when the antibody test may have reverted to negative (a period of 3 years is suggested);
- If the test is not performed, the donor must be deferred until the test is performed and negative.

Persons who give a history of malaria

- Must be deferred until asymptomatic and off treatment.
- May be accepted as blood donors if the result of a validated immunological test for antibodies to the malaria parasite performed at least 4 months since cessation of treatment/last symptoms is negative.
- If the test is repeatedly reactive, the donor must be deferred and may be re-evaluated after a suitable period when the antibody test may have reverted to negative (a period of 3 years is suggested).
- If the test is not performed, the donor should be deferred until the test is performed and negative.
Persons who report an undiagnosed febrile illness consistent with malaria during or within 6 months of the end of a visit to a malaria area

- May be accepted as blood donors if the result of a validated immunological test for antibodies to the malaria parasite, performed at least 4 months since cessation of treatment/last symptoms, is negative.
- If the test is repeatedly reactive, the donor should be deferred and may be re-evaluated after a suitable period when the antibody test may have reverted to negative (a period of 3 years is suggested).
- If the test is not performed, the donor should be deferred until the test is performed and negative.

All other persons who have visited a malaria endemic area without reporting any clinical symptoms consistent with malaria

- May be accepted as blood donors if the result of a validated immunological test for antibodies to the malaria parasite performed at least 4 months after the last visit to a malaria endemic area is negative.
- If the test is repeatedly reactive, the donor must be deferred and may be re-evaluated after a suitable period when the antibody test may have reverted to negative (a period of 3 years is suggested).
- If the test is not performed, the donor may be re-accepted once a period of 12 months has elapsed after the most recent return from a malaria area.

Q Fever

Deferral until two years following the date confirmed as cured.

---

Tests and deferral periods may be waived by the blood establishment if the donation is used exclusively for plasma fractionation.
Syphilis
Deferral until one year following the date confirmed as cured.

Toxoplasmosis
Deferral until 6 months following clinical recovery.

Tuberculosis
Deferral until two years after having been declared as cured.

Variant Creutzfeldt-Jakob disease
Deferral of donors as a preventative measure for vCJD must be based on appropriate risk assessment.

West Nile virus (WNV)
Deferral until 28 days after leaving an area with on-going transmission of the disease to humans. Persons with a diagnosis of WNV must be deferred until 120 days after diagnosis.

5. Specific standards for donors of different types of components

Whole blood donors
A standard donation must not be collected from persons weighing less than 50 kg.

Quantity of donation

Volume of donation
A standard donation of whole blood (excluding anticoagulants) must not exceed 500 mL and usually consists of a donation of 450 mL ± 10 per cent. This does not include any allowance for samples taken for laboratory tests and for retention of a donor sample. The volume

---

3 Tests and deferral periods may be waived by the blood establishment if the donation is used exclusively for plasma fractionation.

4 Tests and deferral periods may be waived by the blood establishment if the donation is used exclusively for plasma fractionation.
of a standard donation of whole blood (including samples) must not exceed 15 per cent of the calculated blood volume of the donor.

**Frequency of whole blood donations**

A maximum of 6 standard donations per year can be taken from men and up to 4 per year from women, with a minimum interval between standard donations of 2 months.

These maximum donation rates must never be exceeded under any circumstances, and should only be adopted after careful consideration of the dietary habits of the populations concerned and in the knowledge that extra care may be necessary, beyond routine haemoglobin or haematocrit estimation, in the monitoring of donors for iron deficiency.

**Laboratory examination**

- Haemoglobin concentration must be determined each time the donor attends to donate blood or blood components.
- Minimum values before donation:
  - female donors: 125 g/L or 7.8 mmol/L (minimum haematocrit = 0.38)
  - male donors: 135 g/L or 8.4 mmol/L (minimum haematocrit = 0.4)
- Individual donations may be accepted below these levels after consultation with the responsible physicians or as established by a Competent Authority, based on norms for their specific populations.

**Apheresis donors**

The supervision and medical care of apheresis donors must be the responsibility of a physician specially trained in these techniques.

Other than in exceptional circumstances (to be decided by the responsible physician), donors for apheresis procedures must meet the criteria for whole blood donations.
People with a sickle cell trait must not donate by apheresis.

Donors taking medicinal drugs that inhibit platelet functions must be temporarily deferred from donation by platelet apheresis.

*Frequency of donation and maximal amounts of plasma and red cells to be collected*

The total blood volume of each donor must be estimated.

The maximal extra-corporeal volume during apheresis must never be higher than 20 per cent.

The collection volume (excluding anti-coagulant) for each plasmapheresis procedure must not exceed 16 per cent of the estimated total blood volume, and should never exceed 750 mL unless fluid replacement is undertaken.

Not more than 1.5 L of plasma may be collected from any one donor per week.

A maximum of 33 plasmapheresis procedures may be performed per donor per year. This equates to a maximum annual collection volume of 25 L, based on the maximum volume of 750 mL plasma (excluding anti-coagulant) per procedure.

In any apheresis procedure involving collection of plasma, platelets and/or red cells in one apheresis procedure, the total volume of all components collected (plasma, platelets and red cells) must not exceed 16 per cent of total blood volume, with a maximum of 750 mL (exclusive of anti-coagulant), unless fluid replacement is undertaken.

The total amount of red cells collected must not exceed the theoretical amount of red cells that would bring the donor haemoglobin in isovolemic situation below 110 g/L.

The interval between one plasmapheresis or plateletpheresis procedure and a donation of whole blood or apheresis procedure incorporating collection of a single or double unit of red cells (whereby one unit is equivalent to a red cell component obtained from one whole blood donation) must be at least 48 hours. The interval between a whole blood donation, an apheresis red cell collection or a failed return of
red cells during apheresis, and the next apheresis procedure without red cell collection, must be at least one month. The interval between two single-unit red cell collections must be the same as for collections of whole blood.

**Additional requirements for donors undergoing plasmapheresis**

Protein analysis, such as determination of total serum or plasma protein and/or electrophoresis and/or quantitation of single proteins (especially albumin and IgG) must be performed. Analysis must be carried out at the first donation and at least every year thereafter. Total proteins must not be less than 60 g/L. IgG levels must be within reference values of the normal population. Donors with results below these limits must be deferred until IgG and total protein levels are back to normal.

**Additional requirements for donors undergoing plateletpheresis**

Platelet apheresis must not be carried out on individuals whose platelet count is less than $150 \times 10^9$/L. Donors must not be subjected to a platelet apheresis procedure more often than once every 2 weeks. An exception to the donation interval and platelet count may be made in the case of HLA-/HPA-matched donations and for IgA-negative donors at the discretion of the physician responsible for the procedure.

**Additional requirements for donors undergoing double unit red cell apheresis**

The donor must have an estimated blood volume of $> 4500$ mL. The total blood volume must be calculated on the basis of gender, height and weight (see Appendix 2, Tables 1 and 2).

Haemoglobin levels must be determined before each donation and the minimum value must be $> 140$ g/L. The haemoglobin level of the donor must not fall below $110$ g/L after donation.

The interval between a whole blood donation and the donation of a double unit of red cells must be at least 3 months. The interval between a double-unit red cell apheresis and a donation of whole
blood or another double-unit red cell apheresis must be at least 6 months for women and 4 months for men.

The maximum volume of red cells collected must not exceed 400 mL (without re-suspension solution) per collection procedure.

Total red cell volume collected per year must not exceed that acceptable for whole blood donors.

6. **Post-donation information**

Blood donors must be instructed to inform the blood establishment when signs or symptoms occur after a donation that might indicate that the donation may have been infectious.
Chapter 3

Standards for collection of blood and blood components

1. Premises for donor sessions

Premises (including those of mobile teams) must satisfy general requirements for the health and safety of the staff and donors concerned with due regard to relevant legislation or regulations.

Suitable facilities must be provided to allow a private interview with each donor, assuring privacy and confidentiality.

Before premises are accepted for mobile donor sessions, their suitability must be assessed against the following criteria:

- sufficient size to allow proper operation and ensure donor privacy;
- safety for staff and donors;
- the presence of ventilation, electrical supply, lighting, hand-washing facilities, reliable communication, blood storage and transport.
2. Procedures and equipment used at blood donation sessions

The blood collection procedure must be designed to ensure that the identity of the donor is verified and securely recorded and that the link between the donor and the blood, blood components and blood samples is clearly established (Directive 2005/62/EC Annex 6.2.1).

The sterile blood bag systems used for the collection of blood and blood components and their processing must be CE marked or comply with equivalent standards if the blood and blood components are collected in third countries. The batch number of the blood bag must be traceable for each blood component (Directive 2005/62/EC Annex 6.2.2).


Sterile collection systems must be used for the collection of blood and blood components. These must be used in accordance with the instructions of the manufacturer. A check must be made before use to ensure that the collection system employed has not been damaged or contaminated, and that it is appropriate for the intended collection procedure. Defects in blood bags must be reported to the supplier and be subjected to trend analysis.

3. Pre-donation checks

The blood container must be inspected before use for defects and must be inspected for the prescribed content and appearance of the anticoagulant solution. If one or more bags in any package is found to be abnormally damp, all the bags in the package must be rejected.

The donor must be re-identified immediately prior to venepuncture.

4. Labelling

Laboratory samples must be taken at the time of donation and be appropriately stored prior to testing (Directive 2005/62/EC Annex 6.2.4).

The procedure used for the labelling of records, blood bags and laboratory samples with donation numbers must be designed to avoid any risk of identification error and mix-up (Directive 2005/62/EC Annex 6.2.5).
Laboratory samples must be taken at the time of each donation. Procedures must be designed to minimise the risk of microbial contamination of the collected blood or deterioration of the sample, and to prevent potential misidentification of donations and samples.

At the time of blood donation, the blood container and those of the samples collected for testing must be labelled to uniquely identify the blood donation. The labelling system must comply with relevant national legislation and international agreements.

The blood donation must be identified by a unique identity number which is both eye- and machine-readable. The labelling system must allow full traceability to all relevant data registered by the blood establishment about the donor and the blood donation.

A careful check must be made of the identity indicator of the donor against the labels issued for that donation.

The manufacturer’s label on the blood containers (plastic blood bags and bag systems) must contain the following eye-readable information:

- the manufacturer’s name and address;
- the name of the blood bag and/or the name of the blood bag plastic material;
- the name, composition and volume of anti-coagulant or additive solution (if any);
- the product catalogue number and the lot number.

5. Venepuncture, bleeding and mixing

Preparation of the venepuncture site

The skin at the venepuncture site must be free from lesions, including eczema.

The venepuncture site must be prepared using a defined and validated disinfection procedure. The antiseptic solution must be allowed to
dry completely before venepuncture. The prepared area must not be touched with fingers before the needle has been inserted.

The effectiveness of the disinfection procedure must be monitored and corrective action taken where it is indicated to be defective.

**Successful venepuncture and proper mixing**

The needle must be inserted into the vein at the first attempt. A second venepuncture with a new needle in the other arm is acceptable with the consent of the donor, provided that bacterial sterility of the system is not compromised.

Where an anti-coagulant solution is used in the collection, the collection bag must be mixed gently immediately after starting collection and at regular intervals during the entire collection period. The flow of blood must be sufficient and uninterrupted.

The maximum collection time for acceptance of the donation for component processing must be specified and controlled. Donations that exceed the maximum time period must be recorded and discarded.

If the duration of the bleeding is longer than 12 minutes, the blood must not be used for the preparation of platelets.

If the duration of the bleeding is longer than 15 minutes, the plasma must not be used for direct transfusion or the preparation of coagulation factors.

If manual mixing is used, the blood bag must be inverted every 30-45 seconds. When an automated mixing system is used, an appropriately validated system is required.

At completion of the donation, the donation number must be checked on all records, blood bags and laboratory samples. Donation number labels of a given donation that have not been used must be destroyed via a controlled procedure. Procedures to prevent mislabelling must be in place.
Each activity associated with the donation must be recorded. This also applies to any unsuccessful donations, the rejection of a donor, adverse reactions and adverse events. An authorised interviewer must sign the donor selection records and the final assessment.

6. Handling of filled containers and samples

After blood collection, the blood bags must be handled in a way that maintains the quality of the blood and at a storage and transport temperature appropriate to further processing requirements (Directive 2005/62/EC Annex 6.2.6).

There must be a system in place to ensure that each donation can be linked to the collection and processing system into which it was collected and/or processed (Directive 2005/62/EC Annex 6.2.7).

The blood container must be checked after donation for any defect. During separation from the donor, a completely efficient method of sealing the tube is obligatory.

The blood bag and corresponding samples must not be removed from the donor’s bedside until labelling has been checked and is verified as correct.

After collection, blood bags must be placed promptly into controlled temperature storage and transported to the processing site under temperature conditions appropriate for the component that is to be prepared. Validation data must be available to demonstrate that the storage parameters after collection and the method of transport used maintains the blood within the specified temperature range throughout the period of transportation.

7. Special requirements for apheresis

Separation and collection of blood components by cell separators requires premises of suitable size, regular servicing and maintenance of machines (and adequately trained personnel for operating such machines).

The donor must be observed closely during the procedure. A qualified healthcare professional familiar with all aspects of apheresis must
be available to provide assistance and emergency medical-care procedures in case of an adverse reaction.

Collection of adequate granulocyte yields by apheresis requires pre-medication of the donor. The potential risk to the donor must be evaluated against the anticipated benefit to the intended recipient.

Return of red blood cells of donors undergoing manual apheresis

Since the biggest inherent danger in manual apheresis is an accidental interchange between two bags of concentrated red blood cells during their centrifugation and return to individual donors, a robust identification system must be in place.

8. Repository of archive samples

If archive samples from donations are kept, then procedures must be in place prescribing their use and final disposal.
Chapter 4

Standards for the processing, storage and distribution of blood components

1. Processing

All equipment and technical devices must be used in accordance with validated procedures (Directive 2005/62/EC Annex 6.4.1).

The processing of blood components must be carried out using appropriate and validated procedures, including measures to avoid the risk of contamination and microbial growth in the prepared blood components (Directive 2005/62/EC Annex 6.4.2).

The premises used for the processing of blood components must be kept in a clean and hygienic condition and the microbial contamination load on critical equipment, surfaces and in the environment of the processing areas must be monitored.

Procedures must detail the specifications for any materials that will influence the quality of the final blood component. In particular, specifications must be in place for blood and blood components (intermediate and final components), starting materials, additive solutions, primary packaging material (bags) and equipment.
Procedures must be developed and validated for all processing activities. These must include time limits for the processing of blood components.

Sterile connecting devices must be used in accordance with a validated procedure. The resulting weld must be checked for satisfactory alignment and its integrity must be validated. When validated, connections made using sterile connecting devices are regarded as closed system processing.

2. Component labelling and information

At all stages, all containers must be labelled with relevant information of their identity. In the absence of a validated computerised system for status control, the labelling must clearly distinguish released from non-released units of blood and blood components (Directive 2005/62/EC Annex 6.5.1).

The labelling system for the collected blood, intermediate and finished blood components and samples must unmistakably identify the type of content and comply with the labelling and traceability requirements referred to in Article 14 of Directive 2002/98/EC and Directive 2005/61/EC.


For autologous blood and blood components, the label also must comply with Article 7 of Directive 2004/33/EC and the additional requirements for autologous donations specified in Annex IV to that Directive (Directive 2005/62/EC Annex 6.5.3).

Before use, all blood components must be labelled with relevant identity information. The type of label to be used, as well as the labelling methodology, must be established in written procedures. Critical information must be provided in machine-readable format to eliminate transcription errors.

The blood establishment responsible for the preparation of blood components must provide clinical users of blood components with information on their use, composition and any special conditions that do not appear on the component label.
3. Release of blood components

There must be a safe and secure system to prevent each single blood and blood component from being released until all mandatory requirements set out in Directive 2005/62/EC have been fulfilled. Each blood establishment must be able to demonstrate that each blood or blood component has been formally released by an authorised person. Records must demonstrate that before a blood component is released, all current declaration forms, relevant medical records and test results meet all acceptance criteria (Directive 2005/62/EC Annex 6.6.1).

Before release, blood and blood components must be kept administratively and physically segregated from released blood and blood components. In the absence of a validated computerised system for status control, the label of a unit of blood or blood component must clearly distinguish released from non-released units of blood and blood components (Directive 2005/62/EC Annex 6.5.1 and 6.6.2).

Each blood establishment must be able to demonstrate that a blood or blood component has been approved for release by an authorised person, preferably assisted by validated information technology systems. The specifications for release of blood components must be defined, validated and documented.

Where release is subject to computer-derived information, the following requirements must be met:

- The computer system must be validated to be fully secure against the possibility of blood and blood components being released that do not fulfil all test or donor selection criteria;
- The manual entry of critical data, such as laboratory test results, must require independent verification by a second authorised person.
- The computer system must block the release of all blood or blood components considered not acceptable for release. There must also be a means to block the release of any future donations from the donor.

In the absence of a computerised system for component status control, or in the event of computer system failure, the following requirements must be met:
• The label of a blood component must identify the component status and must clearly distinguish a released from a non-released (quarantined) component;

• Records must demonstrate that before a component is released, all current donor declaration forms, relevant medical records and test results have been verified by an authorised person;

• Before final component release, if blood or blood component(s) have been prepared from a donor who has donated on previous occasions, a comparison with previous records must be made to ensure that current records accurately reflect the donor history;

• There must be a system of administrative and physical quarantine for blood and blood components to ensure that they cannot be released until all mandatory requirements have been satisfied.

In the event that the final component fails release due to a confirmed positive infection test result for Hepatitis B virus, Hepatitis C virus or HIV 1/2 (Annex IV of Directive 2002/98/EC), a check must be made to ensure that other components from the same donation and components prepared from previous donations given by the donor are identified. There must be an immediate update of the donor record (Directive 2005/62/EC Annex 6.6.3, 6.3.2 and 6.3.3).

In the event that a final component fails release due to a potential impact on patient safety, then all other implicated components must be identified and appropriate action must be taken. A check must be made to ensure that (if relevant) other components from the same donation(s) and components prepared from previous donations given by the donor(s) are identified. The donor record must be updated immediately to ensure (if appropriate) that the donor(s) cannot make a further donation.
4. Storage and distribution

The quality system of the blood establishment must ensure that, for blood and blood components intended for the manufacture of medicinal products, the storage and distribution requirements comply with Directive 2003/94/EC (Directive 2005/62/EC Annex 7.1).

Procedures for storage and distribution must be validated to ensure blood and blood component quality during the entire storage period and to exclude mix-ups of blood components. All transportation and storage actions, including receipt and distribution, must be defined by written procedures and specifications (Directive 2005/62/EC Annex 7.2).

Storage and distribution routines must take place in a safe and controlled way in order to ensure component quality during the entire storage period and to exclude misidentification of blood components.

All transportation and storage actions, including receipt and distribution, must be defined by written procedures and specifications.

Storage conditions must be controlled, monitored and checked. Appropriate alarms must be present and regularly checked, and these checks must be recorded. Appropriate actions on alarms must be defined.

Intermediate storage and transport must be carried out under defined conditions to ensure that the specified requirements are met.

Prior to distribution, blood components must be visually inspected. There must be a record identifying the person distributing the components and the institution receiving them.

Autologous blood and blood components, as well as blood components collected and prepared for specific purposes, must be stored separately (Directive 2005/62/EC Annex 7.3).

Storage areas must provide effective segregation of quarantined and released materials or components. There must be a separate area for storage of rejected components and materials.
Packaging must maintain the integrity and storage temperature of blood or blood components during distribution and transportation (Directive 2005/62/EC Annex 7.5).
Return of blood and blood components into inventory for subsequent re-issue can only be accepted when all quality requirements and procedures laid down by the blood establishment to ensure blood component integrity are fulfilled (Directive 2005/62/EC Annex 7.6).

Blood components must not be returned to the blood establishment for subsequent distribution, unless there is a procedure for return of blood components that is regulated by a contract and that there is documented evidence for each returned blood component that the agreed storage conditions have been met. Before subsequent distribution the records must identify that the blood component has been inspected before re-issue.

5. **Irradiation of blood components**

The irradiation process must ensure that no part of the component receives a dose less than 25 Gray or more than 50 Gray. The exposure time must be set to ensure that all blood and blood components receive the specified recommended minimum dose, with no part receiving more than the maximum recommended dose. Regular dose-mapping of equipment must be undertaken. Exposure time must be standardised for each irradiation source and revalidated at suitable intervals.

Radiation indicators must be used as an aid to differentiating irradiated from non-irradiated blood and blood components. A defined procedure must ensure the segregation of components that have not been irradiated from those that have been irradiated.

Red cell components may be irradiated up to 28 days after collection. Irradiated cells must be transfused as soon as possible, but no later than 14 days after irradiation and, in any case, no later than 28 days after collection. More stringent requirements are included in specific component monographs (see Chapter 5).
6. **Leucocyte depletion**
Processes used for leucocyte depletion must be validated. The validation must be carried out by the blood establishment using the manufacturer’s instructions and against the requirements for leucocyte depletion and other quality aspects of the components (including those for plasma for fractionation).

For quality control, an appropriate validated method must be used for counting leucocytes.

7. **Bacterial safety**
A systematic programme to assure the bacterial safety of blood collection and processing procedures must be in place.
Chapter 5

Component monographs

Part A. Whole Blood components
1. Whole Blood, 220
2. Whole Blood, Leucocyte-Depleted, 223

Part B. Red cell components
1. Red Cells, 230
2. Red Cells, Buffy Coat Removed, 233
3. Red Cells, in Additive Solution, 237
4. Red Cells, Buffy Coat Removed, in Additive Solution, 241
5. Red Cells, Leucocyte-Depleted, 245
6. Red Cells, Leucocyte-Depleted in Additive Solution, 248
7. Red Cells, Apheresis, 252
8. Red Cells, Washed, 257
9. Red Cells, Cryopreserved, 260

Part C. Platelet components
1. Platelets, Recovered, Single Unit, 266
2. Platelets, Recovered, Pooled, 270
3. Platelets, Recovered, Pooled, Leucocyte-Depleted, 275
4. Platelets, Recovered, Pooled, in Additive Solution, 280
5. Platelets, Recovered, Pooled, Leucocyte-Depleted, in Additive Solution, 284
6. Platelets, Pooled, Pathogen-reduced, 288
7. Platelets, Apheresis, 293
8. Platelets, Apheresis, Leucocyte-Depleted, 297
9. Platelets, Apheresis, in Additive Solution, 301
10. Platelets, Apheresis, Leucocyte-Depleted, in Additive Solution, 305
11. Platelets, Apheresis, Pathogen-reduced, 309
12. Platelets, Cryopreserved, 314

Part D. Plasma components
1. Plasma, Fresh Frozen, 320
2. Plasma, Fresh Frozen, Pathogen Reduced, 324
3. Cryoprecipitate, 329
4. Plasma, Fresh Frozen, Cryoprecipitate-Depleted, 333

Part E. White cell components
1. Granulocytes, Apheresis, 338
Component monographs
Part A. Whole Blood components
1. Whole Blood

Definition and properties

*Whole Blood* is blood taken from a suitable donor using a sterile and pyrogen-free anti-coagulant and container. *Whole Blood* is a source material for component preparation, which is its major use. *Whole Blood* for transfusion is used without further processing.

*Whole Blood* for transfusion should not contain irregular antibodies of clinical significance.

Preparation

By definition, no (post-donation) preparation is required to produce a unit of *Whole Blood*.

Requirements and quality control

Table 5A-1 lists the requirements. Additional testing might be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
</tbody>
</table>

*a If different from ‘All units’, the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.*
<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>450 mL ± 50 mL volume (excluding anti-coagulant)</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
<tr>
<td></td>
<td>A non-standard donation should be labelled accordingly</td>
<td></td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>Minimum 45 g per unit</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haemolysis at the end of storage</td>
<td>&lt; 0.8 per cent of red cell mass</td>
<td>4 units per month</td>
</tr>
</tbody>
</table>

If different from 'All units', the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

**Storage and transport**

*Whole Blood* for transfusion must be kept at a controlled temperature, i.e. between + 2 and + 6 °C. The storage time depends on the anti-coagulant/preservative solution used. For example, the storage time is 35 days if stored in CPDA-1. Validated transport systems must ensure that at no time during a maximum transit time of 24 hours does the temperature exceed + 10 °C.

*Whole Blood* for preparation of blood components may be kept up to 24 hours in conditions validated to maintain a temperature between + 20 °C and + 24 °C, which is a prerequisite for the production of platelet preparations from *Whole Blood*.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
- the name of the blood component;
• the ABO and RhD groups;
• blood group phenotypes other than ABO and RhD (optional);
• the date of donation;
• the date of expiry;
• the name of the anti-coagulant solution;
• additional component information: irradiated, etc. (if appropriate);
• the volume or weight of the blood component;
• the storage temperature;
• that the component must not be used for transfusion if there is abnormal haemolysis or other deterioration;
• that the component must be administered through an approved blood administration set.

**Warnings**

Compatibility of *Whole Blood* for transfusion with the intended recipient must be verified by suitable pre-transfusion testing.

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with *Whole Blood* from RhD-positive donors.

Micro-aggregates are formed on storage.

*Whole Blood* for transfusion is not recommended in cases of:

• anaemia without blood volume loss;
• plasma intolerance;
• intolerance due to allo-immunisation against leucocyte antigens.

Adverse reactions include:

• haemolytic transfusion reaction;
• non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
• anaphylaxis;
• allo-immunisation against red cell and HLA antigens;
• transfusion-related acute lung injury (TRALI);
• post-transfusion purpura;
• graft versus host disease (GvHD);
• sepsis due to inadvertent bacterial contamination;
• viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
• syphilis can be transmitted if components are stored for less than 96 hours at +4 °C;
• protozoal transmission (e.g. malaria) may occur in rare instances;
• transmission of other pathogens that are not tested for or recognised;
• citrate toxicity in neonates and in patients with impaired liver function;
• metabolic imbalance in massive transfusion (e.g. hyperkalaemia);
• transfusion-associated circulatory overload;
• iron overload.

2. Whole Blood, Leucocyte-Depleted

Definition and properties

Whole Blood, Leucocyte-Depleted (LD) is a component derived from Whole Blood by removing the leucocytes to a maximum residual content.

Whole Blood, LD contains a minimum haemoglobin content of 43 g. Whole Blood, LD normally contains less than \(1.0 \times 10^6\) leucocytes.
Preparation
Generally a filtration technique is used to produce Whole Blood, LD. Pre-storage leucocyte depletion within 48 hours after donation is the standard.

Requirements and quality control
Table 5A-2 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

Table 5A-2

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
</tr>
<tr>
<td>Volume</td>
<td>450 ± 50 mL volume (excluding anti-coagulant)</td>
</tr>
<tr>
<td></td>
<td>A non-standard donation should be labelled accordingly</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>Minimum 43 g per unit</td>
</tr>
<tr>
<td>Residual leucocytes b</td>
<td>&lt; $1 \times 10^6$ per unit by count</td>
</tr>
<tr>
<td>Haemolysis at the end of storage</td>
<td>&lt; 0.8 per cent of red cell mass</td>
</tr>
</tbody>
</table>

\[a\] If different from 'All units', the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

\[b\] These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.
Storage and transport

*Whole Blood, LD* must be kept at a controlled temperature between +2 °C and +6 °C. The storage time depends on the anti-coagulant/preservative solution used. For example, the storage time is 35 days in CPDA-1.

Validated transport systems must ensure that at no time during a maximum transit time of 24 hours did the temperature exceed +10 °C.

Labelling

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
- the name of the blood component;
- the ABO and RhD groups;
- blood group phenotypes other than ABO and RhD (optional);
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- additional component information: irradiated, etc. (if appropriate);
- the volume or weight of the blood component;
- the storage temperature;
- that the component must not be used for transfusion if there is abnormal haemolysis or other deterioration;
- that the component must be administered through an approved blood administration set.
Warnings
Compatibility of Whole Blood, LD with the intended recipient must be verified by suitable pre-transfusion testing.
RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with red cells from RhD-positive donors.
Whole Blood, LD is not recommended in cases of:
- anaemia without blood volume loss;
- plasma intolerance.
Adverse reactions include:
- haemolytic transfusion reaction;
- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- anaphylaxis;
- allo-immunisation against red cell and HLA antigens;
- transfusion-related acute lung injury (TRALI);
- post-transfusion purpura;
- graft versus host disease (GvHD);
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- syphilis can be transmitted if components are stored for less than 96 hours at + 4 °C;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised;
- citrate toxicity in neonates and in patients with impaired liver function;
- metabolic imbalance in massive transfusion (e.g. hyperkalaemia);
- circulatory overload;
- iron overload.
Component monographs
Part B. Red cell components
1. **Red Cells**

**Definition and properties**

*Red Cells* are obtained by removal of a major part of the plasma from *Whole Blood*.

*Red Cells* also contain the greater part of the Whole Blood leucocytes (about 2.5 to 3.0 × 10⁹ cells) and a variable content of platelets, depending on the method of centrifugation.

**Preparation**

For the preparation of *Red Cell components*, plasma is removed from *Whole Blood* by centrifugation.

**Requirements and quality control**

Table 5B-1 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control³</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1&amp;2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
</tbody>
</table>

³ If different from ‘All units’, the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.
### Parameter to be checked

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>280 ± 50 mL</td>
<td>1 per cent of all units</td>
</tr>
<tr>
<td>Haematocrit</td>
<td>0.65-0.75</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>minimum 45 g per unit</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haemolysis at the end of storage</td>
<td>&lt; 0.8 per cent of red cell mass</td>
<td>4 units per month</td>
</tr>
</tbody>
</table>

*If different from 'All units', the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.*

### Storage and transport

*Red Cells* must be kept at a controlled temperature between +2 °C and +6 °C. The storage time depends on the anti-coagulant/preservative solution used. For example, the storage time is 35 days in CPDA-1.

Validated transport systems must ensure that at no time during a maximum transit time of 24 hours did the temperature exceed +10 °C.

### Labelling

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
- the name of the blood component;
- the ABO and RhD groups;
- blood group phenotypes other than ABO and RhD (optional);
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
• additional component information: irradiated, etc. (if appropriate);
• the volume or weight of the blood component;
• the storage temperature;
• that the component must not be used for transfusion if there is abnormal haemolysis or other deterioration;
• that the component must be administered through an approved blood administration set.

Warnings
Micro-aggregates are formed on storage.
Compatibility of Red Cells with the intended recipient must be verified by suitable pre-transfusion testing.
RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with Red Cells from RhD-positive donors.

Red Cells are not recommended in cases of:
• plasma intolerance;
• intolerance due to allo-immunisation against leucocyte antigens;
• exchange transfusion in newborns, unless supplementary plasma is added.

Adverse reactions include:
• haemolytic transfusion reaction;
• non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
• anaphylaxis;
• allo-immunisation against red cell and HLA antigens;
• transfusion-related acute lung injury (TRALI);
• post-transfusion purpura;
Chapter 5

Component monographs

- graft versus host disease (GvHD);
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- syphilis can be transmitted if components are stored for less than 96 hours at + 4 °C;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised;
- citrate toxicity in neonates and in patients with impaired liver function;
- metabolic imbalance in massive transfusion (e.g. hyperkalaemia);
- transfusion-associated circulatory overload;
- iron overload.

2. Red Cells, Buffy Coat Removed

Definition and properties

Red Cells, Buffy Coat Removed (BCR) is a red cell component prepared by the removal of a major part of the plasma and the buffy coat layer from Whole Blood.

Red Cells, BCR contains a minimum haemoglobin content of 43 g. The haematocrit is 0.65 to 0.75.

Red Cells, BCR normally contains less than $1.2 \times 10^9$ leucocytes and a variable content of platelets, depending on the method of centrifugation.

Preparation

Red Cells, BCR is derived from Whole Blood by centrifugation. The plasma and 20 to 60 mL of the buffy coat layer are removed from Whole Blood after centrifugation, resulting in the loss of 10 to 30 mL.
of the red cells from the donated *Whole Blood*. Sufficient plasma is retained to give a haematocrit of 0.65-0.75.

**Requirements and quality control**

Table 5B-2 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>$250 \pm 50 \text{mL}$</td>
<td>1 per cent of all units</td>
</tr>
<tr>
<td>Haematocrit</td>
<td>0.65-0.75</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>Minimum 43 g per unit</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Residual leucocyte content $^b$</td>
<td>$&lt;1.2 \times 10^9 \text{per unit}$</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haemolysis at the end of storage</td>
<td>$&lt;0.8 \text{per cent of red cell mass}$</td>
<td>4 units per month</td>
</tr>
</tbody>
</table>

$^a$ If different from 'All units', the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

$^b$ These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

**Storage and transport**

*Red Cells, BCR* must be kept at a controlled temperature between $+2 \, ^\circ\text{C}$ and $+6 \, ^\circ\text{C}$. The storage time depends on the anticoagulant/
preservative solution used. For example, the storage time is 35 days in CPDA-1.

Validated transport systems must ensure that at no time during a maximum transit time of 24 hours did the temperature exceed +10 °C.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
- the name of the blood component;
- the ABO and RhD groups;
- blood group phenotypes other than ABO and RhD (optional);
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- additional component information: irradiated, etc. (if appropriate);
- the volume or weight of the blood component;
- the storage temperature;
- that the component must not be used for transfusion if there is abnormal haemolysis or other deterioration;
- that the component must be administered through an approved blood administration set.
Warnings
Compatibility of Red Cells, BCR with the intended recipient must be verified by suitable pre-transfusion testing.

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with red cells from RhD-positive donors.

Red Cells, BCR is not recommended in cases of:
- plasma intolerance (may not concern units with a low plasma content, unless IgA incompatibility is present);
- exchange transfusions in newborns, unless supplementary plasma is added.

Adverse reactions include:
- haemolytic transfusion reaction;
- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- anaphylaxis;
- allo-immunisation against red cell and HLA antigens;
- transfusion-related acute lung injury (TRALI);
- post-transfusion purpura;
- graft versus host disease (GvHD);
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- syphilis can be transmitted if components are stored for less than 96 hours at +4 °C;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised;
• citrate toxicity in neonates and in patients with impaired liver function;
• metabolic imbalance in massive transfusion (e.g. hyperkalaemia);
• transfusion-associated circulatory overload;
• iron overload.

3. Red Cells, in Additive Solution

Definition and properties

Red Cells, in Additive Solution (AS) is a red cell component prepared by the removal of the plasma from Whole Blood with subsequent addition of an appropriate additive solution.

Red Cells, AS contains a minimum haemoglobin content of 45 g. The haematocrit is 0.50-0.70.

Red Cells, AS also contains the greater part of the Whole Blood leucocytes (about 2.5 to 3.0 × 10⁹ cells) and a variable content of platelets, depending on the method of centrifugation.

Preparation

Whole Blood is collected, using CPD as the anti-coagulant solution. After centrifugation of Whole Blood, plasma is removed and the additive solution is added immediately to red cells and mixed carefully.

Requirements and quality control

Table 5B-3 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).
Table 5B-3

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>To be defined for the system used</td>
<td>1 per cent of all units</td>
</tr>
<tr>
<td>Haematocrit</td>
<td>0.50-0.70</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>Minimum 45 g per unit</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haemolysis at the end of storage</td>
<td>&lt; 0.8 per cent of red cell mass</td>
<td>4 units per month</td>
</tr>
</tbody>
</table>

*a* If different from 'All units', the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

Storage and transport

Red Cells, AS must be kept at a controlled temperature between + 2 and + 6 °C during storage. Depending on the anti-coagulant/additive system, the storage time may be extended up to the approved limit of the additive solution system.

Validated transport systems must ensure that at no time during a maximum transit time of 24 hours did the temperature exceed + 10 °C.

Labelling

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown
on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
- the name of the blood component;
- the ABO and RhD groups;
- blood group phenotypes other than ABO and RhD (optional);
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- the name and volume of the additive solution;
- additional component information: irradiated, etc. (if appropriate);
- the volume or weight of the blood component;
- the storage temperature;
- that the component must not be used for transfusion if there is abnormal haemolysis or other deterioration;
- that the component must be administered through an approved blood administration set.

**Warnings**

Micro-aggregates are formed on storage.

Compatibility of *Red Cells, AS* with the intended recipient must be verified by suitable pre-transfusion testing.

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with *Red Cells, AS* from RhD-positive donors.

*Red Cells, AS* is not recommended in cases of:

- plasma intolerance;
intolerance due to allo-immunisation against leucocyte antigens;
exchange transfusion in newborns, unless used within 5 days of donation and only if the additive solution is replaced by fresh frozen plasma on the day of use.

Adverse reactions include:

- haemolytic transfusion reaction;
- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- anaphylaxis;
- allo-immunisation against red cell and HLA antigens;
- transfusion-related acute lung injury (TRALI);
- post-transfusion purpura;
- graft versus host disease (GvHD);
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- syphilis can be transmitted if components are stored for less than 96 hours at + 4°C;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised;
- citrate toxicity in neonates and in patients with impaired liver function;
- metabolic imbalance in massive transfusion (e.g. hyperkalaemia);
- transfusion-associated circulatory overload;
- iron overload.
4. Red Cells, Buffy Coat Removed, in Additive Solution

Definition and properties

Red Cells, Buffy Coat Removed, in Additive Solution (BCR-AS) is a red cell component prepared by the removal of a major part of the plasma and the buffy coat layer from Whole Blood, with subsequent addition of an appropriate nutrient solution.

Red Cells, BCR-AS contains a minimum haemoglobin content of 43 g. The haematocrit is 0.50 to 0.70.

Red Cells, BCR-AS contains less than $1.2 \times 10^9$ leucocytes and a variable platelet content, depending on the method of centrifugation.

Preparation

Red Cells, BCR-AS is derived from Whole Blood by centrifugation. For preparation, the plasma and 20 to 60 mL of the buffy coat layer are removed, resulting in the loss of 10 to 30 mL of the red cells from the donated Whole Blood. The additive solution is immediately added to the red cells and carefully mixed.

Requirements and quality control

Table 5B-4 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).
### Table 5B-4

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>To be defined for the system used</td>
<td>1 per cent of all units</td>
</tr>
<tr>
<td>Haematocrit</td>
<td>0.50-0.70</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>Minimum 43 g per unit</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Residual leucocyte content&lt;sup&gt;b&lt;/sup&gt;</td>
<td>&lt; $1.2 \times 10^9$ per unit</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haemolysis at the end of storage</td>
<td>&lt; 0.8 per cent of red cell mass</td>
<td>4 units per month</td>
</tr>
</tbody>
</table>

<sup>a</sup> If different from ‘All units’, the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

<sup>b</sup> These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

### Storage and transport

*Red Cells, BCR-AS* must be kept at a controlled temperature between +2 and +6 °C during storage. Depending on the anti-coagulant/additive system, storage time may be extended up to the approved limit of the additive solution system.

Validated transport systems must ensure that at no time during a maximum transit time of 24 hours did the temperature exceed +10 °C.
Labelling
The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
- the name of the blood component;
- the ABO and RhD groups;
- blood group phenotypes other than ABO and RhD (optional);
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- the name and volume of the additive solution;
- additional component information: irradiated, etc. (if appropriate);
- the volume or weight of the blood component;
- the storage temperature;
- that the component must not be used for transfusion if there is abnormal haemolysis or other deterioration;
- that the component must be administered through an approved blood administration set.

Warnings
Compatibility of Red Cells, BCR-AS with the intended recipient must be verified by suitable pre-transfusion testing.

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with red cells from RhD-positive donors.

Red Cells, BCR-AS is not recommended in cases of:
• plasma intolerance;
• intolerance due to allo-immunisation against leucocyte antigens.

Adverse reactions include:
• haemolytic transfusion reaction;
• non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
• anaphylaxis;
• allo-immunisation against red cell and HLA antigens;
• transfusion-related acute lung injury (TRALI);
• post-transfusion purpura;
• graft versus host disease (GvHD);
• sepsis due to inadvertent bacterial contamination;
• viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
• syphilis can be transmitted if component is stored for less than 96 hours at + 4 °C;
• protozoal transmission (e.g. malaria) may occur in rare instances;
• transmission of other pathogens that are not tested for or recognised;
• citrate toxicity in neonates and in patients with impaired liver function;
• metabolic imbalance in massive transfusion (e.g. hyperkalaemia);
• transfusion-associated circulatory overload;
• iron overload.
5. Red Cells, Leucocyte-Depleted

Definition and properties

Red Cells, Leucocyte-Depleted (LD) is a red cell component derived from Whole Blood donation, Red Cells or Red Cells, BCR by removing the leucocytes.

Red Cells, LD contains a minimum haemoglobin content of 40 g. The haematocrit is 0.65-0.75.

Red Cells, LD contains less than $1.0 \times 10^6$ leucocytes.

Preparation

Generally a filtration technique is used to produce Red Cells, LD. Leucocyte depletion within 48 hours after donation is the standard.

Red Cells, LD can be produced:

- by leucocyte filtration of Whole Blood, with subsequent centrifugation and removal of the plasma;
- by leucocyte filtration of a red cell component.

Requirements and quality control

Table 5B-5 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

Table 5B-5

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
</tbody>
</table>

$^a$ If different from ‘All units’, the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

$^b$ These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.
<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>To be defined for the system used</td>
<td>1 per cent of all units</td>
</tr>
<tr>
<td>Haematocrit</td>
<td>0.50–0.70</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>Minimum 40 g per unit</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
<tr>
<td>Residual leucocyte content(^b)</td>
<td>&lt; 1 × 10^6 per unit by count</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>Minimum 40 g per unit</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
<tr>
<td>Haemolysis at the end of storage</td>
<td>&lt; 0.8 per cent of red cell mass</td>
<td>4 units per month</td>
</tr>
</tbody>
</table>

\(^a\) If different from 'All units', the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

\(^b\) These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

**Storage and transport**

*Red Cells, LD* must be kept at a controlled temperature between +2 and +6 °C during storage. Depending on the anti-coagulant/additive system, the storage time may be extended up to the approved limit of the additive solution system.

Validated transport systems must ensure that at no time during a maximum transit time of 24 hours did the temperature exceed +10 °C.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown
on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
- the name of the blood component;
- the ABO and RhD groups;
- blood group phenotypes other than ABO and RhD (optional);
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- the name and volume of the additive solution (if appropriate);
- additional component information: irradiated, etc. (if appropriate);
- the volume or weight of the blood component;
- the storage temperature;
- that the component must not be used for transfusion if there is abnormal haemolysis or other deterioration;
- that the component must be administered through an approved blood administration set.

**Warnings**

Compatibility of *Red Cells, LD* with the intended recipient must be verified by suitable pre-transfusion testing.

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with red cells from RhD-positive donors.

*Red Cells, LD* is not recommended in the case of:

- plasma intolerance.

Potential adverse reactions include:
- transfusion-associated circulatory overload;
- haemolytic transfusion reaction;
- anaphylaxis;
- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- allo-immunisation against red cell and HLA (very rarely) antigens;
- transfusion-related acute lung injury (TRALI);
- post-transfusion purpura;
- graft versus host disease (GvHD);
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- syphilis can be transmitted if components are stored for less than 96 hours at + 4 °C;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised;
- citrate toxicity in neonates and in patients with impaired liver function;
- metabolic imbalance in massive transfusion (e.g. hyperkalaemia);
- iron overload.

6. Red Cells, Leucocyte-Depleted in Additive Solution

Definition and properties

Red Cells, Leucocyte depleted in Additive Solution (LD-AS) is a red cell component derived from Whole Blood donation, from Red Cells, AS or
Red Cells, BCR-AS by removing the leucocytes to a maximum residual content.

Red Cells, LD-AS contains a minimum haemoglobin content of 40 g. The haematocrit is 0.50 to 0.70.

Red Cells, LD-AS contains less than $1.0 \times 10^6$ leucocytes.

**Preparation**

Generally, a filtration technique is used to produce Red Cells, LD-AS. Leucocyte depletion within 48 hours after donation is the standard.

Red Cells, LD-AS can be produced:

- by leucocyte filtration of Whole Blood, with subsequent centrifugation and removal of the plasma and immediate addition of the additive solution, followed by careful mixing;

- by leucocyte filtration of Red Cells, AS or Red Cells, BCR-AS.

**Requirements and quality control**

Table 5B-6 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
</tbody>
</table>

*If different from ‘All units’, the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.*

b These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.
<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>To be defined for the system used</td>
<td>1 per cent of all units</td>
</tr>
<tr>
<td>Haematocrit</td>
<td>0.50-0.70</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Residual leucocyte content*</td>
<td>&lt; 1 × 10⁶ per unit by count</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>Minimum 40 g per unit</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
<tr>
<td>Haemolysis at the end of storage</td>
<td>&lt; 0.8 per cent of red cell mass</td>
<td>4 units per month</td>
</tr>
</tbody>
</table>

¹ If different from 'All units', the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

² These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

**Storage and transport**

*Red Cells, LD-AS* must be kept at a controlled temperature between + 2 and + 6 °C during storage. Depending on the anti-coagulant/additive system, the storage time may be extended up to the approved limit of the additive solution system.

Validated transport systems must ensure that at no time during a maximum transit time of 24 hours did the temperature exceed + 10 °C.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
- the name of the blood component;
- the ABO and RhD groups;
- blood group phenotypes other than ABO and RhD (optional);
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- the name and volume of the additive solution;
- additional component information: irradiated, etc. (if appropriate);
- the volume or weight of the blood component;
- the storage temperature;
- that the component must not be used for transfusion if there is abnormal haemolysis or other deterioration;
- that the component must be administered through an approved blood administration set.

**Warnings**

Compatibility of *Red Cells, LD-AS* with the intended recipient must be verified by suitable pre-transfusion testing.

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with red cells from RhD-positive donors.

*Red Cells, LD-AS* is not recommended in the case of:

- plasma intolerance (may not apply to units with a low plasma content).

Adverse reactions include:

- haemolytic transfusion reaction;
non-haemolytic transfusion reaction (mainly chills, fever and urticaria);

- anaphylaxis;

- allo-immunisation against red cell and HLA (very rarely) antigens;

- transfusion-related acute lung injury (TRALI);

- post-transfusion purpura;

- graft versus host disease (GvHD);

- sepsis due to inadvertent bacterial contamination;

- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;

- syphilis can be transmitted if components are stored for less than 96 hours at + 4 °C;

- protozoal transmission (e.g. malaria) may occur in rare instances;

- transmission of other pathogens that are not tested for or recognised;

- citrate toxicity in neonates and in patients with impaired liver function;

- metabolic imbalance in massive transfusion (e.g. hyperkalaemia);

- transfusion-associated circulatory overload;

- iron overload.

7. **Red Cells, Apheresis**

**Definition and properties**

*Red Cells, Apheresis (Aph)* is a red cell component obtained by apheresis of a single donor using automated cell-separation equipment.
Red Cells, Aph contains a minimum haemoglobin content of 40 g. The haematocrit is 0.65 to 0.75 (0.50 to 0.70 if an additive solution is used). The leucocyte content of Red Cells, Aph can vary. When leucocyte-depleted, Red Cells, Aph normally contains less than $1.0 \times 10^6$ leucocytes.

**Preparation**

For preparation of Red Cells, Aph, Whole Blood is removed by an appropriate apheresis machine from the donor and anti-coagulated with a citrate-containing solution. The plasma is returned to the donor. Either one or two units of Red Cells, Aph can be collected during a single procedure.

Red Cells, Aph can be used either unmodified or can undergo further processing, e.g. leucocyte depletion or addition of an additive solution.

**Requirements and quality control**

Table 5B-7 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
</tbody>
</table>

* If different from 'All units', the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

* These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.
Guide to the preparation, use and quality assurance of blood components

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>To be defined by the system used</td>
<td>1 per cent of all units</td>
</tr>
<tr>
<td>Haematocrit</td>
<td>0.65-0.75</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haematocrit (if additive solution)</td>
<td>0.50-0.70</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>Minimum 40 g per unit</td>
<td>4 units per month</td>
</tr>
<tr>
<td>Residual leucocyte content&lt;sup&gt;b&lt;/sup&gt; (if leucocyte-depleted)</td>
<td>&lt; $1 \times 10^6$ per unit by count</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>Haemolysis at the end of storage</td>
<td>&lt; 0.8 per cent of red cell mass</td>
<td>4 units per month</td>
</tr>
</tbody>
</table>

<sup>a</sup> If different from 'All units', the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

<sup>b</sup> These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

### Storage and transport

*Red Cells, Aph* must be kept at a controlled temperature between + 2 and + 6 °C during storage. Depending on the anti-coagulant/additive system, the storage time may be extended up to the approved limit of the additive solution system.

*Red Cells, Aph* to be stored must be collected and prepared in a functionally closed system. If prepared or filtered by methods under an open system, the storage time is limited to 24 hours at + 2 and + 6 °C.

Validated transport systems must ensure that at no time during a maximum transit time of 24 hours did the temperature exceed + 10 °C.

### Labelling

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown
on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If 2 or more units are collected from the donor in one session, each component must have a unique component identity number;
- the name of the blood component;
- the ABO and RhD groups;
- blood group phenotypes other than ABO and RhD (optional);
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- the name and volume of the additive solution (if appropriate);
- additional component information: irradiated, etc. (if appropriate);
- the volume or weight of the blood component;
- the storage temperature;
- that the component must not be used for transfusion if there is abnormal haemolysis or other deterioration;
- that the component must be administered through an approved blood administration set.

**Warnings**

Compatibility of *Red Cells, Aph* with the intended recipient must be verified by suitable pre-transfusion testing.

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with red cells from RhD-positive donors.

*Red Cells, Aph* is not recommended in the case of:
plasma intolerance (may not apply to units with a low plasma content unless IgA incompatibility is present).

Adverse reactions include:

- transfusion-associated circulatory overload;
- haemolytic transfusion reaction;
- anaphylaxis;
- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- allo-immunisation against red cell and HLA (very rarely after leucocyte-depletion) antigens;
- transfusion-related acute lung injury (TRALI);
- post-transfusion purpura;
- graft versus host disease (GvHD);
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- syphilis can be transmitted if components are stored for less than 96 hours at + 4 °C;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised;
- citrate toxicity in neonates and in patients with impaired liver function;
- metabolic imbalance in massive transfusion (e.g. hyperkalaemia);
- iron overload.
8. Red Cells, Washed

Definition and properties

Red Cells, Washed (W) is derived from secondary processing of a red cell component or Whole Blood involving sequential washing and re-suspension of red cells in an additive solution.

Most of the plasma, leucocytes and platelets are removed. The amount of residual plasma depends upon the washing protocol. The haematocrit can be varied according to clinical need.

Preparation

After centrifugation of the primary component and removal of the plasma or additive solution (and, if applicable, the buffy coat layer), the red cells are washed by sequential addition and removal of an additive solution. Centrifugation must be performed at a controlled temperature.

Requirements and quality control

Table 5B-8 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
</tbody>
</table>

\(a\) If different from ‘All units’, the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.
Parameter to be checked | Requirements | Frequency of control
--- | --- | ---
Anti-HCV | Negative by approved screening test | All units
Volume | To be defined for the system used | All units
Haematocrit | 0.65-0.75 | All units
Haemoglobin | Minimum 40 g per unit | All units
Haemolysis at end of the process | < 0.8 per cent of red cell mass | All units
Protein content of final supernatant | < 0.5 g per unit | All units

* If different from 'All units', the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

**Storage and transport**

*Red Cells*, *W* must be kept at a controlled temperature between + 2 °C and + 6 °C during storage.

When an open system is used for washing, the storage time should be as short as possible after washing and must never exceed 24 hours.

If a closed system and a suitable additive solution are used, storage times may be prolonged, subject to validation.

Validated transport systems must ensure that at no time does the temperature exceed + 10 °C.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
• the name of the blood component;
• the ABO and RhD groups;
• blood group phenotypes other than ABO and RhD (optional);
• the date of donation;
• the date and time of expiry;
• the name of the anti-coagulant solution;
• the name and volume of the washing solution;
• additional component information: irradiated, etc. (if appropriate);
• the volume or weight of the blood component;
• the storage temperature;
• that the component must not be used for transfusion if there is abnormal haemolysis or other deterioration;
• that the component must be administered through an approved blood administration set.

Warnings
Compatibility of Red Cells, W with the intended recipient must be verified by suitable pre-transfusion testing.

RhD-negative female recipients of child-bearing age or younger should not be transfused with red cells from RhD-positive donors.

Adverse reactions include:
• haemolytic transfusion reaction;
• non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
• anaphylaxis;
• allo-immunisation against red cell and HLA (very rarely) antigens;
• graft versus host disease (GvHD);
• sepsis due to inadvertent bacterial contamination;
• viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
• syphilis can be transmitted if components are stored for less than 96 hours at + 4 °C;
• protozoal transmission (e.g. malaria) may occur in rare instances;
• transmission of other pathogens that are not tested for or recognised;
• metabolic imbalance in massive transfusion (e.g. hyperkalaemia);
• transfusion-associated circulatory overload;
• iron overload.

9. Red Cells, Cryopreserved

Definition and properties

Red Cells, Cryopreserved (Cryo) is a red cell component derived by secondary processing of a red cell component or Whole Blood. Red cells are frozen (preferably within 7 days of collection) using a cryoprotectant and stored at – 60 °C to – 80 °C or below, depending on the method of cryopreservation.

A reconstituted unit of Red Cells, Cryo contains low amounts of protein, leucocytes and platelets. Each unit of Red Cells, Cryo contains a minimum haemoglobin content of 36 g. The haematocrit is 0.35-0.70.

Preparation

Two methods are generally used for the preparation of Red Cells, Cryo. One is a high glycerol, the other a low glycerol technique. Both methods require a washing/de-glycerolisation procedure.
Requirements and quality control

Table 5B-9 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

**Table 5B-9**

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
<td></td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
<td></td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
<td></td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
<td></td>
</tr>
<tr>
<td>Volume</td>
<td>&gt; 185 mL</td>
<td>All units</td>
<td></td>
</tr>
<tr>
<td>Haemoglobin (supernatant) b</td>
<td>&lt; 0.2 g per unit</td>
<td>All units</td>
<td></td>
</tr>
<tr>
<td>Haematocrit</td>
<td>0.65-0.75</td>
<td>All units</td>
<td></td>
</tr>
<tr>
<td>Haemoglobin</td>
<td>Minimum 36 g per unit</td>
<td>All units</td>
<td></td>
</tr>
</tbody>
</table>
| Osmolarity c                    | < 340 mOsm/L                          | 1 per cent of all units with a minimum of 4 units per month.  
If less, each unit. |   |
| Residual leucocyte content      | < 0.1 × 10⁹ cells per unit            | 1 per cent of units with a minimum of 4 units per month.  
If less, each unit. |   |
| Sterility                       | Sterile                               | 1 per cent of all units with a minimum of 4 units per month.  
If less, each unit. |   |

a If different from ‘All units’, the frequency of control is an indication of minimal frequency but, where SPC is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

b Final suspending solution.

c These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.
Since cryopreservation allows prolonged storage, serum and/or plasma samples obtained at collection must also be stored to enable future testing for newly discovered markers of transmissible diseases when components are thawed for use.

**Storage and transport**

*Red Cells, Cryo in frozen state*

*Red Cells, Cryo* in the frozen state must be constantly maintained between:

- – 60 °C to – 80 °C if stored in an electric freezer and when a high glycerol method is used;
- – 140 °C to – 150 °C if stored in vapour phase liquid nitrogen and when a low glycerol method is used.

The storage time may extend to at least 10 years if the correct storage temperature can be guaranteed.

*Thawed reconstituted Red Cells, Cryo*

In contrast, thawed and reconstituted Red Cells, Cryo must be stored between + 2 and + 6 °C. The storage time must be as short as possible after washing, and must never exceed 24 hours when an open system is used.

If transport in the frozen state is unavoidable, storage conditions must be maintained. Transport of thawed, reconstituted red cells is limited by the short storage time. Storage conditions must be maintained during transport.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements.

The following information must be traceable for each frozen unit:

- the producer’s identification;
- the unique identity number;
the date of donation;
the date of expiry;
the name and volume of the cryoprotective solution;
additional component information (if appropriate);
the volume or weight of the blood component;
the storage temperature.

Labelling of reconstituted components
After thawing and reconstitution (washing), the date of expiry must be changed to the date (and time) of expiry. Also, the name and volume of the cryoprotective solution must be changed to the name and volume of the additive solution (if any). The following information must be shown on the label of the reconstituted component or must be contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
- the name of the blood component;
- the ABO and RhD groups;
- blood group phenotypes other than ABO and RhD (optional);
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- the name and volume of the additive solution;
- additional component information (if appropriate);
- the volume or weight of the blood component;
- the storage temperature;
- that the component must not be used for transfusion if there is abnormal haemolysis or other deterioration;
that the component must be administered through an approved blood administration set.

**Warnings**

Compatibility of *Red Cells, Cryo* with the intended recipient must be verified by suitable pre-transfusion testing.

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with red cells from RhD-positive donors.

When *Red Cells, Cryo* are processed in an open system, the risk of bacterial contamination is increased and therefore extra vigilance is required during transfusion.

Adverse reactions include:

- transfusion-associated circulatory overload;
- haemolytic transfusion reaction;
- anaphylaxis;
- allo-immunisation against red cell and HLA (very rarely) antigens;
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised;
- iron overload.
Component monographs
Part C. Platelet components
1. **Platelets, Recovered, Single Unit**

**Definition and properties**

*Platelets, Recovered, Single Unit (Rec, SU)* is a platelet component derived from a single *Whole Blood* donation. It contains the majority of the original *Whole Blood* platelet content, suspended in plasma.

*Platelets, Rec, SU* contains more than $60 \times 10^9$ platelets.

*Platelets, Rec, SU* contains up to $0.2 \times 10^9$ leucocytes if prepared by the platelet-rich plasma method, and up to $0.05 \times 10^9$ leucocytes if prepared by the buffy coat method.

*Platelets, Rec, SU* can be used for neonatal and infant transfusion. In order to achieve a ‘standard adult dose’, 4 to 6 units of *Platelets, Rec, SU* have to be transfused.

**Preparation**

*Preparation from platelet-rich plasma (PRP)*

A unit of *Whole Blood*, stored for up to 24 hours in conditions validated to maintain the temperature between $+20 \, ^\circ\!C$ and $+24 \, ^\circ\!C$, is centrifuged so that an optimal number of platelets remain in the plasma and the number of leucocytes and red cells are reduced to a defined level. Platelets from PRP are sedimented by hard-spin centrifugation; the supernatant platelet-poor plasma is removed, leaving 50-70 mL of it with the platelets. The platelets are allowed to disaggregate and are then re-suspended in the remnant plasma.

*Preparation from buffy coat*

A *Whole Blood* unit, stored for up to 24 hours in conditions validated to maintain the temperature between $+20$ and $+24 \, ^\circ\!C$, is centrifuged so that platelets are primarily sedimented to the buffy coat layer together with the leucocytes. The buffy coat is separated and processed further to obtain a platelet concentrate. Single buffy coats diluted with plasma are centrifuged so that the platelets remain in the supernatant, but red cells and leucocytes are sedimented to the bottom of the bag.
Requirements and quality control

Table 5C-1 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

Demonstration of the swirling phenomenon, which is based on light scattering by platelets in motion and of normal morphology, must be carried out prior to the issuance and transfusion of this component.

**Table 5C-1**

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>&gt; 40 mL per 60 × 10⁹ of platelets</td>
<td>All units</td>
</tr>
<tr>
<td>Platelet content per final unit ⁠&lt;sup&gt;b&lt;/sup&gt;</td>
<td>&gt; 60 × 10⁹</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
</tbody>
</table>
| Residual leucocytes per final unit ⁠<sup>c</sup> | a. < 0.05 × 10⁹  
 b. < 0.2 × 10⁹ | 1 per cent of all units with a minimum of 10 units per month |

<sup>a</sup> If different from 'All units', the frequency of control is an indication of minimal frequency but, where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

<sup>b</sup> These requirements are deemed to have been met if 75 per cent of the tested units fall within the values indicated.

<sup>c</sup> These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

<sup>d</sup> Measurement of the pH in a closed system is preferable to prevent CO₂ escape. Measurement may be made at another temperature and then corrected.
Guide to the preparation, use and quality assurance of blood components

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control (^d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH measured (+ 22 °C) at the end of the recommended shelf-life (^d)</td>
<td>&gt; 6.4</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
</tbody>
</table>

\(a\) If different from 'All units', the frequency of control is an indication of minimal frequency but, where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

\(b\) These requirements are deemed to have been met if 75 per cent of the tested units fall within the values indicated.

\(c\) These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

\(d\) Measurement of the pH in a closed system is preferable to prevent CO\(_2\) escape. Measurement may be made at another temperature and then corrected.

## Storage and transport

*Platelets, Rec, SU* must be stored under conditions which guarantee that their viability and haemostatic activities are optimally preserved.

The storage temperature must be between + 20 and + 24 °C, under constant agitation.

The maximum storage time for *Platelets, Rec, SU* is 5 days. Storage may be extended to 7 days, in conjunction with appropriate detection or reduction of bacterial contamination.

During transportation, the temperature of *Platelets, Rec, SU* must be kept as close as possible to the recommended storage temperature and, upon receipt, unless intended for immediate therapeutic use, they must be transferred to storage under the recommended conditions.

## Labelling

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number; if platelets are pooled the original donations must be traceable;
• the name of the blood component;
• the ABO and RhD groups;
• the date of donation;
• the date of expiry;
• the name of the anti-coagulant solution;
• additional component information: irradiated, etc. (if appropriate);
• the volume of the blood component;
• the number of platelets (average or actual, as appropriate);
• the storage temperature;
• that the component must be administered through an approved blood administration set.

Warnings
RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD-positive donors.

*Platelets, Rec, SU* are not recommended in cases of:
• plasma intolerance.

Adverse reactions include:
• haemolytic reaction due to transfusion of ABO-incompatible plasma in the component;
• non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
• anaphylaxis;
• allo-immunisation against HLA and red cell antigens;
• allo-immunisation against HPA antigens;
• transfusion-related acute lung injury (TRALI);
• post-transfusion purpura;
• graft versus host disease (GvHD);
• sepsis due to inadvertent bacterial contamination;
• viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
• syphilis transmission;
• protozoal transmission (e.g. malaria) may occur in rare instances;
• transmission of other pathogens that are not tested for or recognised;
• citrate toxicity in neonates and in patients with impaired liver function;
• transfusion-associated circulatory overload.

2. Platelets, Recovered, Pooled

Definition and properties
Platelets, Recovered, Pooled (Rec, Pool) is a platelet component derived from 4 to 6 fresh Whole Blood donations, which contains the majority of the original platelet content in a therapeutically effective dose, suspended in plasma.

Platelets, Rec, Pool contain a minimum content of $2 \times 10^{11}$ platelets.

Platelets, Rec, Pool contain a maximum of $1 \times 10^9$ leucocytes.

Preparation
Platelets, Rec, Pool can be produced:
• directly from Whole Blood-derived buffy coats, which is the method of choice;
• by secondary processing, after pooling of 4-6 units of Platelets, Rec, SU.
**Preparation from buffy coat**

A *Whole Blood* unit, stored in conditions validated to maintain the temperature between +20 and +24 °C, for up to 24 hours, is centrifuged so that the platelets are primarily sedimented to the buffy coat layer, together with the leukocytes. The buffy coat is separated and further processed so that, usually, 4 to 6 blood group-compatible buffy coats are pooled in a sterile manner and re-suspended with plasma. After careful mixing, the buffy coat pool is centrifuged (soft-spin) so that the platelets remain in the supernatant, but the red cells and leukocytes are effectively sedimented to the bottom of the bag. The platelet-containing supernatant is immediately transferred into a suitable platelet storage bag in a sterile manner.

**Preparation from Platelets, Recovered, Single Units (PRP method)**

Four to six units of *Platelets, Rec, SU* prepared by the PRP method are connected and pooled. If storage for longer than 6 hours is intended, pooling must be undertaken in a sterile manner.

**Requirements and quality control**

Table 5C-2 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

Demonstration of the swirling phenomenon, which is based on light scattering by platelets in motion and of normal morphology, may be carried out either as a separate quality-control procedure or as a routine part of the issuance and transfusion of this component.
## Table 5C-2

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>$&gt; 40 \text{ mL per } 60 \times 10^9 \text{ of platelets}$</td>
<td>All units</td>
</tr>
<tr>
<td>Platelet content per final unit $^b$</td>
<td>Minimum $2 \times 10^{11}$</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>Residual leucocyte content $^c$</td>
<td>$&lt; 1 \times 10^9 \text{ per final unit}$</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>pH measured (+ 22 °C) at the end of the recommended shelf-life $^d$</td>
<td>$&gt; 6.4$</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
</tbody>
</table>

$^a$ If different from 'All units', the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

$^b$ These requirements are deemed to have been met if 75 per cent of the tested units fall within the values indicated.

$^c$ These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

$^d$ Measurement of the pH in a closed system is preferable to prevent CO$_2$ escape. Measurement may be made at another temperature and then corrected.

## Storage and transport

*Platelets, Rec, Pool* must be stored under conditions which guarantee that their viability and haemostatic activities are optimally preserved. The storage temperature must be between + 20 and + 24 °C, under constant agitation.
The maximum storage time for *Platelets, Rec, Pool* is 5 days. Storage may be extended to 7 days, in conjunction with appropriate detection or reduction of bacterial contamination.

When an open system has been used for the preparation of *Platelets, Rec, Pool*, the storage time must not exceed 6 hours.

During transportation, the temperature of *Platelets, Rec, Pool* must be kept as close as possible to the recommended storage temperature and, upon receipt, unless intended for immediate therapeutic use, the component must be transferred to storage under the recommended conditions.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number; if platelets are pooled the original donations must be traceable;
- the name of the blood component;
- the ABO and RhD groups;
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- additional component information: irradiated, number of donations combined to make the pool, etc. (if appropriate);
- the volume of the blood component;
- the number of platelets (average or actual, as appropriate);
- the storage temperature;
that the component must be administered through an approved blood administration set.

**Warnings**

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD-positive donors.

*Platelets, Rec, Pool* are not recommended in the case of:

- plasma intolerance.

Adverse reactions include:

- transfusion-associated circulatory overload;
- haemolytic reaction due to transfusion of ABO-incompatible plasma in the component;
- anaphylaxis;
- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- allo-immunisation against HLA and red cell antigens;
- allo-immunisation against HPA antigens;
- transfusion-related acute lung injury (TRALI);
- post-transfusion purpura;
- graft versus host disease (GvHD);
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- syphilis transmission;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised;
• citrate toxicity in neonates and in patients with impaired liver function.

3. **Platelets, Recovered, Pooled, Leucocyte-Depleted**

**Definition and properties**

*Platelets, Recovered, Pooled, Leucocyte-Depleted (Rec, Pool, LD)* is a leucocyte-depleted platelet component derived from 4 to 6 donations of fresh *Whole Blood* and which contains most of the original platelet content in a therapeutically effective dose suspended in plasma.

*Platelets, Rec, Pool, LD* contains a minimum content of $2 \times 10^{11}$ platelets.

*Platelets, Rec, Pool, LD* contains a maximum leucocyte content of $1.0 \times 10^6$ cells.

**Preparation**

*Platelets, Rec, Pool, LD* is leucocyte-depleted by filtration. Pre-storage leucocyte filtration is recommended in preference to filtration during or shortly before transfusion.

*Platelets, Rec, Pool, LD* can be produced:

- directly from *Whole Blood*-derived buffy coats, which is the method of choice;
- by secondary processing, after pooling 4-6 units of *Platelets, Rec, SU*.

**Preparation from buffy coat**

A *Whole Blood* unit, stored in conditions validated to maintain a temperature between + 20 and + 24 °C for up to 24 hours, is centrifuged so that the platelets are primarily sedimented to the buffy coat layer, together with the leucocytes. The buffy coat is separated and further processed so that, usually, 4 to 6 blood group-compatible buffy coats are pooled in a sterile manner and re-suspended with plasma. After careful mixing, the buffy coat pool is centrifuged (soft-spin) so that the platelets remain in the supernatant, but the red cells
and leucocytes are sedimented to the bottom of the bag. The platelet-containing supernatant is immediately filtered and transferred into a suitable platelet storage bag in a sterile manner.

**Preparation from Platelets, Recovered, Single Units (PRP method)**

Four to six units of *Platelets, Rec, SU*, prepared by the PRP method, are connected, pooled, immediately filtered and transferred into a suitable platelet storage bag. If storage for longer than 6 hours is intended, preparation must be undertaken in a sterile manner.

**Requirements and quality control**

Table 5C-3 lists the requirements for the final component. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards of screening for infectious markers).

Demonstration of the swirling phenomenon, which is based on light scattering by platelets in motion and of normal morphology, may be carried out either as a separate quality-control procedure or as a routine part of the issuance and transfusion of this component.

**Table 5C-3**

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
</tbody>
</table>

*a* If different from ‘All units’, the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

*b* These requirements are deemed to have been met if 75 per cent of the tested units fall within the values indicated.

*c* These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

*d* Measurement of the pH in a closed system is preferable to prevent CO₂ escape. Measurement may be made at another temperature and then corrected.
### Parameter to be checked

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>&gt; 40 mL per 60 × 10⁹ of platelets</td>
<td>All units</td>
</tr>
<tr>
<td>Platelet content&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Minimum 2 × 10¹¹ per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>Residual leucocytes&lt;sup&gt;c&lt;/sup&gt;</td>
<td>&lt; 1 × 10⁶ per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>pH measured (+ 22 °C) at the end of the recommended shelf-life&lt;sup&gt;d&lt;/sup&gt;</td>
<td>&gt; 6.4</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
</tbody>
</table>

<sup>a</sup> If different from 'All units', the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

<sup>b</sup> These requirements are deemed to have been met if 75 per cent of the tested units fall within the values indicated.

<sup>c</sup> These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

<sup>d</sup> Measurement of the pH in a closed system is preferable to prevent CO₂ escape. Measurement may be made at another temperature and then corrected.

### Storage and transport

*Platelets, Rec, Pool, LD* must be stored under conditions which guarantee that its viability and haemostatic activities are optimally preserved.

The storage temperature must be + 20 and + 24 °C, under constant agitation.

The maximum storage time for *Platelets, Rec, Pool, LD* is 5 days. Storage may be extended to 7 days, in conjunction with detection or reduction of bacterial contamination.

When an open system has been used for the preparation of *Platelets, Rec, Pool, LD*, the storage time must not exceed 6 hours.
During transportation, the temperature of *Platelets, Rec, Pool, LD* must be kept as close as possible to the recommended storage temperature and, on receipt, unless intended for immediate therapeutic use, the component must be transferred to storage under the recommended conditions.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If platelets are pooled, the original donations must be traceable;
- the name of the blood component;
- the ABO and RhD groups;
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- additional component information: irradiated, number of donations combined to make the pool, etc. (if appropriate);
- the volume of the blood component;
- the number of platelets (average or actual, as appropriate);
- the storage temperature;
- that the component must be administered through an approved blood administration set.

**Warnings**

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD-positive donors.
Platelets, Rec, Pool, LD are not recommended in the case of:

- plasma intolerance.

Adverse reactions include:

- transfusion-associated circulatory overload;
- haemolytic reaction due to transfusion of ABO-incompatible plasma in the component;
- anaphylaxis;
- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- allo-immunisation against HLA (very rarely after leucocyte-depletion) and red cell antigens;
- allo-immunisation against HPA antigens;
- transfusion-related acute lung injury (TRALI);
- post-transfusion purpura;
- graft versus host disease (GvHD);
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- syphilis transmission;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised;
- citrate toxicity in neonates and in patients with impaired liver function.
4. Platelets, Recovered, Pooled, in Additive Solution

Definition and properties

Platelets, Recovered, Pooled, in Additive Solution (Rec, Pool, AS) is a platelet component derived from 4 to 6 donations of fresh Whole Blood which contains most of the original platelet content in a therapeutically effective dose suspended in a mixture of plasma (30-40 per cent) and an additive solution (60-70 per cent).

*Platelets, Rec, Pool, AS* contains a minimum content of $2 \times 10^{11}$ platelets.

*Platelets, Rec, Pool, AS* contains a maximum of $0.3 \times 10^9$ leucocytes.

Preparation

*Platelets, Rec, Pool, AS* is prepared from Whole Blood-derived buffy coats.

A Whole Blood unit, stored in conditions validated to maintain a temperature between + 20 and + 24 °C for up to 24 hours, is centrifuged so that the platelets are primarily sedimented to the buffy coat layer, together with the leucocytes. The buffy coat is separated and further processed so that, usually, 4 to 6 blood group-compatible buffy coats are pooled in a sterile manner and suspended in an additive solution. After careful mixing, the buffy coat pool is centrifuged (soft-spin) so that the platelets remain in the supernatant, but the red cells and leucocytes are effectively sedimented to the bottom of the bag.

The platelet-containing supernatant is immediately transferred into a suitable platelet storage bag in a sterile manner.

Requirements and quality control

Table 5C-4 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).
Demonstration of the swirling phenomenon, which is based on light scattering by platelets in motion and of normal morphology, may be carried out either as a separate-quality control procedure or as a routine part of the issuance and transfusion of this component.

### Table 5C-4

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>$&gt; 40 \text{ mL per } 60 \times 10^9$ of platelets</td>
<td>All units</td>
</tr>
<tr>
<td>Platelet content $^b$</td>
<td>Minimum $2 \times 10^{11}$ per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>Residual leucocyte content $^c$</td>
<td>$&lt; 0.3 \times 10^9$ per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>pH measured (+ 22 °C) at the end of the recommended shelf-life $^d$</td>
<td>$&gt; 6.4$</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
</tbody>
</table>

$a$ If different from 'All units', the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

$b$ These requirements are deemed to have been met if 75 per cent of the tested units fall within the values indicated.

$c$ These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

$d$ Measurement of the pH in a closed system is preferable to prevent CO2 escape. Measurement may be made at another temperature and then corrected.
Storage and transport

Platelets, Rec, Pool, AS must be stored under conditions which guarantee that its viability and haemostatic activities are optimally preserved.

The storage temperature must be +20 and +24 °C, under constant agitation.

The maximum storage time for Platelets, Rec, Pool, AS is 5 days. Storage may be extended to 7 days, in conjunction with detection or reduction of bacterial contamination and depending on the type of additive solution. When an open system has been used for preparation of Platelets, Rec, Pool, AS, the storage time must not exceed 6 hours.

During transportation, the temperature of Platelets, Rec, Pool, AS must be kept as close as possible to the recommended storage temperature and, on receipt and unless intended for immediate therapeutic use, the component must be transferred to storage under the recommended conditions.

Labelling

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If platelets are pooled, the original donations must be traceable;
- the name of the blood component;
- the ABO and RhD groups;
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- the name and volume of the additive solution;
• additional component information: irradiated, number of donations combined to make the pool, etc. (if appropriate);
• the volume of the blood component;
• the number of platelets (average or actual, as appropriate);
• the storage temperature;
• that the component must be administered through an approved blood administration set.

**Warnings**

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD-positive donors.

*Platelets, Rec, Pool, AS* is not recommended in case of:

• plasma intolerance.

Adverse reactions include:

• transfusion-associated circulatory overload;
• haemolytic reaction due to anti-A, -B in case of incompatible transfusions;
• anaphylaxis;
• non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
• allo-immunisation against HLA and red cell antigens;
• allo-immunisation against HPA antigens;
• transfusion-related acute lung injury (TRALI);
• post-transfusion purpura;
• graft versus host disease (GvHD);
• sepsis due to inadvertent bacterial contamination;
• viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
• syphilis transmission;
• protozoal transmission (e.g. malaria) may occur in rare instances;
• transmission of other pathogens that are not tested for or recognised;
• citrate toxicity in neonates and in patients with impaired liver function.

5. Platelets, Recovered, Pooled, Leucocyte-Depleted, in Additive Solution

Definition and properties

*Platelets, Recovered, Pooled, Leucocyte-Depleted, in Additive Solution (Rec, Pool, LD-AS)* is a leucocyte-depleted platelet component derived from 4 to 6 fresh *Whole Blood* donations, which contains the majority of the original platelet content in a therapeutically effective dose, suspended in a mixture of plasma (30-40 per cent) and an additive solution (60-70 per cent).

*Platelets, Rec, Pool, LD-AS* contains a minimum content of $2 \times 10^{11}$ platelets.

*Platelets, Rec, Pool, LD-AS* contains a maximum of $1.0 \times 10^6$ leucocytes.

Preparation

*Platelets, Rec, Pool, LD-AS* is prepared from *Whole Blood*-derived buffy coats and is then leucocyte-depleted by filtration. Pre-storage leucocyte filtration within 6 hours of preparation is recommended.

A Whole Blood unit, stored in conditions validated to maintain a temperature between + 20 and + 24 °C for up to 24 hours, is centrifuged so that the platelets are primarily sedimented to the buffy coat layer, together with leucocytes. The buffy coat is separated and further processed so that, usually, 4 to 6 blood group-compatible buffy coats are pooled in a sterile manner and suspended in an additive.
solution. After careful mixing, the buffy coat pool is centrifuged (soft-spin) so that the platelets remain in the supernatant, but the red cells and leucocytes are effectively sedimented to the bottom of the bag. The platelet-containing supernatant is immediately filtered and transferred into a suitable platelet storage bag in a sterile manner.

**Requirements and quality control**

Table 5C-5 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

Demonstration of the swirling phenomenon, which is based on light scattering by platelets in motion and of normal morphology, may be carried out either as a separate quality-control procedure or as a routine part of the issuance and transfusion of this component.

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>&gt; 40 mL per 60 $\times 10^9$ of platelets</td>
<td>All units</td>
</tr>
</tbody>
</table>

$^a$ If different from ‘All units’, the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

$^b$ These requirements are deemed to have been met if 75 per cent of the tested units fall within the values indicated.

$^c$ These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

$^d$ Measurement of the pH in a closed system is preferable to prevent CO$_2$ escape. Measurement may be made at another temperature and then corrected.
<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platelet content (^b)</td>
<td>Minimum (2 \times 10^{11}) per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>Residual leucocyte content (^c)</td>
<td>(&lt; 1 \times 10^6) per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>pH measured (+ 22 °C) at the end of the recommended shelf-life (^d)</td>
<td>(&gt; 6.4)</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
</tbody>
</table>

\(^a\) If different from 'All units', the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

\(^b\) These requirements are deemed to have been met if 75 per cent of the tested units fall within the values indicated.

\(^c\) These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

\(^d\) Measurement of the pH in a closed system is preferable to prevent CO\(_2\) escape. Measurement may be made at another temperature and then corrected.

**Storage and transport**

*Platelets, Rec, Pool, LD-AS* must be stored under conditions which guarantee that their viability and haemostatic activities are optimally preserved.

The storage temperature must be + 20 and + 24 °C under constant agitation.

The maximum storage time for *Platelets, Rec, Pool, LD-AS* is 5 days. Storage may be extended to 7 days, in conjunction with detection or reduction of bacterial contamination and depending on the type of additive solution.

During transportation, the temperature of *Platelets, Rec, Pool, LD-AS* must be kept as close as possible to the recommended storage temperature and, on receipt, unless intended for immediate therapeutic use, the component must be transferred to storage under the recommended conditions.
Labelling
The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If platelets are pooled, the original donations must be traceable;
- the name of the blood component;
- the ABO and RhD groups;
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- the name and volume of the additive solution;
- additional component information: irradiated, number of donations combined to make the pool, etc. (if appropriate);
- the volume of the blood component;
- the number of platelets (average or actual, as appropriate);
- the storage temperature;
- that the component must be administered through an approved blood administration set.

Warnings
RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD-positive donors.

*Platelets, Rec, Pool, LD, AS* is not recommended in the case of:

- plasma intolerance.

Adverse reactions include:
transfusion-associated circulatory overload;
haemolytic reaction due to anti-A, -B in case of incompatible transfusions;
anaphylaxis;
non-haemolytic transfusion reactions (mainly chills, fever and urticaria). The incidence is reduced by the use of pre-storage leucocyte-depleted platelets;
allo-immunisation against HLA (very rarely after leucocyte-depletion) and red cell antigens;
allo-immunisation against HPA antigens;
transfusion-related acute lung injury (TRALI);
post-transfusion purpura;
graft versus host disease (GvHD);
sepsis due to inadvertent bacterial contamination;
viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
syphilis transmission;
protozoal transmission (e.g. malaria) may occur in rare instances;
transmission of other pathogens that are not tested for or recognised;
citrate toxicity in neonates and in patients with impaired liver function.

6. **Platelets, Pooled, Pathogen-reduced**

**Definition and properties**

*Platelets, Pooled, Pathogen Reduced (Pool, PR)* is a leucocyte-depleted platelet component derived from 4 to 6 fresh *Whole Blood* donations, which contains the majority of the original platelet content in a therapeutically effective dose suspended in plasma or a mixture of
plasma (30-40 per cent) and an additive solution (60-70 per cent). Subsequently, the component is subjected to treatment with an approved and validated PRT before storage.

*Platelets, Pool, PR* contains a minimum content of $2 \times 10^{11}$ platelets.

*Platelets, Pool, PR* contains a maximum leucocyte content of $1.0 \times 10^{6}$ cells.

The PRT typically reduces the risk of infection with enveloped viruses (e.g. HBV, HCV, HIV) and with most bacteria (with the exception of bacterial spores) by at least one-thousand-fold.

Depending on the procedure, some PRT have been shown to inactivate lymphocytes and, if this is the case, irradiation to prevent transfusion-associated GvHD is not required.

**Preparation**

*Platelets, Pool, PR* is prepared by pooling several *Whole Blood* donations as described for *Platelets, Recovered, Pooled, Leucocyte-Depleted* and *Platelets, Recovered, Pooled, Leucocyte-Depleted, in Additive Solution*.

The PRT is undertaken according to manufacturers’ instructions.

**Requirements and quality control**

The parameters listed in Table 5C-6 must be checked with the given frequency. A technical procedure must be in place to ensure that the illumination of the PRT has been performed correctly. Additional testing might be necessary to comply with national requirements (see Chapter 9, Standards for screening for infectious markers).

Demonstration of the swirling phenomenon, which is based on light scattering by platelets in motion and of normal morphology, may be carried out either as a separate quality-control procedure or as a routine part of the issuance and transfusion of this component.
### Table 5C-6

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>&gt; 40 ml per 60 × 10⁹ of platelets</td>
<td>All units</td>
</tr>
<tr>
<td>Platelet content b</td>
<td>Minimum 2 × 10¹¹</td>
<td>1% of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>Residual leucocytes c</td>
<td>&lt; 1 × 10⁶/unit</td>
<td>1% of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>pH measured (+ 22 °C) at the end of the recommended shelf life d</td>
<td>&gt; 6.4</td>
<td>1% of all units with a minimum of 4 units per month</td>
</tr>
</tbody>
</table>

_a_ If different from ‘All units’ the frequency of control is an indication of minimal frequency, but where SPC is used to minimise the risk of process deviation this frequency may be adjusted accordingly.

_b_ These requirements shall be deemed to have been met if 75 per cent of the units tested fall within the values indicated.

_c_ These requirements shall be deemed to have been met if 90 per cent of the units tested fall within the values indicated.

_d_ Measurement of the pH in a closed system is preferable to prevent CO₂ escape. Measurement may be made at another temperature and converted by calculation for reporting pH at + 22 °C.

### Storage and transport

*Platelets, Pool, PR* must be stored under conditions which guarantee that their viability and haemostatic activities are optimally preserved.

Storage temperature must be between + 20 °C to + 24 °C under constant agitation.
The maximum storage time for *Platelets, Pool, PR* may be extended to 7 days depending on the PRT and on the type of additive solution. During transportation the temperature of *Platelets, Pool, PR* must be kept as close as possible to recommended storage temperature and, on receipt, unless intended for immediate therapeutic use, they should be transferred to storage under recommended conditions.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the product information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number (the original donations contributing to the pool must be traceable);
- the name of the blood component
- the name of the PRT used;
- the ABO and RhD group;
- the date of donation;
- the date of expiry;
- the name of the anticoagulant solution;
- the name and volume of the additive solution;
- additional component information: leucocyte-depleted, number of donations combined to make the pool;
- the volume of the blood component;
- the number of platelets (average or actual, as appropriate);
- the temperature of storage;
- that the component must be administered through an approved blood administration set.
Warnings

RhD negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD positive donors.

*Platelets, Pool, PR* is not recommended:

- in a patient with intolerance to plasma proteins;
- when prepared by amotosalen treatment in neonates undergoing phototherapy;
- in a patient with known allergy to the compounds used for, or generated by, the PRT.

Adverse effects include:

- transfusion associated circulatory overload;
- haemolytic reactions due to anti-A, -B in case of incompatible transfusions;
- non-haemolytic transfusion reactions may occur (mainly chills, fever and urticaria). The incidence is reduced by the use of pre-storage leucocyte-depleted platelets;
- allo-immunisation against HLA (very rarely after leucocyte-depletion) and red cell antigens;
- allo-immunisation against HPA antigens;
- transfusion related acute lung injury (TRALI);
- post-transfusion purpura;
- viral transmission and bacterial contamination (other than bacterial spores) is highly unlikely. Transmission of other pathogens that are not sensitive to PRT is possible;
- citrate toxicity in patients with impaired liver function;
- anaphylaxis and allergic reactions (including allergy to the compounds used for, or generated by, PRT).
7. **Platelets, Apheresis**

**Definition and properties**

*Platelets, Apheresis (Aph)* is a component obtained by platelet apheresis of a single donor using automated cell separation equipment, which contains platelets in a therapeutically effective dose suspended in plasma.

*Platelets, Aph* contains a minimum content of $2 \times 10^{11}$ platelets.

*Platelets, Aph* contains a maximum leucocyte content of $0.3 \times 10^9$ cells.

**Preparation**

For preparation of Platelets, Aph, *Whole Blood* is removed from the donor by the apheresis machine, anti-coagulated with a citrate solution and then the platelets are harvested.

For use in neonates and infants, *Platelets, Aph* can be divided into satellite units under sterile conditions.

**Requirements and quality control**

Table 5C-7 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

Demonstration of the swirling phenomenon, which is based on light scattering by platelets in motion and of normal morphology, may be carried out either as a separate quality-control procedure or as a routine part of the issuance and transfusion of this component.
### Table 5C-7

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>&gt; 40 mL per 60 × 10⁹ of platelets</td>
<td>All units</td>
</tr>
<tr>
<td>Platelet content</td>
<td>Standard unit: minimum 2 × 10¹¹ per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td></td>
<td>For use in neonates or infants: minimum 0.5 × 10¹¹ per unit</td>
<td></td>
</tr>
<tr>
<td>Residual leucocyte content b</td>
<td>&lt; 0.3 × 10⁹ per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>pH measured (+ 22 °C) at the end of the recommended shelf-life c</td>
<td>&gt; 6.4</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
</tbody>
</table>

---

*a* If different from ‘All units’, the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

*b* These requirements are deemed to have been met if 90 per cent of the tested units all within the values indicated.

*c* Measurement of the pH in a closed system is preferable to prevent CO₂ escape. Measurement may be made at another temperature and then corrected.

---

**Storage and transport**

*Platelets, Aph* must be stored under conditions which guarantee that their viability and haemostatic activities are optimally preserved.

The storage temperature must be between + 20 to + 24 °C, under constant agitation.
Platelets, Aph to be stored for more than 6 hours must be collected and prepared in a functionally closed system. The maximum storage time for Platelets, Aph is 5 days. Storage may be extended to 7 days, in conjunction with detection or reduction of bacterial contamination.

During transportation, the temperature of Platelets, Aph must be kept as close as possible to the recommended storage temperature and, on receipt, unless intended for immediate therapeutic use, the component must be transferred to storage under the recommended conditions.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If two or more units are collected from the donor in one session, each component must have a unique component identity number;
- the name of the blood component;
- the ABO and RhD groups;
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- additional component information: irradiated, etc. (if appropriate);
- the volume of the blood component;
- the number of platelets (average or actual, as appropriate);
- the storage temperature;
- the relevant HLA and/or HPA type, if determined;
that the component must be administered through an approved blood administration set.

**Warnings**

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD-positive donors.

*Platelets, Aph* is not recommended in the case of:

- plasma intolerance.

Adverse reactions include:

- transfusion-associated circulatory overload;
- haemolytic reaction due to transfusion of ABO-incompatible plasma in the component;
- anaphylaxis;
- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- allo-immunisation against HLA and red cell antigens;
- allo-immunisation against HPA antigens;
- transfusion-related acute lung injury (TRALI);
- post-transfusion purpura;
- graft versus host disease (GvHD);
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- syphilis transmission;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised;
citrate toxicity in neonates and in patients with impaired liver function.

8. **Platelets, Apheresis, Leucocyte-Depleted**

**Definition and properties**

*Platelets, Apheresis, Leucocyte-Depleted (Aph, LD)* is a leucocyte-depleted platelet component obtained by platelet apheresis of a single donor using automated cell separation equipment, which contains platelets in a therapeutically effective dose suspended in plasma.

*Platelets, Aph, LD* contains a minimum content of $2 \times 10^{11}$ platelets.

*Platelets, Aph, LD* normally contains a maximum content of $1.0 \times 10^6$ leucocytes.

**Preparation**

To prepare *Platelets, Aph, LD*, *Whole Blood* is removed from the donor by the apheresis machine, anti-coagulated with a citrate solution and the platelets are then harvested. Centrifugation, filtration or other in-process steps are included in the process to reduce the number of contaminating leucocytes. Pre-storage leucocyte depletion is recommended (within 6 hours after preparation if performed by filtration).

For use in neonates and infants, *Platelets, Aph, LD* can be divided into satellite units under sterile conditions.

**Requirements and quality control**

Table 5C-8 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

Demonstration of the swirling phenomenon, which is based on light scattering by platelets in motion and of normal morphology, may be carried out either as a separate quality control procedure or as a routine part of the issuance and transfusion of this component.
## Table 5C-8

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>&gt; 40 mL per 60 × 10⁹ of platelets</td>
<td>All units</td>
</tr>
<tr>
<td>Platelet content</td>
<td>Standard unit: minimum 2 × 10¹¹ per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td></td>
<td>For use in neonates or infants: minimum 0.5 × 10¹¹ per unit</td>
<td></td>
</tr>
<tr>
<td>Residual leucocyte content(^b)</td>
<td>&lt; 1 × 10⁶ per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>pH measured (+ 22 °C) at the end of the recommended shelf-life (^c)</td>
<td>&gt; 6.4</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
</tbody>
</table>

\(^a\) If different from ‘All units’, the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

\(^b\) These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

\(^c\) Measurement of the pH in a closed system is preferable to prevent CO\(_2\) escape. Measurement may be made at another temperature and then corrected.

### Storage and transport

*Platelets, Aph, LD* must be stored under conditions which guarantee that their viability and haemostatic activities are optimally preserved.

The storage temperature must be between + 20 to + 24 °C, under constant agitation.
Platelets, Aph, LD to be stored for more than 6 hours must be collected and prepared in a functionally-closed system. The maximum storage time for Platelets, Aph, LD is 5 days. Storage may be extended to 7 days, in conjunction with detection or reduction of bacterial contamination.

During transportation, the temperature of Platelets, Aph, LD must be kept as close as possible to the recommended storage temperature and, upon receipt, unless intended for immediate therapeutic use, the component must be transferred to storage under the recommended conditions.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If two or more units are collected from the donor in one session, each component must have a unique component identity number;
- the name of the blood component;
- the ABO and RhD groups;
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- additional component information: irradiated, etc. (if appropriate);
- the volume of the blood component;
- the number of platelets (average or actual, as appropriate);
- the storage temperature;
- the relevant HLA and/or HPA type, if determined;
• that the component must be administered through an approved blood administration set.

Warnings
RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD-positive donors.

*Platelets, Apheresis, LD* is not recommended in the case of:

• plasma intolerance.

Adverse reactions include:

• transfusion-associated circulatory overload;

• haemolytic reaction due to transfusion of ABO-incompatible plasma in the component;

• anaphylaxis;

• non-haemolytic transfusion reaction (mainly chills, fever and urticaria). The incidence is reduced by the use of pre-storage leucocyte-depleted platelets;

• allo-immunisation against HLA (very rarely) and red cell antigens;

• allo-immunisation against HPA antigens;

• transfusion-related acute lung injury (TRALI);

• post-transfusion purpura;

• graft versus host disease (GvHD);

• sepsis due to inadvertent bacterial contamination;

• viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;

• syphilis transmission;

• protozoal transmission (e.g. malaria) may occur in rare instances;
• transmission of other pathogens that are not tested for or recognised;
• citrate toxicity in neonates and in patients with impaired liver function.

9. **Platelets, Apheresis, in Additive Solution**

**Definition and properties**

*Platelets, Apheresis, in Additive Solution (Aph, AS)* is a component obtained by platelet apheresis of a single donor using automated cell separation equipment, which contains platelets in a therapeutically effective dose suspended in a mixture of plasma (30-40 per cent) and an additive solution (60-70 per cent).

*Platelets, Aph, AS* contains a minimum content of $2 \times 10^{11}$ platelets.

*Platelets, Aph, AS* contains a maximum leucocyte content of $0.3 \times 10^9$ cells.

**Preparation**

To prepare *Platelets, Aph, AS*, *Whole Blood* is removed from the donor by the apheresis machine, anti-coagulated with a citrate solution and then the platelets are harvested. Platelets are stored in a combination of plasma and an appropriate additive solution.

For use in neonates and infants, *Platelets, Aph, AS* can be divided into satellite units under sterile conditions.

**Requirements and quality control**

Table 5C-9 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

Demonstration of the swirling phenomenon, which is based on light scattering by platelets in motion and of normal morphology, may be carried out either as a separate quality-control procedure or as a routine part of the issuance and transfusion of this component.
Table 5C-9

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HLA or HPA</td>
<td>As required</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>&gt; 40 mL per 60 $\times 10^9$ of platelets</td>
<td>All units</td>
</tr>
<tr>
<td>Platelet content</td>
<td>Standard unit: minimum 2 $\times 10^{11}$ per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td></td>
<td>For use in neonates or infants: minimum 0.5 $\times 10^{11}$ per unit</td>
<td></td>
</tr>
<tr>
<td>Residual leucocyte content $^b$</td>
<td>&lt; 0.3 $\times 10^9$ per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>pH measured (+ 22 °C) at the end of the recommended shelf-life $^c$</td>
<td>&gt; 6.4</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
</tbody>
</table>

$^a$ If different from 'All units', the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

$^b$ These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

$^c$ Measurement of the pH in a closed system is preferable to prevent CO$_2$ escape. Measurement may be made at another temperature and then corrected.

**Storage and transport**

*Platelets, Aph, AS* must be stored under conditions which guarantee that their viability and haemostatic activities are optimally preserved.
The storage temperature must be +20 to +24 °C, under constant agitation.

*Platelets, Aph, AS* to be stored for more than 6 hours must be collected and prepared in a functionally closed system. The maximum storage time for *Platelets, Aph, AS* is 5 days. Storage may be extended to 7 days, in conjunction with detection or reduction of bacterial contamination and depending on the type of additive solution.

During transportation, the temperature of *Platelets, Aph, AS* must be kept as close as possible to the recommended storage temperature and, on receipt, unless intended for immediate therapeutic use, the component must be transferred to storage under the recommended conditions.

**Labelling**
The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If two or more units are collected from the donor in one session, each component must have a unique component identity number;
- the name of the blood component;
- the ABO and RhD groups;
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- the name and volume of the additive solution;
- additional component information: irradiated, etc. (if appropriate);
- the volume of the blood component;
• the number of platelets (average or actual, as appropriate);
• the storage temperature;
• the relevant HLA and/or HPA type, if determined;
• that the component must be administered through an approved blood administration set.

**Warnings**
RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD-positive donors.

*Platelets, Apheresis, AS* is not recommended in the case of:
• plasma intolerance.

Adverse reactions include:
• transfusion-associated circulatory overload;
• haemolytic reaction due to anti-A, -B in case of incompatible transfusions;
• anaphylaxis;
• non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
• allo-immunisation against HLA and red cell antigens;
• allo-immunisation against HPA antigens;
• transfusion-related acute lung injury (TRALI);
• post-transfusion purpura;
• graft versus host disease (GvHD);
• sepsis due to inadvertent bacterial contamination;
• viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
• syphilis transmission;
protozoal transmission (e.g. malaria) may occur in rare instances;

- transmission of other pathogens that are not tested for or recognised;

- citrate toxicity in neonates and in patients with impaired liver function.

10. **Platelets, Apheresis, Leucocyte-Depleted, in Additive Solution**

Definition and properties

*Platelets, Apheresis, Leucocyte-Depleted, in Additive Solution (Aph, LD-AS)* is a leucocyte-depleted platelet component obtained by platelet apheresis of a single donor using automated cell-separation equipment, which contains platelets in a therapeutically effective dose suspended in a mixture of plasma (30-40 per cent) and an additive solution (60-70 per cent).

*Platelets, Aph, LD-AS* contains a minimum content of $2 \times 10^{11}$ platelets.

*Platelets, Aph, LD-AS* contains a maximum of $1.0 \times 10^6$ leucocytes.

Preparation

To prepare *Platelets, Aph, LD-AS, Whole Blood* is removed from the donor by the apheresis machine, anti-coagulated with a citrate solution and then the platelets are harvested. Platelets are stored in a combination of plasma and an appropriate nutrient solution. Centrifugation, filtration or other in-process steps are included in the process to reduce the number of contaminating leucocytes. Pre-storage leucocyte depletion is recommended (within 6 hours after preparation if performed by filtration).

For use in neonates and infants, *Platelets, Aph, LD-AS* can be divided into satellite units under sterile conditions.
Requirements and quality control

Table 5C-10 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

Demonstration of the swirling phenomenon, which is based on light scattering by platelets in motion and of normal morphology, may be carried out either as a separate quality-control procedure or as a routine part of the issuance and transfusion of this component.

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HLA and/or HPA</td>
<td>As required</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>&gt; 40 mL per 60 × 10⁹ of platelets</td>
<td>All units</td>
</tr>
</tbody>
</table>

* If different from 'All units', the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.
* These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.
* Measurement of the pH in a closed system is preferable to prevent CO₂ escape. Measurement may be made at another temperature and then corrected.
### Parameter to be checked

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control(^a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platelet content</td>
<td>Standard unit: minimum (2 \times 10^{11}) per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td></td>
<td>For use in neonates or infants: minimum (0.5 \times 10^{11}) per unit</td>
<td></td>
</tr>
<tr>
<td>Residual leucocyte content(^b)</td>
<td>(&lt; 1 \times 10^6) per unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>pH measured (+ 22 °C) at the end of the recommended shelf-life(^c)</td>
<td>(&gt; 6.4)</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
</tbody>
</table>

---

\(^a\) If different from 'All units', the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

\(^b\) These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

\(^c\) Measurement of the pH in a closed system is preferable to prevent CO \(_2\) escape. Measurement may be made at another temperature and then corrected.

## Storage and transport

*Platelets, Aph, LD-AS* must be stored under conditions which guarantee that their viability and haemostatic activities are optimally preserved.

The storage temperature must be between + 20 to + 24 °C, under constant agitation.

*Platelets, Aph, LD-AS* to be stored for more than 6 hours must be collected and prepared in a functionally closed system. The maximum storage time for *Platelets, Aph, LD-AS* is 5 days. Storage may be extended to 7 days, in conjunction with detection or reduction of bacterial contamination and depending on the type of additive solution.

During transportation, the temperature of *Platelets, Aph, LD-AS* must be kept as close as possible to the recommended storage temperature and, on receipt, unless intended for immediate therapeutic use, the component must be transferred to storage under the recommended conditions.
Labelling
The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If two or more units are collected from the donor in one session, each component must have a unique component identity number;
- the name of the blood component;
- the ABO and RhD groups;
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- the name and volume of the additive solution;
- additional component information: irradiated, etc. (if appropriate);
- the volume of the blood component;
- the number of platelets (average or actual, as appropriate);
- the storage temperature;
- the relevant HLA and/or HPA type, if determined;
- that the component must be administered through an approved blood administration set.

Warnings
RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD-positive donors.

Platelets, Aph, LD-AS is not recommended in the case of:
- plasma intolerance.
Adverse reactions include:

- transfusion-associated circulatory overload;
- haemolytic reaction due to anti-A, -B in case of incompatible transfusions;
- anaphylaxis;
- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- allo-immunisation against HLA (very rarely after pre-storage leucocyte-depletion) and red cell antigens;
- allo-immunisation against HPA antigens;
- transfusion-related acute lung injury (TRALI);
- post-transfusion purpura;
- graft versus host disease (GvHD);
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible despite careful donor selection and screening procedures;
- syphilis transmission;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised;
- citrate toxicity in neonates and in patients with impaired liver function.

11. **Platelets, Apheresis, Pathogen-reduced**

**Definition and properties**

*Platelets, Apheresis, Pathogen Reduced (Aph, PR)* is a leucocyte-depleted platelet component obtained by platelet apheresis of a single donor using automated cell separation equipment, which contains
platelets in a therapeutically effective dose suspended in plasma or a mixture of plasma (30-40 per cent) and an additive solution (60-70 per cent). Subsequently, the component is subjected to treatment with an approved and validated PRT before storage.

*Platelets, Aph, PR* contains a minimum content of $2 \times 10^{11}$ platelets.

*Platelets, Aph, PR* contains a maximum leucocyte content of $1.0 \times 10^6$ cells.

The PRT typically reduces the risk of infection by enveloped viruses (e.g. HBV, HCV, HIV) and most bacteria (with the exception of bacterial spores) by at least one-thousand-fold.

Depending on the procedure, some PRT have been shown to inactivate lymphocytes and, if so, irradiation to prevent transfusion-associated GvHD is not required.

### Preparation

To prepare *Platelets, Aph, PR, Whole Blood* is removed from the donor by the apheresis machine, anti-coagulated with a citrate solution and then the platelets are harvested. Platelets are stored in plasma or a mixture of plasma (30-40 per cent) and an additive solution (60-70 per cent). Centrifugation, filtration or other in-process steps are included in the process to reduce the number of contaminating leucocytes.

The PRT is undertaken according to manufacturer instructions.

### Requirements and quality control

The parameters listed in Table 5C-11 must be checked according to the reported frequency. A technical procedure must be in place to ensure that the illumination of the PRT has been performed correctly. Additional testing might be necessary to comply with national requirements (see Chapter 9 Standards for screening for infectious markers).

Demonstration of the swirling phenomenon, which is based on light scattering by platelets in motion and of normal morphology, may
be carried out either as a separate quality control procedure or as a routine part of the issuance and transfusion of this component.

**Table 5C-11**

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Volume</td>
<td>$&gt; 40$ mL per $60 \times 10^9$ of platelets</td>
<td>All units</td>
</tr>
<tr>
<td>Platelet content $^b$</td>
<td>Minimum $2 \times 10^{11}$</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>Residual leucocytes $^c$</td>
<td>$&lt; 1 \times 10^6$/unit</td>
<td>1 per cent of all units with a minimum of 10 units per month</td>
</tr>
<tr>
<td>pH measured (+ 22 °C) at the end of the recommended shelf-life $^d$</td>
<td>$&gt; 6.4$</td>
<td>1 per cent of all units with a minimum of 4 units per month</td>
</tr>
</tbody>
</table>

$^a$ If different from 'All units', the frequency of control is an indication of minimal frequency, but where statistical process control is used to minimise the risk of process deviation, this frequency may be adjusted accordingly.

$^b$ These requirements are deemed to have been met if 75 per cent of the tested units fall within the values indicated.

$^c$ These requirements are deemed to have been met if 90 per cent of the tested units fall within the values indicated.

$^d$ Measurement of the pH in a closed system is preferable to prevent CO$_2$ escape. Measurement may be made at another temperature and then corrected.

**Storage and transport**

*Platelets, Aph, PR* must be stored under conditions which guarantee that their viability and haemostatic activities are optimally preserved.
The storage temperature must be between +20 to +24 °C, under constant agitation.

The maximum storage time for Platelets, Aph, PR may be extended to 7 days depending on the type of additive solution and the PRT.

During transportation, the temperature of Platelets, Aph, PR must be kept as close as possible to the recommended storage temperature and, on receipt, unless intended for immediate therapeutic use, they should be transferred to storage under the recommended conditions.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the product information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
- the name of the blood component;
- the name of the PRT used;
- the ABO and RhD groups;
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- the name and volume of the additive solution;
- additional component information: leucocyte-depleted, number of donations combined to make the pool, etc. (as appropriate);
- the volume of the blood component;
- the number of platelets (average or actual, as appropriate);
- the storage temperature;
- that the component must be administered through an approved blood administration set.
**Warnings**

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD-positive donors.

*Platelets, Aph, PR* is not recommended in cases of:

- plasma intolerance;
- neonates undergoing phototherapy, when prepared by amotosalen treatment;
- in patients with a known allergy to the compounds used for, or generated by, the PRT.

Adverse reactions include:

- transfusion-associated circulatory overload;
- haemolytic reactions due to anti-A, -B in case of incompatible transfusions;
- non-haemolytic transfusion reactions may occur (mainly chills, fever and urticaria). The incidence is reduced by the use of pre-storage leucocyte-depleted platelets;
- allo-immunisation against HLA (very rarely after leucocyte-depletion) and red cell antigens;
- allo-immunisation against HPA antigens;
- transfusion-related acute lung injury (TRALI);
- post-transfusion purpura;
- viral transmission and bacterial contamination (other than bacterial spores) is highly unlikely. Transmission of other pathogens that are not sensitive to PRT is possible;
- citrate toxicity in patients with impaired liver function;
- anaphylaxis and allergic reactions, including allergy to the compounds used for, or generated by, the PRT.
12. **Platelets, Cryopreserved**

**Definition and properties**

*Platelets, Cryopreserved (Cryo)* is a component prepared by the freezing of *Platelets, Aph, LD* within 24 hours of collection, using a cryoprotectant.

Reconstituted *Platelets, Cryo* contain more than 40 per cent of the original component.

The method facilitates extended storage of platelets from selected donors and of autologous platelets.

**Preparation**

*Platelets, Cryo* are prepared by secondary processing of *Platelets, Aph, LD*. The component is cryopreserved within 24 hours of collection using a cryoprotectant. Two methods are, in general, used for preparation of *Platelets, Cryo*: DMSO (6% w/v) and a very low glycerol (5% w/v) technique.

Before use, the platelets are thawed, washed and resuspended in (autologous) plasma or in a suitable additive solution.

**Requirements and quality control**

As indicated for *Platelets, Aph* (see Table 5C-7), with the following additions and changes:

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>50-200 mL</td>
<td>All units</td>
</tr>
<tr>
<td>Platelet content</td>
<td>&gt; 40 per cent of the pre-freeze platelet content</td>
<td>All units</td>
</tr>
</tbody>
</table>

*Platelets, Cryo* when thawed will not swirl.
Storage and transport

Platelets in the frozen state must be constantly maintained at:

- – 80 °C, if stored in an electric freezer.
- – 150 °C, if stored in vapour phase liquid nitrogen.

If storage will be extended for more than one year, storage at – 150 °C is preferred.

If transport in the frozen state is unavoidable, storage conditions must be maintained during transportation.

Thawed platelets must be used as soon as possible after thawing. If short-to-intermediate storage is required, the component must be kept between + 20 °C to + 24 °C.

Transportation of thawed platelets is limited by the short shelf-life of this component. During transportation, the temperature of Platelets, Cryo must be kept as close as possible between + 20 to + 24 °C.

Labelling

The labelling must comply with the relevant national legislation and international agreements.

The following information must be shown on the label or contained in the component information leaflet, as appropriate and must be traceable for each frozen unit:

- the producer’s identification;
- the unique identity number;
- the date of donation;
- the date of expiry;
- the name and volume of the cryoprotective solution;
- additional component information if appropriate;
- the volume or weight of the blood component;
- the storage temperature.
Labelling of the reconstituted component

After thawing and reconstitution (washing), the date of expiry must be changed to the date (and time) of expiry, and the name and volume of the cryoprotective solution must be changed to the name and volume of the additive solution (if any).

The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If 2 or more units are collected from the donor in one session, each component must have a unique component identity number;
- the ABO and RhD groups;
- the date of preparation;
- the name and volume of the cryoprotective solution;
- the name of the blood component;
- additional component information: Leucocyte depleted, irradiated, etc. (if appropriate);
- the date of expiry (and time of expiry when required);
- the volume or weight of the blood component;
- the storage temperature;
- the HLA and/or HPA type (if determined);
- that the component must be administered through an approved blood administration set.

Warnings

Residual cryoprotectant (e.g. DMSO) can be toxic.

RhD-negative female recipients of child-bearing age or younger should preferably not be transfused with platelets from RhD-positive donors.

Adverse reactions include:
- transfusion-associated circulatory overload;
- haemolytic reaction due to anti-A, -B in case of incompatible transfusions when thawed platelets are re-suspended in plasma;
- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- allo-immunisation against HLA (very rarely) and red cell antigens;
- allo-immunisation against HPA antigens;
- transfusion-related acute lung injury (TRALI);
- post-transfusion purpura;
- graft versus host disease (GVHD);
- sepsis due to inadvertent bacterial contamination;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- syphilis transmission;
- protozoal transmission (e.g. malaria) may occur in rare instances;
- transmission of other pathogens that are not tested for or recognised.
Component monographs

Part D. Plasma components
1. **Plasma, Fresh Frozen**

**Definition and properties**

*Plasma, Fresh Frozen (FFP)* is a component for transfusion or for fractionation, prepared either from *Whole Blood* or from plasma collected by apheresis, frozen within a period of time and to a temperature that adequately maintains the labile coagulation factors in a functional state.

FFP used as Human plasma for fractionation must comply with the specifications of the European Pharmacopoeia monograph Human plasma for fractionation (0853).

FFP used for clinical transfusion must comply with the specifications as given in this section (Chapter 5, Part D).

It must contain, on average, 70% or more of the value of the freshly collected plasma unit and at least similar quantities of the other labile coagulation factors and naturally occurring inhibitors.

It must not contain irregular antibodies of clinical significance. If leucocyte-depleted, the component must contain less than $1 \times 10^6$ leucocytes.

**Preparation**

*From Whole Blood*

Plasma is separated from *Whole Blood* that has been collected using a blood bag with integral transfer packs employing hard-spin centrifugation and collected preferably within 6 hours. Alternatively, plasma may be separated from platelet-rich plasma. Plasma may also be separated from *Whole Blood* that, immediately after donation, has been cooled rapidly by a special device validated to maintain the temperature between $+20^\circ C$ and $+24^\circ C$ and is held at that temperature for up to 24 hours.

Freezing must take place in a system that allows complete freezing within one hour to a temperature below $–30^\circ C$. If FFP is to be
prepared from a single-pack *Whole Blood* donation, adequate sterility precautions must be adopted.

**By apheresis**

FFP may be collected by apheresis. The freezing process must commence preferably within 6 hours of collection and not more than 18 hours after completion of the procedure if the unit is refrigerated. Freezing must take place in a system that allows complete freezing within one hour to a temperature below – 30 °C.

**Quarantine FFP**

Quarantine FFP can be released once the donor has been re-tested, at least for HBsAg, anti-HIV and anti-HCV, with negative results after a defined period of time that is designed to exclude the risk associated with the window period. A period of six months is generally applied. This may be reduced if NAT testing is performed.

**Requirements and quality control**

Table 5D-1 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping only for clinical FFP</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
</tbody>
</table>

*a* Unless performed on the source whole blood.

*b* Unless intended only for fractionation.
Table 5D-1 (b)

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>Stated volume ± 10 per cent</td>
<td>All units</td>
</tr>
<tr>
<td>Factor VIII</td>
<td>Average (after freezing and thawing): not less than 70 IU Factor VIII per 100 mL</td>
<td>Every 3 months 10 units in the first month of storage a</td>
</tr>
<tr>
<td>Residual cells b</td>
<td>Red cells: &lt; 6.0 × 10⁹/L Leucocytes: &lt; 0.1 × 10⁹/L Platelets: &lt; 50 × 10⁹/L</td>
<td>1 per cent of all units, with a minimum of 4 units per month</td>
</tr>
<tr>
<td></td>
<td>If leucocyte-depleted: &lt; 1 × 10⁶</td>
<td>1 per cent of all units, with a minimum of 10 units per month c</td>
</tr>
<tr>
<td>Leakage</td>
<td>No leakage in any part of container. Requires visual inspection after pressure in a plasma extractor before freezing</td>
<td>All units</td>
</tr>
<tr>
<td>Visual changes</td>
<td>No abnormal colour or visible clots</td>
<td>All units</td>
</tr>
</tbody>
</table>

a The exact number of units to be tested could be determined by statistical process control.  
b Cell counting should be performed before freezing.  
c This requirement is deemed to have been met if 90 per cent of the tested units fall within the values indicated.

Storage and transport

The following storage times and temperatures are permitted:

- 36 months at below – 25 °C  
- 3 months at – 18 °C to – 25 °C  

The storage temperature must be maintained during transport. Unless for immediate use, the packs must be transferred at once to storage at the recommended temperature.

In order to preserve labile factors, FFP must be used as soon as possible following thawing. It must not be re-frozen.
Labelling
The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If two or more units are collected from the donor in one session, each component must have a unique component identity number;
- the name of the blood component;
- the ABO and RhD groups (only for clinical FFP);
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- additional component information: leucocyte-depleted, irradiated, quarantined, etc. (if appropriate);
- the volume or weight of the blood component;
- the storage temperature;
- that the component must be administered through an approved blood administration set

After thawing, the date of expiry must be changed to the appropriate date (and time) of expiry. The storage temperature must also be changed accordingly.

Warnings
Transfusion of ABO blood group-incompatible plasma may result in haemolytic transfusion reaction.

FFP must not be used in a patient with an intolerance to plasma proteins.
Before use, the component must be thawed in a properly controlled environment and the integrity of the pack must be verified to exclude any defects or leakages. No insoluble cryoprecipitate must be visible on completion of the thaw procedure.

Adverse reactions include:

- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- transfusion-related acute lung injury (TRALI);
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- sepsis due to inadvertent bacterial contamination;
- transmission of other pathogens that are not tested for or recognised;
- citrate toxicity in neonates and in patients with impaired liver function;
- transfusion-associated circulatory overload;
- anaphylaxis and allergic reactions.

2. **Plasma, Fresh Frozen, Pathogen Reduced**

**Definition and properties**

*Plasma, Fresh Frozen, Pathogen Reduced (PR)* is a component for transfusion prepared from a single donation either of *Whole Blood* or of plasma collected by apheresis which is subjected to treatment with an approved and validated PRT and subsequent freezing within a period of time to a temperature that adequately maintains the labile coagulation factors in a functional state.

*Plasma, Fresh Frozen, PR* used for clinical transfusion must comply with the specifications given in this monograph.

It contains, on average, about 50 to 70 per cent of the labile coagulation factors and naturally occurring inhibitors present in fresh unfrozen/thawed plasma.
The PRT typically reduces the risk of infection by enveloped viruses (e.g. HBV, HCV, HIV) by at least one-thousand-fold.

*Plasma, Fresh Frozen, PR* must not contain irregular antibodies of clinical significance.

If leucocyte-depleted, the component must contain less than $1 \times 10^6$ leucocytes.

**Preparation**

*Plasma, Fresh Frozen, PR* is prepared from plasma obtained from *Whole Blood* or collected by apheresis as described for *Plasma, Fresh Frozen*. The PRT can be applied either before or after freezing and thawing of the plasma.

The PRT is undertaken according to manufacturers’ instructions.\(^1\)

**Requirements and quality control**

Table 5D-2 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9 Standards for screening for infectious markers).

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD (^a)</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td></td>
<td>Only for clinical FFP</td>
<td></td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening</td>
<td>All units</td>
</tr>
</tbody>
</table>

\(^a\) Unless performed on whole blood used as the source.

\(^1\) For pools of less than 12 single units, solvent detergent may be used as the PRT, but this is not covered in this monograph.
<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
</tbody>
</table>

* Unless performed on whole blood used as the source.

### Table 5D-2 (b)

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volume</strong></td>
<td>Stated volume ± 10 per cent</td>
<td>All units</td>
</tr>
<tr>
<td><strong>Factor VIII</strong></td>
<td>Average: not less than 50 IU Factor VIII per 100 mL</td>
<td>Every 3 months 10 units in the first month of storage a</td>
</tr>
<tr>
<td><strong>Fibrinogen</strong></td>
<td>Average (after freezing and thawing): ≥ 60 per cent of the potency of the freshly-collected plasma unit</td>
<td>Every 3 months 10 units in the first month of storage a</td>
</tr>
<tr>
<td><strong>Residual cells b</strong></td>
<td>Red cells: &lt; 6.0 × 10⁹/L Leucocytes: &lt; 0. × 10⁶/L Platelets: &lt; 50 × 10⁹/L</td>
<td>1 per cent of all units, with a minimum of 4 units per month</td>
</tr>
<tr>
<td></td>
<td>If leucocyte-depleted: &lt; 1 × 10⁶/L</td>
<td>1 per cent of all units, with a minimum of 10 units per month c</td>
</tr>
<tr>
<td><strong>Leakage</strong></td>
<td>No leakage in any part of container. Requires visual inspection after pressure in a plasma extractor, before freezing and after thawing</td>
<td>All units</td>
</tr>
<tr>
<td><strong>Visual changes</strong></td>
<td>No abnormal colour or visible clots</td>
<td>All units</td>
</tr>
</tbody>
</table>

* The exact number of units to be tested could be determined by statistical process control.
* Cell counting should be performed before freezing.
* This requirement is deemed to have been met if 90 per cent of the tested units fall within the values indicated.
Storage and transport

The following storage times and temperatures are permitted:

- 36 months at or below – 25 °C
- 3 months at – 18 °C to – 25 °C

The storage temperature must be maintained during transport. Unless for immediate use, the packs must be transferred at once to storage at the recommended temperature.

In order to preserve labile factors, Plasma, Fresh Frozen, PR must be used as soon as possible following thawing. It must not be re-frozen.

Labelling

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If two or more units are collected from the donor in one session, each component must have a unique component identity number;
- the name of the blood component;
- the name of the PRT used;
- the ABO and RhD groups;
- the date of donation;
- the date of expiry;
- the name of the anti-coagulant solution;
- additional component information: leucocyte-depleted, irradiated, etc. (if appropriate);
- the volume or weight of the blood component;
- the storage temperature;
that the component must be administered through an approved blood administration set.

After thawing, the date of expiry must be changed to the appropriate date (and time) of expiry. The storage temperature must also be changed accordingly.

**Warnings**

Transfusion of ABO blood group-incompatible plasma may result in haemolytic transfusion reaction.

*Plasma Fresh Frozen, PR* must not be used in cases of:

- patients with intolerance to plasma proteins;
- neonates undergoing phototherapy when the plasma is prepared by amotosalen treatment;
- patients with G6PD deficiency when the plasma is prepared by the methylene blue procedure;
- patients with a known allergy to the compounds used for, or generated by, the PRT.

Before use, the component must be thawed in a properly controlled environment and the integrity of the pack must be verified to exclude any defects or leakages. No insoluble cryoprecipitate must be visible on completion of the thaw procedure.

Adverse reactions include:

- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- transfusion-related acute lung injury (TRALI);
- viral transmission (hepatitis B and C, HIV) is highly unlikely, but transmission of other pathogens that are not tested for or are not sensitive to PRT is possible;
- citrate toxicity in neonates and in patients with impaired liver function;
- transfusion-associated circulatory overload;
• anaphylaxis and allergic reactions, including allergy to the compounds used for, or generated by, the PRT.

3. Cryoprecipitate

Definition and properties

Cryoprecipitate is a component containing the cryoglobulin fraction of plasma obtained by further processing of Plasma, Fresh Frozen and then concentrated.

It contains a major portion of the Factor VIII, von Willebrand factor, fibrinogen, Factor XIII and fibronectin present in freshly drawn and separated plasma.

Preparation

Plasma, Fresh Frozen is thawed, either overnight between +2 to +6 °C or by the rapid thaw-siphon thaw technique. After thawing, the component is re-centrifuged using a hard spin at the same temperature. The supernatant cryoprecipitate-poor plasma is then partially removed. The sedimented cryoprecipitate is then rapidly frozen.

When Cryoprecipitate is prepared from Whole Blood-derived plasma, the maximal final volume of the component is 40 mL.

Alternatively, Plasma, Fresh Frozen obtained by apheresis may be used as the starting material and the final component can be prepared using the same freezing/thawing/re-freezing technique.

Leucocyte depletion of the starting material and/or virus inactivation, and/or quarantine is a requirement in some countries.

Requirements and quality control

Table 5D-3 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).
### Table 5D-3a

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD&lt;sup&gt;a,b&lt;/sup&gt;</td>
<td>Grouping Only for clinical FFP</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
</tbody>
</table>

<sup>a</sup> Unless performed on whole blood used as the source.

<sup>b</sup> Unless intended only for fractionation.
Table 5D-3b

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume $^a$</td>
<td>30-40 mL</td>
<td>All units</td>
</tr>
</tbody>
</table>
| Factor VIII             | $\geq 70$ IU per unit | Every 2 months:  
a. pool of 6 units of mixed blood  
    groups during their first month  
    of storage  
b. pool of 6 units of mixed blood  
    groups during their last month  
    of storage |
| Fibrinogen              | $\geq 140$ mg per unit | 1 per cent of all units with a minimum of 4 units per month |
| Von Willebrand Factor   | $> 100$ IU per unit | Every 2 months:  
a. pool of 6 units of mixed blood  
    groups during their first month  
    of storage  
b. pool of 6 units of mixed blood  
    groups during their last month  
    of storage |

$^a$ This table is designed for quality control of cryoprecipitate obtained from FFP derived from one unit of whole blood. In the event that apheresis FFP is used as a starting material, the volume may be different.

Storage and transport

The stability of Cryoprecipitate on storage is dependent on the storage temperature. The optimal storage temperature is below – 25 °C.

Recommended storage times are:

- 36 months at or below – 25 °C;
- 3 months at – 18 °C to – 25 °C.

The storage temperature must be maintained during transport. The receiving hospital blood bank must ensure that the Cryoprecipitate has remained frozen during transit. Unless for immediate use,
the *Cryoprecipitate* must be transferred at once to storage at the
temperature stated above.

Before use, *Cryoprecipitate* must be thawed in a properly controlled
environment at + 37 °C immediately after removal from storage.
Dissolution of the precipitate must be encouraged by careful
manipulation during the thawing procedure.

In order to preserve labile factors, *Cryoprecipitate* must be used as
soon as possible following thawing. It must not be re-frozen.

**Labelling**

The labelling must comply with the relevant national legislation and
international agreements. The following information must be shown
on the label or contained in the component information leaflet, as
appropriate:

- the producer’s identification;
- the unique identity number. If two or more units are collected
  from the donor in one session, each component must have a
  unique component identity number;
- the name of the blood component;
- the ABO group;
- the date of preparation;
- the date of expiry;
- additional component information: leucocyte-depleted,
  irradiated, quarantined, etc. (if appropriate);
- the volume or weight of the blood component;
- the storage temperature;
- that the component must be administered through an approved
  blood administration set.

After thawing, the date of expiry must be changed to the appropriate
date (and time) of expiry. The storage temperature must also be
changed accordingly.
Warnings
Before use the component must be thawed in a properly controlled environment and the integrity of the pack must be verified to exclude any defects or leakages.

*Cryoprecipitate* is not recommended for patients with an intolerance to plasma proteins.

Adverse reactions include:

- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- transfusion-related acute lung injury (TRALI);
- possibility of development of inhibitors to Factor VIII in patients with haemophilia;
- in rare instances, haemolysis of recipient red blood cells due to high titre allo-agglutinins in the donor have been recorded;
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- sepsis due to inadvertent bacterial contamination;
- transmission of other pathogens that are not tested for or recognised;
- citrate toxicity in neonates and in patients with impaired liver function.

4. **Plasma, Fresh Frozen, Cryoprecipitate-Depleted**

*Definition and properties*

*Plasma, Fresh Frozen, Cryoprecipitate-Depleted* is a component prepared from *Plasma, Fresh Frozen* by the removal of the cryoprecipitate.

Its content of albumin, immuno-globulins and coagulation factors is the same as that of *Plasma, Fresh Frozen*, except that the levels of
the labile Factors V and VIII are markedly reduced. The fibrinogen concentration is also reduced in comparison to Plasma, Fresh Frozen.

**Preparation**

*Plasma, Fresh Frozen, Cryoprecipitate-Depleted* is the by-product of the preparation of *Cryoprecipitate* from *Plasma, Fresh Frozen*.

Leucocyte depletion of the starting material and/or virus inactivation, and/or quarantine, is a requirement in some countries.

**Requirements and quality control**

As indicated for *Plasma, Fresh Frozen* (see Table 5D-1 above), with the additional requirement given in Table 5D-4 below. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards of screening for infectious markers).

<table>
<thead>
<tr>
<th>Table 5D-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter to be checked</td>
</tr>
<tr>
<td>Volume</td>
</tr>
</tbody>
</table>

**Storage and transport**

The stability of *Plasma, Fresh Frozen, Cryoprecipitate-Depleted* on storage is dependent on the storage temperature. The optimal storage temperature is below – 25 °C. Approved storage times are:

- 36 months at or below – 25 °C;
- 3 months at – 18 °C to – 25 °C.

The storage temperature must be maintained during transport. The receiving hospital blood bank must ensure that *Plasma, Fresh Frozen, Cryoprecipitate-Depleted* has remained frozen during transit. Unless for immediate use, the units must be transferred at once to storage at the temperature stated above.
In order to preserve labile factors, *Plasma Fresh Frozen, Cryoprecipitate-Depleted* must be used as soon as possible following thawing. It must not be re-frozen.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number. If two or more units are collected from the donor in one session, each component must have a unique component identity number;
- the ABO group;
- the date of preparation;
- the name of the anti-coagulant solution;
- the name of the blood component;
- additional component information: leucocyte-depleted, irradiated, quarantined, pathogen-reduced, etc. (if appropriate);
- the date of expiry;
- the volume or weight of the blood component;
- the storage temperature;
- that the component must be administered through an approved blood administration set.

After thawing, the date of expiry must be changed to the appropriate date (and time) of expiry. The storage temperature must also be changed accordingly.

**Warnings**

Transfusion of ABO blood group-incompatible plasma may result in haemolytic transfusion reaction.
Plasma Fresh Frozen, Cryoprecipitate-Depleted is not recommended for patients with an intolerance to plasma proteins.

Adverse reactions include:

- non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
- transfusion-related acute lung injury (TRALI);
- viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
- sepsis due to inadvertent bacterial contamination;
- transmission of other pathogens that are not tested for or recognised;
- citrate toxicity in neonates and in patients with impaired liver function;
- transfusion-associated circulatory overload.
Component monographs

Part E. White cell components
1. Granulocytes, Apheresis

Definition and properties

Granulocytes, Apheresis is a component that contains granulocytes suspended in plasma and is obtained by apheresis of a single donor using automated cell separation equipment.

An adult therapeutic dose of Granulocytes, Apheresis contains between $1.5 \times 10^8$ and $3.0 \times 10^8$ granulocytes/kg body weight of the designated recipient.

Granulocytes, Apheresis has a significant content of red blood cells, lymphocytes and platelets.

Granulocytes, Apheresis must be irradiated.

IMPORTANT NOTICE

The clinical efficacy, indication and dosage of granulocyte transfusions have not been established. Potential donors of granulocytes need to receive medication before collection, and sedimenting agents are required during the apheresis procedure, both of which have potentially severe side-effects that are described below. Thus, it is essential to secure the informed consent of the donor. In addition to the recognised complications of routine donor apheresis (see Chapters 2 and 3), the following side-effects may occur.

- Hydroxyethyl starch (HES): acts as a volume expander. Donors who have received HES may experience headaches or peripheral oedema because of an expanded circulatory volume. HES may accumulate (which can result in pruritus) and allergic reactions are possible.

- Corticosteroids: may cause, for example, hypertension, diabetes, cataracts and peptic ulcer.

- G-CSF: The most common short-term complication after G-CSF administration in peripheral blood stem cell (PBSC) donors is bone pain though, on very rare occasions, splenic rupture or lung injury may occur. Concerns over acute myeloid leukaemia
(AML)/myelodysplasia (MDS) development following G-CSF administration are based primarily on reports of increased rates of AML/MDS among women with breast cancer who received chemotherapy or patients with severe chronic neutropenia (SCN) who received G-CSF support. To date, registry data from Europe and the United States have not identified any increased risk of AML/MDS (including those based on the data of over 100,000 healthy individuals who donated PBSC and received G-CSF as pre-treatment). However, the median follow-up of these studies is less than 5 years.

**Preparation**

Donors of *Granulocytes, Apheresis* require pre-treatment with corticosteroids and/or growth factors. *Granulocytes, Apheresis* are collected from a single donor by apheresis. Optimal collection yields require the use of a sedimenting agent, such as HES, low molecular weight dextran or modified fluid gelatine.

**Requirements and quality control**

Table 5E-1 lists the requirements. Additional testing may be required to comply with national requirements (see also Chapter 9, Standards for screening for infectious markers).

**Table 5E-1**

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABO, RhD</td>
<td>Grouping</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HIV 1 &amp; 2</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td>Anti-HCV</td>
<td>Negative by approved screening test</td>
<td>All units</td>
</tr>
<tr>
<td><strong>Parameter to be checked</strong></td>
<td><strong>Requirements</strong></td>
<td><strong>Frequency of control</strong></td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>HLA (when required)</td>
<td>Typing</td>
<td>As required</td>
</tr>
<tr>
<td>Volume</td>
<td>&lt; 500 mL</td>
<td>All units</td>
</tr>
<tr>
<td>Granulocyte content</td>
<td>Achieve clinical dose: e.g. adult patient of 60 kg = 0.9-1.8 × 10¹⁰ granulocytes per unit</td>
<td>All units</td>
</tr>
</tbody>
</table>

**Storage and transport**

*Granulocytes, Apheresis* are not suitable for storage and must be transfused as soon as possible after collection. If unavoidable, storage must be limited to the shortest possible period.

The unit must be transported to the user in a suitable container between +20 and +24 °C, but without agitation.

**Labelling**

The labelling must comply with the relevant national legislation and international agreements. The following information must be shown on the label or contained in the component information leaflet, as appropriate:

- the producer’s identification;
- the unique identity number;
- the ABO and RhD groups;
- the date of donation;
- the name of the anti-coagulant solution, additive solutions and/or other agents;
- the name of the blood component;
- additional component information: irradiated, etc. (as appropriate);
- the date of expiry (and time of expiry, when required);
• the number of granulocytes;
• the storage temperature;
• HLA type, if determined;
• that the component must be administered through an approved blood administration set.

Warnings
Because of the possibility of severe adverse effects associated with the collection (donor side-effects) and transfusion of granulocytes (recipient side-effects), the goals of granulocyte transfusion must be defined clearly before a course of therapy is initiated.

As there is a significant content of red blood cells, compatibility of donor red cells with the designated recipient must be verified by suitable pre-transfusion testing. RhD-negative female recipients of child-bearing potential must not be transfused with Granulocyte Concentrates from RhD-positive donors; if RhD-positive concentrates have to be used, the prevention of RhD immunisation by use of RhD-immunoglobulin must be considered.

Attention to HLA compatibility is also required for allo-immunised recipients.

Granulocytes, Apheresis must be irradiated.

CMV-seronegative components for CMV-seronegative recipients must be considered.

Administration through a micro-aggregate or leucocyte-reduction filter is contraindicated.

The risk of adverse reactions is increased with concomitant administration of Amphotericin B.

Adverse reactions include:
• non-haemolytic transfusion reaction (mainly chills, fever and urticaria);
• allo-immunisation against red cell antigens, HLA, HPA and HNA;
• transfusion-related acute lung injury (TRALI);
• post-transfusion purpura;
• sepsis due to inadvertent bacterial contamination;
• viral transmission (hepatitis, HIV, etc.) is possible, despite careful donor selection and screening procedures;
• syphilis transmission;
• protozoal transmission (e.g. malaria, toxoplasmosis) may occur in rare instances;
• transmission of other pathogens that are not tested for or recognised;
• citrate intoxication in neonates and in patients with impaired liver function;
• accumulation of HES in multi-exposed patients.
Chapter 6

Standards for blood components for intra-uterine, neonatal and infant use

Specially designed blood components are required for intra-uterine, neonatal and infant transfusion.

These recipients are particularly prone to the complications of cytomegalovirus infection and appropriate steps are required to minimise this risk.

Methods of preparation, storage and administration of these components should be validated to ensure that the delivered potassium load is within acceptable limits.

If components are split for use in neonates and infants, each satellite pack must have a unique unit identity number that allows traceability to the source donation.

Part A. Components for intra-uterine transfusions
1. Red Cells, Leucocyte-Depleted for Intrauterine Transfusion, 346
2. Platelets, Leucocyte-Depleted for Intra-uterine Transfusion, 348

Part B. Components for neonatal exchange transfusion
1. Whole Blood, Leucocyte-Depleted for Exchange Transfusion, 352
2. Whole Blood, Leucocyte-Depleted, Plasma Reduced for Exchange Transfusion, 353

3. Red Cells, Leucocyte-Depleted, suspended in Fresh Frozen Plasma, for Exchange Transfusion, 355

Part C. Components (small volume) for neonatal and infant transfusion

1. Red Cells for Neonatal and Infant Small Volume Transfusion, 360
Standards for blood components for intra-uterine, neonatal and infant use
Part A. Components for intra-uterine transfusions
1. **Red Cells, Leucocyte-Depleted for Intrauterine Transfusion**

**Definition and properties**

*Red Cells, Leucocyte-Depleted for Intra-uterine Transfusion (IUT)* is a red cell component for intra-uterine transfusion.

*Red Cells, IUT* has a haematocrit (Ht) of 0.70 to 0.85.

*Red Cells, IUT* contains less than $1 \times 10^6$ leucocytes per unit.

**Preparation**

*Red Cells IUT* is prepared by the secondary processing of *Whole Blood LD*, *Red Cells LD* or *Red Cells LD-AS*. In order to achieve the required haematocrit, the storage medium is partly removed and/or exchanged for another appropriate solution.

*Red Cells, IUT* must be compatible with both mother and foetus. In the event that the foetal blood group is not known, a type O RhD-negative donation must be selected unless the mother has blood group antibodies that necessitate the use of another blood group. The red cells must be antigen-negative for any relevant maternal antibody.

The component must not contain irregular antibodies of clinical significance.

*Red Cells, IUT* must be used within five days of donation.

*Red Cells, IUT* must be irradiated and used within 24 hours of irradiation.

**Requirements and quality control**

As indicated for the source component with the following additional changes given in Table 6A-1.
Table 6A-1

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haematocrit</td>
<td>0.70-0.85</td>
<td>All units</td>
</tr>
</tbody>
</table>

**Storage and transport**

The storage and transport conditions are as for the source components. The storage time must not be longer than 24 hours after concentration and irradiation. The component must be used within five days of donation.

**Labelling**

The additional and/or amended labelling requirements to those of the source component are:

- the relevant blood group phenotype if the maternal antibody is other than anti-RhD;
- the modified date and time of preparation;
- the modified date and time of expiry;
- the name of the anti-coagulant or additive solution;
- additional component information: irradiated, etc. (as appropriate);
- the volume or weight of the blood component;
- the haematocrit of the blood component.

**Warnings**

Compatibility of this component with maternal serum/plasma must be verified by suitable pre-transfusion testing.

The rate of transfusion should be controlled to avoid excessive fluctuations in blood volume.
As the foetus is at increased risk of graft versus host disease, the component must be irradiated.

Adverse reactions:

Note: Although the component is given to the foetus, adverse reactions may also affect the mother.

The general adverse reactions are outlined in the relevant source component monograph.

In addition, the foetus is especially vulnerable to:

- CMV infection;
- citrate toxicity;
- metabolic imbalance (e.g. hyperkalaemia);
- transfusion-associated circulatory overload.

2. **Platelets, Leucocyte-Depleted for Intra-uterine Transfusion**

**Definition and properties**

*Platelets, Leucocyte-Depleted for Intra-uterine Transfusion (IUT)* is a platelet component for intra-uterine transfusion obtained from a single donor either by apheresis or from whole blood.

*Platelets, IUT* must be leucocyte-depleted, irradiated and may be hyper-concentrated.

*Platelets, IUT* contains from 45-85 × 10⁹ platelets (on average, 70 × 10⁹) in 50-60 mL of suspension medium.

**Preparation**

*Platelets, IUT* is prepared either from *Platelets, Apheresis, LD* or by leucocyte-depletion of *Platelets, Recovered* and, where appropriate, the donation is from an HPA-compatible donor.

The component can be concentrated if necessary by removing part of the supernatant solution by centrifugation. This must be followed by a 1-hour rest period.
If platelets obtained from the mother are to be transfused, then these must be depleted of plasma and re-suspended in an additive solution. *Platelets, IUT* must be irradiated.

**Requirements and quality control**

As indicated for the source component, with the following additional standards given in Table 6A-2.

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirements</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPA (^a)</td>
<td>Typing</td>
<td>When required</td>
</tr>
<tr>
<td>Volume</td>
<td>50-60 mL</td>
<td>All units</td>
</tr>
<tr>
<td>Platelet content</td>
<td>45-85 × 10^9 per unit</td>
<td>All units</td>
</tr>
</tbody>
</table>

\(^a\) HPA typing of the selected donor, not of the individual component.

**Storage and transport**

Storage and transport requirements are as defined for the source component, but *Platelets, IUT* must be used within 6 hours after any secondary concentration process.

**Labelling**

The additional and/or amended labelling requirements to those of the source component *Platelets, IUT* are:

- if components are split for use in neonates and infants, each split must have a unique unit identity number that allows traceability to the source donation;
- additional component information: irradiated, plasma- or supernatant-reduced, etc. (if appropriate);
- the volume or weight of the blood component;
- the platelet count;
• the date and time of expiry.

**Warnings**

As the foetus is at increased risk of graft versus host disease, the component must be irradiated.

The rate of transfusion must be controlled to avoid excessive fluctuations in blood volume and possible bleeding after puncture must be monitored.

Adverse reactions:

Note: Although the component is given to the foetus, adverse reactions may also affect the mother.

The general adverse reactions are outlined in the relevant source component monograph.

In addition, the foetus is especially vulnerable to:

• CMV infection;
• citrate toxicity;
• transfusion-associated circulatory overload.
Standards for blood components for intra-uterine, neonatal and infant use
Part B. Components for neonatal exchange transfusion
1. Whole Blood, Leucocyte-Depleted for Exchange Transfusion

Definition and properties

Whole Blood, Leucocyte-Depleted for Exchange Transfusion (ET) corresponds to Whole Blood, LD with the properties as defined in the relevant monograph, selected for neonatal exchange transfusion to be transfused within five days of donation.

Preparation

If the maternal antibody is anti-RhD, the component is prepared from type O RhD-negative red cells. If the maternal antibody is other than anti-RhD, red cells are selected that are antigen-negative for any relevant maternal antibodies.

Whole Blood, ET must be irradiated:

- if there is a prior history of intra-uterine transfusion;
- for all other patients, unless compelling clinical circumstances indicate that delay would compromise the clinical outcome.

Whole Blood, ET must be used within 24 hours of irradiation.

Requirements and quality control

As indicated for Whole Blood, LD.

Storage and transport

The storage and transport of Whole Blood, ET is as described in the monograph for Whole Blood, LD.

The storage time must not be longer than 24 hours after irradiation and five days from donation.

Labelling

Additional and/or amended labelling requirements to those of Whole Blood, LD are:

- blood group phenotype, if the antibody is other than anti-RhD;
the modified date and time of expiry;
additional component information: irradiated, etc. (as appropriate).

**Warnings**

Blood group compatibility with any maternal antibodies is essential. The rate of transfusion must be controlled to avoid excessive fluctuations in blood volume.

Adverse reactions:

In addition to the adverse reactions identified for Whole Blood, LD, particular concerns in the context of newborns undergoing exchange transfusion are:

- metabolic imbalance including: citrate toxicity, hypocalcaemia, hyperkalaemia, hypoglycaemia, hypokalaemia;
- thrombocytopenia;
- cytomegalovirus infection;
- graft versus host disease, unless irradiated;
- transfusion-associated circulatory overload;
- haemolytic transfusion reaction.

2. **Whole Blood, Leucocyte-Depleted, Plasma Reduced for Exchange Transfusion**

**Definition and properties**

*Whole Blood, Leucocyte-Depleted, Plasma Reduced for Exchange Transfusion (PR, ET)* is *Whole Blood, ET* with a proportion of the plasma removed.

**Preparation**

*Whole Blood, LD* is selected within five days from donation and a proportion of the plasma is removed to achieve a clinically prescribed haematocrit.
If the maternal antibody is anti-RhD, the component is prepared from a type O RhD-negative donation. If the maternal antibody is other than anti-RhD, red cells are selected that are antigen negative for any relevant maternal antibodies.

*Whole Blood, PR, ET* must be irradiated:

- if there is a prior history of intra-uterine transfusion;
- for all other patients, unless compelling clinical circumstances indicate that delay would compromise the clinical outcome.

*Whole Blood, PR, ET* must be used within 24 hours of irradiation.

**Requirements and quality control**

As indicated for *Whole Blood, LD*, with the following additional standards.

<table>
<thead>
<tr>
<th>Table 6B-2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter to be checked</strong></td>
</tr>
<tr>
<td>Haematocrit</td>
</tr>
</tbody>
</table>

**Storage and transport**

The storage and transport of *Whole Blood, PR, ET* is as in the monograph described for *Whole Blood, LD*.

The storage time must not be longer than 24 hours after irradiation and 5 days from donation.

**Labelling**

Additional and/or amended labelling requirements to those of *Whole Blood, LD* are:

- blood group phenotype, if the antibody is other than anti-RhD;
- the modified date and time of expiry;
• additional component information: irradiated, haematocrit, etc. (as appropriate).

Warnings
Blood group compatibility with any maternal antibodies is essential. The rate of transfusion must be controlled to avoid excessive fluctuations in blood volume.

Adverse reactions:
In addition to the adverse reactions identified for Whole Blood, LD, particular concerns in the context of newborns undergoing exchange transfusion are:

• metabolic imbalance including: citrate toxicity, hypocalcaemia, hyperkalaemia, hypoglycaemia, hypokalaemia;
• thrombocytopenia;
• cytomegalovirus infection;
• graft versus host disease, unless irradiated;
• transfusion-associated circulatory overload;
• haemolytic transfusion reaction.

3. Red Cells, Leucocyte-Depleted, suspended in Fresh Frozen Plasma, for Exchange Transfusion

Definition and properties
Red Cells, Leucocyte-Depleted, suspended in Fresh Frozen Plasma, for Exchange Transfusion (Red Cells, in FFP, ET) is a reconstituted component derived from Red Cells, LD or Red Cells, LD-AS to which Plasma, Fresh Frozen is added.

Preparation
Red Cells, LD or Red Cells, LD-AS are selected within 5 days from collection for secondary processing. The supernatant containing the additive solution and/or plasma is removed after centrifugation,
and then thawed fresh frozen plasma is added to reach the clinically required haematocrit.

If the maternal antibody is anti-RhD, the component is prepared from type O RhD-negative red cells. If the maternal antibody is other than anti-RhD, red cells are selected that are antigen-negative for any relevant maternal antibodies. The red cells and FFP must be ABO-compatible with both mother and infant.

Red Cells, in FFP, ET must be irradiated:

- if there is a prior history of prior intra-uterine transfusion;
- for all other patients, unless compelling clinical circumstances indicate that delay would compromise the clinical outcome.

Red Cells, in FFP, ET must be used within 24 hours of irradiation.

Requirements and quality control

As indicated for the source components (Red Cells, LD; Red Cells, LD-AS and FFP), with the following additional standards given below (Table 6B-3).

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirement</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haematocrit</td>
<td>As clinically prescribed or locally defined</td>
<td>All units</td>
</tr>
</tbody>
</table>

Storage and transport

The storage and transport of Red Cells, in FFP, ET is as in the monograph described for Red Cells, LD or Red Cells, LD-AS.

In addition, storage time must not be longer than 24 hours after reconstitution and irradiation and 5 days from the red cell donation.
Labelling
The additional and/or amended labelling requirements to those of the reconstituting components are:

- a new unique identity number by which the source donation identity numbers must be traceable;
- the name of the blood component;
- the ABO and RhD group of the red cells;
- blood group phenotype, if the antibody is other than anti-RhD;
- the date and time of preparation;
- the new date and time of expiry;
- additional component information: irradiated, haematocrit, etc. (as appropriate).

Warnings
Compatibility of Red Cells, in FFP, ET with the intended recipient must be verified by suitable pre-transfusion testing. Blood group compatibility with any maternal antibodies is essential.

The rate of transfusion must be controlled to avoid excessive fluctuations in blood volume.

Adverse reactions:
The side-effects correspond to those of the two constituting components.

Particular concerns in the context of newborns undergoing exchange transfusion are:

- metabolic imbalance including: citrate toxicity, hypocalcaemia, hyperkalaemia, hypoglycaemia, hypokalaemia;
- thrombocytopenia;
- cytomegalovirus infection;
- graft versus host disease, unless irradiated;
- transfusion-associated circulatory overload;
- haemolytic transfusion reaction.
Standards of blood components for intra-uterine, neonatal and infant use
Part C. Components (small volume) for neonatal and infant transfusion
1. Red Cells for Neonatal and Infant Small Volume Transfusion

Definition and properties

Red Cells for Neonatal and Infant Small Volume Transfusion is a red cell component derived from Red Cells, BCR; Red Cells, BCR-AS; Red Cells, LD; or Red Cells, LD-AS, which is divided into satellite units. The properties are those of the source component.

Preparation

Red Cells for Neonatal and Infant Small Volume Transfusion are prepared by the secondary processing of Red Cells, BCR; Red Cells, BCR-AS; Red Cells, LD; or Red Cells, LD-AS. The selected component is divided into 3 to 8 satellite packs by using a closed or functionally closed system.

The component may be irradiated where clinically indicated.

Quality control

Quality control of the primary source component is described in the relevant component monograph standards. Additional quality control of the final component is given in the Table 6C-1.

Table 6C-1

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirement</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume</td>
<td>25-100 mL per unit</td>
<td>All units</td>
</tr>
</tbody>
</table>

Storage and transport

Storage and transport requirements are as described for the primary source red cell component.

The storage time must not exceed that of the original component. If the component is irradiated, it must be used within 48 hours.
Labelling
The additional and/or amended labelling requirements to those of the primary red cell component are:

- if components are split for use in neonates and infants, each satellite pack must have a unique unit identity number which allows traceability to the source donation;
- the name of the blood component;
- additional component information: irradiated, etc. (if appropriate);
- the volume or weight of the component;
- the date and time of expiry.

Warnings
Transfusion rates must be carefully controlled.

*Red Cells for Neonatal and Infant Small Volume Transfusion* must not be used for rapid transfusion or large volume transfusion, unless used within 5 days from the source red cell donation.

Adverse reactions:

Adverse reactions are those of the primary component selected for secondary processing. In addition, of particular concern for infants and neonates are:

- metabolic imbalance (e.g. hyperkalaemia in massive transfusion or if rapidly transfused);
- citrate toxicity;
- transfusion-associated circulatory overload;
- cytomegalovirus infection;
- graft versus host disease, unless the component is irradiated.
Chapter 7

Standards for autologous pre-deposit transfusion

1. Overview

Pre-deposit autologous donation (PAT) means blood and blood components collected from an individual and intended solely for subsequent autologous transfusion or other human application in that same individual, i.e. a transfusion in which the donor and the recipient are the same person.

The Standards for allogeneic whole blood and component donations also apply to PAT and derived components, with the following exemptions for donor selection:

- age and body weight;
- haemoglobin level;
- protein level;
- donor platelet level.

Autologous donation must be performed in or under the control of a blood establishment.
Chapter 7  Standards for autologous pre-deposit transfusion

2. Selection of Patients for PAT and Blood Collection

Role of the physician in charge of collection

The physician in charge of blood collection has ultimate responsibility for ensuring that the patient’s clinical condition allows pre-operative blood donation.

Where autologous donation is contraindicated, the physician in charge of blood collection must inform the patient and the physician in charge of the patient.

Information for donors

Written informed consent must be obtained from the patient by the physician in charge of the blood collection, who must provide the patient with the following information:

- the reasons for requiring a medical history;
- the nature of the procedure and its risks and benefits;
- the possibility of deferral and the reasons why this might occur;
- the tests that are performed and why, and that a positive test for mandatory microbiological markers results in the destruction of the collected unit;
- the significance of ‘informed consent’;
- the possibility that the pre-deposit donations may not suffice and that allogeneic transfusion may be additionally required;
- that unused blood is discarded and is not transfused to other patients and why this is the case.

In the case of a paediatric patient, the information must be provided both to the child and the parents, and the parents must give written informed consent.

Contraindications or deferral criteria

Active bacterial infection is an absolute contraindication.
Serious cardiac disease, depending on the clinical setting of blood collection, is a relative contraindication (see Principles).

Patients positive for infectious disease markers (as for allogeneic donations) must not be included in a PAT donation programme unless no compatible allogeneic blood is available.

3. Preparation, Storage and Distribution of Pre-deposit Autologous Blood Components

Blood typing and microbiological screening
Blood typing and microbiological screening must be carried out according to the minimum requirements for the equivalent allogeneic components.

Patients positive for infectious disease markers must not be included in pre-deposit autologous programmes, unless no compatible allogeneic blood is available.

Preparation
Autologous blood must be processed as for the equivalent allogeneic components.

Labelling
In addition to the labelling information described for allogeneic components, labels on pre-deposit autologous donations must have:

- the statement: ‘AUTOLOGOUS DONATION’;
- the statement: ‘STRICTLY RESERVED FOR’;
- family name and first name;
- date of birth;
- identity number of the patient.
Chapter 7

Standards for autologous pre-deposit transfusion

Storage and handling
Pre-deposit autologous blood components must be stored, transported and distributed under the same conditions as, but clearly separated from, the equivalent allogeneic components.

Warnings
Release procedures must include a confirmation of identity:

- on the component labels;
- on the prescription document;
- and at the bedside.

Pre-transfusion infectious disease marker tests must be carried out as described for allogeneic components.

Untransfused autologous blood components must not be used for allogeneic transfusion or for plasma for fractionation.
Chapter 8

Standards for immunohaematology

1. Overview
Standards in this chapter apply to the immunohaematology testing of donors, donations and patients, whether by serological or molecular methods.

2. Selection and Validation of Reagents and Methods

All laboratory testing procedures must be validated before use (Directive 2005/62/EC Annex 6.3.1). There must be data confirming the suitability of any laboratory reagents used in the testing of donor samples and blood component samples (Directive 2005/62/EC Annex 6.3.4).

Only test reagents that have been licensed or evaluated and considered suitable by a responsible National Health Authority must be used. In the EU, such reagents are considered as in vitro diagnostic devices and must be CE marked. In-house manufactured reagents may be used for rare occasions (e.g. blood group genotyping of high- or low-frequency antigens where commercial CE-marked reagents are not available).

EU Directive 98/79/EC classifies ABO, Rh (C, c, D, E, e) anti-Kell reagents in list A of Annex II. The manufacturer of such reagents must
have a full quality system certified by an authorised body and must submit an application containing all the control results for each lot.

Blood group testing must be undertaken in accordance with the instructions provided by the manufacturer of the reagents and kits.

All techniques and modifications to techniques in use must be validated.

The validation of reagents must detect deviations from the established minimal quality requirements (specifications).

Prospective purchasers must require potential suppliers to provide them with full validation data for all lots of reagents. Each lot of reagent must be qualified by the purchaser to demonstrate suitability for its intended purpose within the system used for testing.

There must be a reliable process in place for transcribing, collating and interpreting results.

### 3. Quality Control

The quality of the laboratory testing must be regularly assessed by the participation in a formal system of proficiency testing, such as an external quality assurance programme (Directive 2005/62/EC Annex 6.3.5).

Quality-control procedures must be implemented for the equipment, reagents and techniques used for ABO, RhD and other blood-group antigen typing and detection and identification of antibodies. The frequency of the control is dependent on the method used.

### 4. Blood Group Testing of Blood Donors and Donations


Blood group serology testing must include procedures for testing specific groups of donors (e.g. first-time donors, donors with a history of transfusion) (Directive 2005/62/EC Annex 6.3.6).
ABO and RhD
The ABO and RhD labeling of blood components of all first-time donors must be based upon the results of two independent ABO and RhD tests. At least one of the ABO tests must include reverse grouping.
A positive RhD test must lead to labelling of the unit as ‘RhD positive’. Components must be labelled as ‘RhD negative’ only if the donor has tested negative for RhD using appropriate reagents or tests specifically selected to detect weak D and D variants.
ABO and RhD testing must be performed on all donations excepted for plasma intended only for fractionation.
The ABO and RhD blood group must be verified on each subsequent donation and a comparison must be made with the historically-determined blood group.
If a discrepancy is found, the applicable blood components must not be released until the discrepancy is unequivocally resolved.

Additional typing
If additional typing is performed then, before the result of the confirmed phenotype is printed on the label, a test must be done at least twice from two different samples collected from two different donations. The results should be linked to the donor record.

Irregular antibody testing
All first-time donors as well as repeat and regular donors with a history of pregnancy or transfusions since the last donation must be tested for clinically significant irregular red cell antibodies.

5. Testing of Patient Samples
The ABO and RhD blood group and, when needed, other blood types must be determined on the patient’s blood sample before issuing components for transfusion. In an emergency situation, when a delay may be life-threatening, components may be issued before all results
of grouping and antibody screening are completed. In these situations, testing must be completed as soon as possible.

A sample of the patient’s plasma/serum used for compatibility testing and/or antibody screening must be retained for a period of time.

**Blood grouping and antibody detection**

The laboratory must have a reliable and validated procedure for blood grouping and antibody detection that includes an effective mechanism to verify the accuracy of the data at the time of issuing a report on the blood group and other test findings for inclusion in the patient’s record.

Sufficiently sensitive techniques for the detection of clinically significant red cell allo-antibodies must be used, including reagent red cells that cover all appropriate antigens, preferably with homozygous expression for the most clinically significant allo-antibodies.

**Compatibility testing**

Compatibility between red cell components and the recipient’s plasma/serum must be assured for transfusions. Sufficiently sensitive techniques for the detection of clinically significant red cell allo-antibodies must be used. Laboratory records of the tests performed and of the destination of all units handled (including patient identification) must be kept.

Compatibility testing must be carried out on a sample taken no more than 3 days before the proposed transfusion for patients who have been transfused or have become pregnant during the last 3 months.

**Serological compatibility testing**

Serological compatibility testing must be performed if clinically significant red cell allo-antibodies are suspected or have been identified by current or previous testing. Whenever possible, red cell components that lack the corresponding antigens must be selected for transfusion, and a serological compatibility test between donor red
cells and recipient plasma/serum must be undertaken before issuing red cell components for transfusion.

**Type and screen**

A type and screen procedure may be used as replacement for serological compatibility testing if antibody screening has not detected clinically significant red cell antibodies. The process must include:

- Reagent red cells that cover all clinically significant antigens (preferably with homozygous expression) must be used for antibody detection;
- A reliable and validated procedure (preferably by computer) that ensures compatibility between the donor red blood cells and recipient plasma.
Chapter 9

Standards for screening for infectious markers

1. Selection and Validation of Infectious Marker Tests

All laboratory testing procedures must be validated before use (Directive 2005/62/EC Annex 6.3.1).


There must be data confirming the suitability of any laboratory reagents used in the testing of donor samples and blood component samples (Directive 2005/62/EC Annex 6.3.4).

The quality of the laboratory testing must be regularly assessed by participation in a formal system of proficiency testing, such as an external quality assurance programme (Directive 2005/62/EC Annex 6.3.5).

Only tests that have been licensed or evaluated and considered suitable by the responsible health authorities can be used. In the EU, these reagents are considered as in vitro diagnostic devices and must be CE marked. EU Directive 98/79/EC classifies the HIV, HTLV, hepatitis B and hepatitis C screening tests in list A. The manufacturer must have a full quality system certified by an authorised body and must submit an application containing all the control results for each lot.
Screening tests for infectious markers must be performed in accordance with the instructions provided by the manufacturer of the reagents and test kits.

All laboratory assays and test systems for infectious disease marker screening, including any upgrades from the manufacturer, used by blood establishments must be validated before introduction to ensure compliance with the intended use of the test.

Correct determination of negative and positive controls, as provided by and in accordance with the manufacturer’s instructions, is a minimum requirement.

2. **Mandatory Serological Screening Tests**

The minimum mandatory serological blood donor screening tests are:

- antibody to HIV-1 (anti-HIV-1) and HIV-2 (anti-HIV-2), including outlying types (e.g. HIV-1 type O);
- antibody to hepatitis C virus (anti-HCV);
- a hepatitis B surface antigen (HBsAg) assay, which will detect at least 0.13 IU/mL of HBsAg.

Appropriate quality control measures must be in place when screening for infectious markers. Specific requirements are shown in Table 9-1.

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirement</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-HIV 1/2 screening sensitivity</td>
<td>Detection of weak positive serum(^a)</td>
<td>Each plate/run</td>
</tr>
<tr>
<td>Anti-HCV screening sensitivity</td>
<td>Detection of weak positive serum(^a)</td>
<td>Each plate/run</td>
</tr>
<tr>
<td>HBsAg screening test</td>
<td>Detection of 0.5 IU/mL standard</td>
<td>Each plate/run</td>
</tr>
</tbody>
</table>

\(^a\) Where possible, the weak positive control should not be the one provided by the manufacturer.
Laboratories undertaking infectious disease testing of blood donations must participate in a regular external quality assurance programme.

### 3. Additional Serological Screening Tests

National authorities may also require additional screening tests such as: Treponema pallidum haemagglutination assay (TPHA); ELISA for syphilis; antibody to human T-cell lymphotropic virus types I (anti-HTLV-I) and II (anti-HTLV-II); antibody to hepatitis B core antigen (anti-HBc).

Appropriate quality control measures must be in place when screening for infectious markers. Specific requirements are shown in Table 9-2.

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirement</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Syphilis: TPHA or ELISA</td>
<td>Detection of weak positive serum(^a)</td>
<td>Each plate/run</td>
</tr>
<tr>
<td>Anti-HTLV I/II screening test</td>
<td>Detection of weak positive serum(^a)</td>
<td>Each plate/run</td>
</tr>
<tr>
<td>Anti-HBc screening test</td>
<td>Detection of weak positive serum(^a)</td>
<td>Each plate/run</td>
</tr>
</tbody>
</table>

\(^a\) Where possible, the weak positive control should not be the one provided by the manufacturer.

### 4. Management of Reactive Results in Serological Screening Tests

There must be clearly defined procedures to resolve discrepant results and ensure that blood and blood components that have a repeatedly reactive result in a serological screening test for infection with the viruses mentioned in Annex IV to Directive 2002/98/EC must be excluded from therapeutic use and be stored separately in a dedicated environment. Appropriate confirmatory testing must take place. In case of confirmed positive results, appropriate donor management must take place, including the provision of information to the donor and follow-up procedures (Directive 2005/62/EC Annex 6.3.3).
Initially reactive donations must be re-tested in duplicate. If any of the repeat tests are reactive, then the donation is deemed repeatedly reactive. The donation must not be used for transfusion or the manufacture of medicinal products. Samples from the donation must be sent to a certified/accredited medical microbiology reference laboratory for confirmation.

Algorithms to enable consistent resolution of repeatedly reactive donations must be in place. In the event that a repeatedly reactive donation is confirmed positive, the donor must be notified and a further sample must be obtained to reconfirm the results and the identity of the donor. The results of confirmatory testing that present evidence of on-going infection must be discussed with the donor and the donor must be deferred from donation and referred for appropriate care.

The above rules do not necessarily apply to all donations found repeatedly reactive for anti-HBc. Additional testing, e.g. for HBs-antibody and/or HBV-DNA might enable some repeatedly reactive donations to be used clinically.

If a confirmed infection by HBV, HCV or HIV is shown in a repeat donor, the blood establishment must undertake a look-back procedure to identify previous potentially infectious donations. If so, the look-back procedure must ensure that:

- The blood establishment informs the hospital in writing about the incident and advises the hospital to trace the recipient(s) of the implicated blood component(s) and to inform the treating physician about the potentially infectious transfusion;
- The relevant organisation that carried out plasma fractionation is notified;
- If the recipient is confirmed to be positive for the given infection, the incident is reported to the national haemovigilance system and/or Competent Authority.
5. **Nucleic Acid Screening**

If screening of blood donations by Nucleic Acid Amplification Techniques (NAT) is required by national authorities for the release of blood components, the NAT assays must be validated to detect 5 000 IU/mL for HCV-RNA, 10 000 IU/mL for HIV-RNA and 100 IU/mL for HBV-DNA in single donations. Appropriate quality control measures must be in place. The specific requirements are shown in Table 9-3.

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirement</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBV-NAT</td>
<td>Detection of 100 IU/mL HBV-DNA per donation</td>
<td>Internal control for each NAT reaction</td>
</tr>
<tr>
<td>HCV-NAT</td>
<td>Detection of 5 000 IU/mL HCV-RNA per donation</td>
<td>Internal control for each NAT reaction</td>
</tr>
<tr>
<td>HIV-NAT</td>
<td>Detection of 10 000 IU/mL HIV RNA per donation</td>
<td>Internal control for each NAT reaction</td>
</tr>
</tbody>
</table>

6. **Selective Screening of Donations**

Screening of selected donations for antibodies to cytomegalovirus (anti-CMV) may be undertaken. When performed the assay and test system must be fully validated. Confirmation of reactive results and notification of reactive donors is not necessary.

Screening of selected donations for malaria antibodies may also be undertaken. In such cases, the assay and test system must be fully validated.

Appropriate quality control measures must be in place when screening for infectious markers. Specific requirements are shown in Table 9-4.
**Table 9-4. Quality control of selective screening tests**

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Requirement</th>
<th>Frequency of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBV-NAT</td>
<td>Detection of 100 IU/mL HBV-DNA per donation</td>
<td>Internal control for each NAT reaction</td>
</tr>
<tr>
<td>HCV-NAT</td>
<td>Detection of 5 000 IU/mL HCV-RNA per donation</td>
<td>Internal control for each NAT reaction</td>
</tr>
<tr>
<td>HIV-NAT</td>
<td>Detection of 10 000 IU/mL HIV RNA per donation</td>
<td>Internal control for each NAT reaction</td>
</tr>
</tbody>
</table>
Chapter 10

Standards for haemovigilance

1. Overview

Haemovigilance procedures must be in place to ensure the organised surveillance of serious adverse or unexpected events or reactions in recipients of blood and blood components and for the epidemiological assessment of infections in donors.

The results of haemovigilance analyses must be fed back periodically to the providers of haemovigilance data and communicated to the field and to the relevant Competent Authorities, together with recommendations for preventive or corrective measures.

2. Pre-requisites for Implementation of a Haemovigilance Network

Haemovigilance must be the shared responsibility of the professionals in the field and the Competent Authorities for blood safety.

Traceability of blood components

There must be procedures in place to ensure full traceability, allowing the tracing of each individual unit of blood (or any blood components derived from it), from the donor to its final destination (whether this
is a patient, a manufacturer of medicinal products or disposal) and vice versa.

Traceability must also cover cases in which the blood unit or component is not transfused to a patient, but is used for the manufacturing of medicinal products or for research and investigational purposes, or if it is disposed of.

Hospitals must inform the blood establishment whenever a recipient of blood components has a serious adverse reaction, indicating that a blood component may have been the cause.

**Confidentiality of haemovigilance data**

Any database of haemovigilance reports must operate in compliance with applicable regulations on the confidentiality of individual medical patient and donor data. Individual reports must be anonymised.

3. **Device Defects**

When a causality assessment suggests that a medical device (including *in vitro* diagnostics) had a possible role in causing an adverse reaction/event, the manufacturer or his authorised representative must be notified at the same time as the national health authority, even if at the time of reporting full causality has not necessarily been established. When haemovigilance and medical device vigilance are the responsibility of separate entities, both the health authority responsible for haemovigilance and the health authority responsible for medical device vigilance must be notified.

4. **Post-transfusion Infection Reported to the Blood Establishment**

Hospitals must inform the blood establishment whenever a recipient of blood components develops laboratory tests results and/or disease symptoms, indicating that a blood component may have been infectious for hepatitis (B or C) or HIV.
The blood establishment must request relevant information from the hospital about the infection and the course of disease in the recipient and possible risk factors in the recipient for the infection.

The blood establishment’s physician must establish a plan of investigation, the results of which must be recorded.

The incident must be reported to the Competent Authorities.
GOOD PRACTICE GUIDELINES

Introduction

Good Practice Guidelines have been elaborated as an ad hoc cooperation between the European Directorate for the Quality of Medicines & HealthCare of the Council of Europe (EDQM/CoE), and the Commission of the European Union (EU).

The Good Practice Guidelines were adopted by the European Committee on Blood Transfusion (CD-P-TS) of the Council of Europe during its plenary session in November 2013. The document is an integral part of the Council of Europe Guide to the preparation, use and quality assurance of blood components.

The Good Practice Guidelines are considered, as is the section Standards, to be ‘minimum standards’. These parts are intended to assist legislators to transpose these into national legislation.

The document identifies the quality system elements that must be met by blood establishments and hospital blood banks that are required to comply with EU Directive 2005/62/EC. It incorporates the ‘quality system standards and specifications’ contained in the Annex of EU Directive 2005/62/EC, the quality system Standards and Principles derived from the Guide to the preparation, use and quality assurance of blood components (17th edition), as well as quality system elements derived from the detailed principles of GMP (as referred to in Article 47 of EU Directive 2001/83/EC).
1. General principles

1.1. General requirements

1.1.1. Each blood establishment must develop and maintain a Quality System that is based on EU Good Manufacturing Practices (GMP) Directive 2003/94/EC and meets the requirements identified in the Directive 2005/62/EC.

1.1.2. For blood and blood components imported from third countries and intended for use or distribution in the EU, there must be a Quality System for blood establishments in the stages preceding importation equivalent to the Quality System provided for in Article 2 of Directive 2005/62/EC.

1.1.3. Quality must be recognised as being the responsibility of all persons involved in the processes of the blood establishment, with management ensuring a systematic approach towards quality and the implementation and maintenance of a Quality System (Directive 2005/62/EC/Annex 1.1.1).

1.1.4. Attainment of this quality objective is the responsibility of executive management. It requires the participation and commitment of staff in many
different departments and at all levels within the organisation by the organisation’s suppliers and by its distributors. To achieve this quality objective reliably there must be a comprehensively designed and correctly implemented Quality System incorporating Good Practice and Quality Risk Management.

1.1.5. Each actor in the supply chain should establish, document, and fully implement a comprehensively designed Quality System to deliver Quality Assurance based on the principles of Quality Risk management by incorporating Good Practice and Quality Control.

1.1.6. The basic concepts of Quality Management, Good Practice and Quality Risk Management are inter-related. They are described here in order to emphasise their relationships and fundamental importance to the preparation of blood and blood components.

1.2. Quality System

1.2.1. Quality Management is a wide-ranging concept covering all matters, which individually or collectively influence the quality of blood and blood components. It is the sum total of the organised arrangements made with the objective of ensuring that blood components are of the quality required for their intended use. Quality Management therefore incorporates Good Practice.

1.2.2. The Quality System encompasses quality management, quality assurance, continuous quality improvement, personnel, premises and equipment, documentation, collection, testing and processing, storage, distribution, quality control, blood component recall, and external and internal auditing, contract management, non-conformance and self-inspection (Directive 2005/62/EC/Annex 1.1.2).
1.2.3. The Quality System must ensure that all critical processes are specified in appropriate instructions and are carried out in accordance with the standards and specifications of Good Practice and comply with appropriate regulations as set out in the chapters on Standards in this Guide (which includes the Annex of Directive 2005/62/EC).

1.2.4. The Quality System must be designed to assure the quality and safety of prepared blood and blood components, as well as ensure donor and staff safety and customer service. This strategy requires the development of clear policies, objectives and responsibilities. It also requires implementation by means of quality planning, quality control, quality assurance and quality improvement to ensure the quality and safety of blood and blood components, and to provide customer satisfaction.

1.2.5. Executive management has the ultimate responsibility to ensure that an effective Quality System is in place and resourced adequately, and that roles and responsibilities, are defined, communicated and implemented throughout the organisation. Executive management’s leadership and active participation in the Quality System is essential. This leadership should ensure the support and commitment of staff at all levels and sites within the organisation to the Quality System.

1.2.6. Executive management should establish a quality policy that describes the overall intentions and direction of the blood establishment and/or hospital blood bank (hereinafter referred to as ‘organisation’) related to quality. They should also ensure Quality System management and Good Practice governance
through management review to ensure its continuing suitability and effectiveness.

1.2.7. The Quality System should be defined and documented. A Quality Manual or equivalent document should be established and contain a description of the Quality System (including management responsibilities).

1.2.8. All blood establishments and hospital blood banks must be supported by a quality assurance function (whether internal or related) for fulfilling quality assurance. That function must be involved in all quality-related matters, and must review and approve all appropriate quality-related documents (Directive 2005/62/EC/Annex 1.2.1).

1.2.9. An independent function with responsibility for quality assurance must be established. This quality assurance function will be responsible for the oversight of all quality processes but need not necessarily be responsible for carrying out the activities.

1.2.10. All procedures, premises and equipment that have an influence on the quality and safety of blood and blood components must be validated before introduction and must be re-validated at regular intervals, as determined as a result of these activities (Directive 2005/62/EC/Annex 1.2.2).

1.2.11. A general policy regarding qualification of facilities and equipment as well as validation of processes, automated systems and laboratory tests must be in place. The formal objective of validation is to ensure compliance with the intended use and regulatory requirements.
1.2.12. A formal change control system must be in place to plan, evaluate and document all changes that may affect the quality, traceability, availability or effect of components, or the safety of components, donors or patients. The potential impact of the proposed change must be evaluated, and the degree of re-validation or additional testing, qualification and validation needed must be determined.

1.2.13. A formal system for the handling of deviations and non-conformances must be in place. An appropriate level of root-cause analysis should be applied during the investigation of deviations, suspected product defects, and other problems. This strategy can be determined using Quality Risk Management principles. If the true root cause(s) of the issue cannot be determined, consideration should be given to identifying the most likely root cause(s) and to addressing them. Where human error is suspected or identified as the cause, this should be justified having taken care to ensure that process, procedural or system-based errors or problems have not been overlooked, if present. Appropriate corrective actions and/or preventative actions (CAPAs) should be identified and taken in response to investigations. The effectiveness of such actions should be monitored and assessed in accordance with Quality Risk Management principles.

1.2.14. Management must review the system at regular intervals to verify its effectiveness and introduce corrective measures if deemed necessary (Directive 2005/62/EC/Annex 1.1.3).

1.2.15. There should be periodic management review and monitoring of its effectiveness, with the involvement of Executive management, of the operation of the
Quality System to identify opportunities for continual improvement of blood and blood components, processes and the system itself.

1.3. **Good Practice**

1.3.1. Good Practice is the part of Quality Management that ensures that blood and blood components are produced and controlled consistently to the quality standards appropriate to their intended use. Good Practice is concerned with collection, processing, testing release and storage (hereinafter included in the generic term ‘preparation’) and quality control. The basic requirements are:

1.3.1.1. All processes are defined clearly and reviewed systematically in the light of experience and shown to be capable of consistently delivering blood and blood components of the required quality and complying with their specifications. This strategy includes ensuring that:

1.3.1.1.1. critical steps and significant changes to the process are validated;

1.3.1.1.2. all requirements are provided including:
1.3.1.1.2.1. appropriately qualified and trained personnel;
1.3.1.1.2.2. adequate premises and space;
1.3.1.1.2.3. suitable equipment and services;
1.3.1.1.2.4. correct materials, containers and labels;
1.3.1.1.2.5. approved procedures and instructions;
1.3.1.1.2.6. suitable storage and transport;
1.3.1.1.3. instructions and procedures are written in an instructional form in clear and unambiguous language, and are applicable specifically to the facilities provided;
1.3.1.4. operators are trained to carry out procedures correctly;

1.3.1.5. records are made, manually and/or by recording instruments, during preparation which demonstrate that all the steps required by the defined procedures and instructions were in fact taken and that the quantity and quality of the blood or blood component was as expected;

1.3.1.6. any significant deviations are fully recorded and investigated;

1.3.1.7. records of preparation (including distribution) that enable the complete history of the blood or blood component to be traced are retained in a comprehensible and accessible form;

1.3.1.8. the distribution of the blood and blood components minimises any risk to their quality;

1.3.1.9 a system is available to recall any blood or blood component (including those prepared using a batch of critical materials that have been distributed or issued);

1.3.1.10 complaints about blood and blood components are examined, the causes of quality defects investigated, and appropriate measures taken in respect of the defective blood components to prevent reoccurrence.

1.3.1.2. Quality Control is the part of Good Practice that is concerned with sampling, specifications and testing, as well as with the organisation, documentation and release procedures which ensure that materials are not released for use in preparation, and blood and blood components are not released for distribution, until their quality has been judged to be satisfactory and that the necessary and relevant tests have been carried out. The basic requirements are:
1.3.1.2.1. adequate facilities, trained personnel and approved procedures are available for sampling, inspecting/testing starting materials, packaging materials, intermediate components, and finished blood and blood components and, if appropriate, for monitoring environmental conditions;

1.3.1.2.2. samples of starting materials, packaging materials, intermediate, and finished blood components are taken by approved personnel and methods;

1.3.1.2.3 test methods are validated;

1.3.1.2.4. records are made, manually and/or by recording instruments, which demonstrate that all the required sampling, inspecting and testing procedures were actually carried out. Any deviations are recorded and investigated fully;

1.3.1.2.5. the finished blood and blood components comply with the specifications and are correctly labeled;

1.3.1.2.6. records are made of the results of inspection, and that testing of materials, intermediate and finished blood and blood components are formally assessed against specifications;

1.3.1.2.7. no blood or blood components are released for distribution that are not in accordance with the requirements of the relevant authorisations.

1.3.1.3. Rolling quality reviews of all blood and blood components (including export-only blood components) should be conducted with the objective of continuously verifying the: consistency of the existing process; appropriateness of current specifications for both starting materials and finished blood components to highlight any trends and to identify product and process improvements.
1.4. Quality Risk Management

1.4.1. Quality Risk Management is the part of the Quality System that ensures that the process performance and quality monitoring and review systems are based on risk. Appropriate statistical tools should be used (where appropriate) in the assessment of ongoing process capability.

1.4.2. The Quality System should ensure that processes are in place to ensure the control of outsourced activities and quality of purchased materials. These processes should incorporate the principles of Quality Risk Management and systematically ensure that:

1.4.2.1. The evaluation of the risk to quality is based on scientific knowledge, experience with the process and, ultimately, is connected to protection of the donor and patient.

1.4.2.2. The level of effort, formality and documentation of the quality risk management process is commensurate with the level of risk.

2. Personnel and organisation

2.1. Personnel must be available in sufficient numbers to carry out the activities related to the collection, testing, processing, storage and distribution of blood and blood components and be trained and assessed to be competent to perform their tasks (Directive 2005/62/EC/Annex 2.1).

2.2. The organisation should have an adequate number of personnel with the necessary qualifications and experience. Management should determine and provide adequate and appropriate resources (human, financial, materials, facilities, equipment) to implement and maintain the Quality Management...
System and continually improve its effectiveness. The responsibilities placed on any one individual should not be so extensive as to present any risk to quality.

2.3. All personnel must have up-to-date job descriptions, which clearly set out their tasks and responsibilities. Responsibility for processing management and quality assurance must be assigned to different individuals, and who function independently (Directive 2005/62/EC/Annex 2.2).

2.4. Personnel in responsible positions should have adequate authority to carry out their responsibilities. Their duties may be delegated to designated deputies of a satisfactory qualification level. There should be no gaps or unexplained overlaps in the responsibilities of those personnel concerned with the application of Good Practice.

2.5. Individual responsibilities should be clearly understood by the individuals and recorded. Personnel signature lists should be available.

2.6. All personnel must receive initial and continued training appropriate to their specific tasks. Training records must be maintained. Training programmes must be in place and must include Good Practice (Directive/2005/62/EC/Annex 2.3).

2.7. Training should be provided for all personnel whose duties take them into preparation areas or into laboratories (including the technical, maintenance and cleaning personnel).

2.8. There should be written policies and procedures to describe the approach to training, including a record of training that has taken place (including its contents and its effectiveness).
2.9. Only persons who are authorised by defined procedures and documented as such may be involved in the collection, processing, testing and distribution processes, including quality control and quality assurance.

2.10. The contents of training programmes must be periodically assessed and the competence of personnel evaluated regularly (Directive/2005/62/EC/Annex 2.4).


2.12. Visitors or untrained personnel should, preferably, not be taken into the processing and laboratory areas. If this is unavoidable, they should be given information in advance, particularly about personal hygiene and prescribed protective clothing. They should be supervised closely.

2.13. It is the organisation’s responsibility to provide instructions on hygiene and health conditions that can be of relevance to the quality of blood components (e.g. during collection) and to ensure that staff report relevant health problems. Personnel should be instructed to use the hand-washing facilities.

2.14. Steps should be taken to ensure as far as is practicable that no person affected by an infectious disease or with open lesions on the exposed surface of the body is engaged in the preparation of blood components.

2.15. There should be a written policy outlining the requirements for the wearing of protective garments.
in different areas. Requirements should be appropriate for the activities to be carried out.

2.16. Eating, drinking, chewing or smoking, or the storage of food, drink, smoking materials or personal medication in the processing, testing and storage areas should be prohibited. In general, any unhygienic practice within the preparation areas or in any other area where blood or blood components might be adversely affected should be forbidden.

3. Premises

3.1. General

3.1.1. Premises including mobile sites must be located, constructed, adapted and maintained to suit the activities to be carried out. They must enable work to proceed in a logical sequence so as to minimise the risk of errors, and must allow for effective cleaning and maintenance in order to minimise the risk of contamination (Directive/2005/62/EC/Annex 3.3.1).

3.1.2. Lighting, temperature, humidity and ventilation should be appropriate and such that they do not adversely affect (directly or indirectly) blood components during their processing and storage, or the accurate functioning of equipment.

3.1.3. Premises should be designed and equipped so as to afford protection against the entry of insects or other animals.

3.1.4. Steps should be taken to prevent the entry of unauthorised people. Areas for processing, laboratory storage, and quality control should not be used as a right of way by personnel who do not work in them.

3.1.5. Facilities should permit ease of maintenance and cleaning. Open drains should be avoided.
3.1.5.1. Preparation areas should be ventilated effectively, with air-control facilities (including temperature and, if necessary, humidity and filtration) appropriate to the operations undertaken within them and to the external environment.

3.1.5.2. Preparation areas should be suitably lit, particularly where visual checks are carried out.

3.1.6. Component sampling may be carried out within the processing area provided it does not carry any risk for other components.

3.2. Blood Donor Area

3.2.1. There must be an area for confidential personal interviews with, and assessment of, individuals to assess their eligibility to donate. This area must be separated from all processing areas (Directive/2005/62/EC/Annex 3.3.2).

3.2.2. Premises must satisfy common-sense requirements for the health and safety of both the staff (including those of mobile teams) and the donors concerned with due regard to relevant legislation or regulations.

3.3. Blood Collection Area

3.3.1. Blood collection must be carried out in an area intended for the safe withdrawal of blood from donors that is appropriately equipped for the initial treatment of donors experiencing adverse reactions or injuries from events associated with blood donation. This area must be organised in such a way as to ensure the safety of both donors and personnel as well as to avoid errors in the collection procedure (Directive/2005/62/EC/Annex 3.3.3).
3.3.2. Before premises are accepted for mobile donor sessions, their suitability must be assessed against the following criteria:

3.3.2.1. Sufficient size to allow proper operation and ensure donor privacy.

3.3.2.2. Safety for staff and donors.

3.3.2.3. The presence of ventilation, electrical supply, toilet, lighting, and hand-washing facilities.

3.3.2.4. Reliable communication, blood storage and transport.

3.3.2.5. Guarantee of adequate interim storage.

3.3.3. The arrangement of the collection room and procedures should ensure that blood is collected in a safe and clean environment and to minimise the risk of errors and microbial contamination.

3.3.4. Consideration should be given to the arrangement of donor beds and the handling of bags, samples and labels.

3.4. Blood Testing and Processing Areas

3.4.1. There must be a dedicated laboratory area for testing that is separate from the blood-donor and blood-component processing area, with access restricted to authorised personnel, and must be used only for the intended purpose (Directive/2005/62/EC/Annex 3.3.4).

3.4.2. Laboratories should be designed to suit the operations to be carried out in them. Sufficient space should be given to avoid mix-ups and cross-contamination. There should be adequate suitable storage space for samples and records.
3.4.3. Special provisions may be necessary to protect sensitive instruments from vibration, electrical interference, humidity, and extremes of temperature.

3.5. **Storage Area**

3.5.1. Storage areas must provide for appropriately secure and segregated storage of different categories of blood and blood components and materials, including quarantine and released materials as well as units of blood or blood components collected under special criteria (e.g. autologous donation). Access must be restricted to authorised persons (Directive/2005/62/EC/Annex 3.3.5.1).

3.5.2. Provisions must be in place in the event of equipment failure or power failure in the main storage facility (Directive/2005/62/EC/Annex 3.3.5.2).

3.5.3. Storage facilities should be clean and free from litter, dust and pests (e.g. insects, rodents).

3.5.4. Storage areas should be of sufficient capacity to allow orderly storage of the various categories of materials and blood components including packaging materials, intermediate and finished components, and materials in quarantine, released, rejected, returned or recalled.

3.5.5. Storage areas should be designed or adapted to ensure good storage conditions. In particular, they should be clean and dry and maintained within predefined temperature limits. Where special storage conditions are required (e.g. temperature, humidity) these should be provided, checked and monitored. An alarm system should alert users in a timely manner to any excursion outside of predefined limits.

3.5.6. Receiving and dispatch bays should protect materials and products from the weather. Reception areas should be designed and equipped to allow containers
of incoming materials to be cleaned where necessary before storage. The reception area should be separate from the storage area.

3.5.7. If quarantine status is ensured by storage in separate areas, these areas must be marked clearly and their access restricted to authorised personnel. Any system replacing the physical quarantine (e.g. computerised system) should provide equivalent security.

3.5.8. Segregated areas should be allocated and identified appropriately for storage of rejected, discarded, recalled or returned materials, or blood and blood components.

3.5.9. Special attention should be paid to the safe and secure storage of printed packaging materials (including sets of donation identifier labels).

3.6. Ancillary Areas

3.6.1. Staff rest and refreshment areas should be separate from other rooms.

3.6.2. Facilities for changing clothes and for washing and toilet purposes should be readily accessible and appropriate for the number of users. Toilets should not directly open to processing, laboratory or storage areas.

3.6.3. Maintenance workshops should, as far as possible, be separated from preparation areas. If parts and tools are stored in processing and laboratory areas, they should be kept in a location reserved for that use.

3.7. Waste Disposal Area

3.7.1. An area must be designated for: the safe disposal of waste, disposable items used during collection, testing and processing and for rejected blood or blood components (Directive/2005/62/EC/Annex 3.6).
4. Equipment and materials

4.1. General Requirements

4.1.1. All equipment must be qualified, calibrated and maintained to suit its intended purpose. Operating instructions must be available and appropriate records kept (Directive/2005/62/EC/Annex 4.1).

4.1.2. Equipment must be selected to minimise any hazard to donors, personnel or blood components (Directive/2005/62/EC/Annex 4.2).

4.1.3. All validated processes must use qualified equipment. Qualification results must be documented. Regular maintenance and calibration must be carried out and documented according to established procedures. The maintenance status of each item of equipment must be available.

4.1.4. All critical equipment must have regular, planned maintenance to detect or prevent avoidable errors and keep the equipment in its optimum functional state. The maintenance intervals and actions must be determined for each item of equipment.

4.1.5. New and repaired equipment must meet qualification requirements when installed and must be authorised before use.

4.1.6. All modifications, enhancements or additions to validated systems and equipment must be managed through the change control procedure of the blood establishment. The effect of each change to the system or equipment, as well as its impact on quality and safety, must be determined to identify the extent of re-validation required.

4.1.7. Instructions for use, maintenance, servicing, cleaning and sanitation must be available.
4.1.8. Procedures must be available for each type of equipment that detail the action to be taken if malfunctions or failures occur.


4.1.10. Manufacturers of sterile materials (e.g. blood bag systems, anticoagulant solutions) should provide a certificate of release for each batch. The blood establishment should define acceptance criteria for such certificates in writing, and should include at least the name of the material, manufacturer, compliance with relevant requirements (e.g. pharmacopoeias or regulations for medical devices) and confirmation that the materials are sterile and pyrogen-free.

4.1.11. Status of materials (quarantined, released, rejected) should be indicated clearly.

4.1.12. Materials and reagents should be stored under the conditions established by the manufacturer and in an orderly manner that permits segregation by batch and lot as well as stock rotation.

4.1.13. Storage and use of materials should follow the ‘first-in first-out’ principle (i.e. the material that entered storage first should be used first) taking into account the expiry date of materials.

4.1.15. Equipment and material inventory records must be kept as a means to build up a history for a processed component to facilitate recalls.

4.1.16. Repair and maintenance operations should not present any hazard to the donor, staff or quality of the blood and blood components.

4.1.17. Equipment should be designed or selected so that it can be thoroughly cleaned (and where necessary decontaminated). This should be performed according to detailed and written procedures. It should be stored only in a clean and dry condition.

4.1.18. Washing/cleaning solutions and equipment should be chosen and used so that they are not sources of contamination.

4.1.19. Equipment should be installed in such a way as to prevent any risk of error or of contamination.

4.1.20. Parts of equipment and materials that come into contact with blood and blood components must not be reactive, additive or absorptive to such an extent that they affect the quality of the component and thus present any hazard.

4.1.21. Balances and measuring equipment of an appropriate range and precision should be available. Equipment for measuring, weighing, recording and control should be calibrated and checked at defined intervals using appropriate methods. Adequate records of such tests should be maintained, including the values obtained prior to any adjustment. Calibration reports should include the accuracy of any testing equipment and traceability to a national standard. The report
and/or calibration certificate must be reviewed and signed to show acceptance of the document. Any failed calibrations will require mention of non-conformance to investigate the potential impact.

4.1.22. Defective equipment should be labelled clearly as such and, if possible, removed from preparation areas.

4.2. Data processing systems

4.2.1. If computerised systems are used, software, hardware and back-up procedures must be checked regularly to ensure reliability, be validated before use, and be maintained in a validated state. Hardware and software must be protected against unauthorised use or unauthorised changes. The back-up procedure must prevent loss of or damage to data at expected and unexpected down-times or function failures (Directive/2005/62/EC/Annex 4.5).

4.2.2. Systems must be properly maintained at all times. Documented maintenance plans must be developed and implemented. This strategy must include audits of quality assurance systems.

4.2.3. Changes in computerised systems must be validated; applicable documentation must be revised and relevant personnel trained appropriately before any change is introduced into routine use. Computerised systems must be maintained in a validated state. This must include user-testing to demonstrate that the system is correctly performing all specified functions both at initial installation and after any system modifications.

4.2.4. There must be a hierarchy of permitted user access to enter, amend, read or print data. Methods of preventing unauthorised entry must be in place,
such as personal identity codes or passwords that are changed regularly.

4.2.5. All necessary measures must be taken to ensure protection of data. These measures must ensure that safeguards against unauthorised additions, deletions or modifications of data and transfer of information are in place to resolve data discrepancies, and to prevent unauthorised disclosure of such information.

4.2.6. Computer systems designed to control decisions related to inventories and release of blood components should prevent the release of all blood or blood components considered not acceptable for release. Preventing release of any components from a future donation from a deferred donor should be possible.

4.3. **Qualification and Validation**

4.3.1. General Principles

4.3.1.1. Facilities and equipment need to be qualified prior to implementation. Systems, processes and tests must be validated, which involves wider consideration beyond the facilities and equipment used. In this document, however, the term ‘validation’ is used in a generic sense, and encompasses both qualification and validation activities.

4.3.1.2. These principles of qualification and validation are applicable to the preparation, distribution and issuance of blood components. It is a requirement of Good Practice that blood establishments and hospital blood banks identify what validation work is needed to prove quality control of the critical aspects of their particular operations. Significant changes to the facilities, equipment and processes which may affect the quality of the blood components should be qualified and/or validated. A risk-assessment
approach should be used to determine the scope and extent of these changes.

4.3.1.3. New processes, facilities, systems, equipment or tests should be submitted to qualification and/or validation before implementation. Change to an existing process should also initiate a risk-based approach to prospective validation as part of the change control procedure.

4.3.1.4. The first steps in this process involve identification of the requirements for the procedure or process, and documenting these specifications.

4.3.1.5. Performing risk assessments at various stages facilitates the definition of requirements and alternatives, aids in the supplier selection process, and helps determine the scope and extent of qualification and/or validation and to determine any mitigation steps.

4.3.1.6. A strategy for undertaking validation should be implemented. The scope of validation should be proportionate to the degree of risk involved in the implementation. Validation should be based mainly on the different elements identified in the risk assessment, user specifications, and documents provided by the supplier.

4.3.2. Planning for Validation

4.3.2.1. All validation activities need to be planned. Key elements of the programme should be defined and documented clearly in a validation master plan (VMP) or equivalent documents. The VMP should be a summary document that is brief, concise and clear. It should contain data on at least the following:

4.3.2.1.1. validation policy;

4.3.2.1.2. organisational structure of validation activities;
4.3.2.1.3. summary of facilities, systems, equipment and processes to be validated;
4.3.2.1.4. documentation format (i.e. the format to be used for protocols and reports);
4.3.2.1.5. planning and scheduling;
4.3.2.1.6. change control;
4.3.2.1.7. reference to existing documents.
4.3.2.2. In the case of large projects, it may be necessary to create separate VMPs, which should be linked and traceable.

4.3.3. Documentation
4.3.3.1. A written protocol that specifies how qualification and validation should be conducted should be established. The protocol should be reviewed and approved. The protocol should specify critical steps and acceptance criteria. A report that cross-references the qualification and/or validation protocol should be prepared. This report should summarise the results obtained, comment on any deviations observed, and draw the necessary conclusions (including recommendations for any changes necessary to correct deficiencies). Any changes to the plan, as defined in the protocol, should be documented with appropriate justifications. After completion of a satisfactory qualification, a formal release for the next step in qualification and validation should be made as a written authorisation.

4.3.4. Qualification. The tasks that must be performed when validating new facilities, systems or equipment can be classified as follows.
4.3.4.1. Design Qualification (DQ). The first element of the validation of new facilities, systems or equipment can
be considered as design qualification. This involves demonstration and documentation of the compliance of the design with Good Practice (i.e. the design is suitable for the intended purpose).

4.3.4.2. Installation Qualification. Installation qualification (IQ) should be performed on new or modified facilities, systems and equipment. IQ should include, but is not limited to, the following:

4.3.4.2.1. Installation of equipment, piping, services and instrumentation, which are checked against up-to-date engineering drawings and specifications;

4.3.4.2.2. Collection and collation of supplier operating and working instructions and maintenance requirements;

4.3.4.2.3. Calibration requirements;

4.3.4.2.4. Verification of construction materials.

4.3.4.3. Operational Qualification (OQ). Completion of a successful OQ should allow finalisation of calibration, operating and cleaning procedures, as well as requirements for operator training and preventative maintenance. It should permit a formal ‘release’ of facilities, systems and/or equipment. Operational qualification (OQ) should follow IQ. OQ should include, but is not limited to, the following:

4.3.4.3.1. Tests that have been developed from knowledge of processes, systems and equipment;

4.3.4.3.2. Tests to include a condition (or a set of conditions) encompassing upper and lower operating limits (sometimes referred to as ‘worst case’ conditions).

4.3.4.4. Performance Qualification (PQ). Although PQ is described as a separate activity, in some cases it may be appropriate to perform it in conjunction with OQ. PQ should follow successful completion of IQ.
and OQ. PQ should include, but is not limited to, the following:

4.3.4.4.1. tests, using production materials, qualified substitutes or simulated product, that have been developed from knowledge of the process and facilities, systems or equipment;

4.3.4.4.2. tests to include a condition or set of conditions encompassing upper and lower operating limits.

4.3.4.5. Qualification of Established (in-use) Facilities, Systems and Equipment. Evidence should be available to support and verify the operating parameters and limits for the critical variables of the operating equipment. In addition, calibration, cleaning, preventative maintenance, operating procedures as well as operator-training procedures and records should be documented.

4.4. Process Validation

4.4.1. General

4.4.1.1. The requirements and principles outlined in this section are applicable to the preparation, distribution and issuance of blood components. They cover the initial validation of new processes, subsequent validation of modified processes and re-validation.

4.4.1.2. Process validation should be completed before distribution and routine clinical use of the new component (‘prospective validation’). In circumstances, where this is not possible, it may be necessary to validate processes during routine production (concurrent validation). Processes that have been in use for some time should also be validated (‘retrospective validation’).
4.4.1.3. The facilities, systems and equipment to be used should be qualified before use and analytical testing methods should be validated. Staff taking part in the validation work should be trained appropriately.

4.4.1.4. Facilities, systems, equipment and processes should be evaluated periodically to verify that they are operating appropriately.

4.4.2. Prospective Validation

4.4.2.1. Prospective validation should include, but is not limited to, the following:

4.4.2.1.1. a short description of the process;

4.4.2.1.2. a summary of the critical processing steps to be investigated;

4.4.2.1.3. a list of the equipment/facilities to be used (including measuring/monitoring/recording equipment), together with their calibration statuses;

4.4.2.1.4. finished blood-component specifications for release;

4.4.2.1.5. a list of analytical methods, as appropriate;

4.4.2.1.6. proposed in-process controls with acceptance criteria;

4.4.2.1.7. additional testing to be carried out, with acceptance criteria and analytical validation, as appropriate;

4.4.2.1.8. a sampling plan;

4.4.2.1.9. methods for recording and evaluating results;

4.4.2.1.10. functions and responsibilities;

4.4.2.1.11. a proposed timetable.

4.4.2.2. Using this approach, several blood components may be prepared under the proposed new conditions. In theory, the number of process runs carried out and the number of observations made should be sufficient to allow the normal extent of variation and trends
to be established, and to provide sufficient data for evaluation.

4.4.2.3. Preparation of blood components during the validation phase should reflect the numbers intended to be produced under normal production circumstances.

4.4.2.4. If it is intended that validation batches will be issued for clinical use, the conditions under which they have been prepared should comply fully with the requirements of Good Practice, including compliance with the approved specification.

4.4.3. Concurrent Validation. In exceptional circumstances, based on risk assessment and to ensure continuity of supply, it may be necessary to commence routine production and supply without a phase of prospective validation. The decision to carry out concurrent validation must be justified, documented and approved by authorised personnel. Documentation requirements for concurrent validation are the same as for prospective validation.

4.4.4. Retrospective Validation

4.4.4.1. Retrospective validation is acceptable only for well-established processes, and is not appropriate if there have been recent changes in the composition of the blood component, operating procedures or equipment.

4.4.4.2. Validation of such processes should be based on historical data. The steps involved require preparation of a specific protocol and reporting of the results of the data review, which lead to a conclusion and recommendations.

4.4.4.3. The source of data for this validation should include (but not be limited to) production and packaging
records, process control charts, maintenance log books, records of personnel changes, process capability studies, and finished blood-component data (including trend cards and storage stability results).

4.4.4.4. Components selected for retrospective validation should be representative of all components made during the review period (including any that failed to meet specifications) and should be sufficient in number to demonstrate process consistency.

4.4.4.5. Additional testing of retained samples may be needed to obtain the necessary amount or type of data to retrospectively validate the process.

4.4.4.6. For retrospective validation, a statistically-appropriate sample should be examined to assess process consistency.

4.4.5. Documentation and Review of Results

4.4.5.1. All generated results and documentation must be reviewed upon completion of the qualification process. The review should confirm that:

4.4.5.1.1. documentation is complete and that the qualifications prove (with a high degree of confidence) that the system meets its acceptance criteria (including percentage conformance to pre-defined specifications within pre-established confidence limits) consistently;

4.4.5.1.2. any non-conformance has been addressed through problem resolution;

4.4.5.1.3. training requirements have been met;

4.4.5.1.4. written procedures for operation, calibration, and maintenance are in place;

4.4.5.1.5. business continuity plans are in place;

4.4.5.1.6. validation activities are approved by the person responsible for Quality Management.
4.5. Change Control

4.5.1. Change control procedures should ensure that sufficient supporting data are generated to demonstrate that the revised process results in a blood component of desired quality that is consistent with approved specifications.

4.5.2. Written procedures should be in place to describe the actions to be taken if a change is proposed for a starting material, blood-component specification, equipment, environment (or site), method of production or testing, or any other change that may affect donor safety, blood-component quality, or the reproducibility of the process.

4.5.3. All changes that may affect blood-component quality or the reproducibility of the process should be requested, documented and accepted in a formal manner.

4.5.4. The likely impact of the change of facilities, systems and equipment on the blood component should be evaluated, including a risk analysis. The need for, and the extent of, re-qualification and re-validation should be determined.

4.5.5. Some changes may require notification to, or license amendment, from a national regulatory authority.

4.6. Re-validation and Maintenance of the Validated State

4.6.1. All critical processes should be constantly monitored and periodically evaluated to confirm that they remain valid. If no significant changes have been made to the validated status, a review with evidence that the process meets the prescribed requirements may be deemed acceptable in place of a full re-validation.
4.6.2. The following items are essential to maintain a validated state:

4.6.2.1. Calibration and monitoring;
4.6.2.2. Preventive maintenance;
4.6.2.3. Training and competency;
4.6.2.4. Supplier re-qualification;
4.6.2.5. Periodic review;
4.6.2.6. Performance monitoring;
4.6.2.7. System retirement.

4.6.3. Operational change control, document control and quality-control procedures support maintenance of the validated state.

4.7. **Control of Equipment and Materials**

4.7.1. General Principles

4.7.1.1. Documented systems for purchasing equipment and materials should be available. These should identify the specific requirements for establishing and reviewing contracts for the supply of both equipment and materials.

4.7.1.2. The contracting process should include:

4.7.1.2.1. checks prior to awarding the contract to help ensure suppliers meet the organisation’s needs;
4.7.1.2.2. appropriate checks on received goods to confirm they meet specifications;
4.7.1.2.3. the requirement for manufacturers to provide a certificate of analysis for critical material;
4.7.1.2.4. checks to ensure that goods in use continue to meet specifications;
4.7.1.2.5. regular contact with suppliers to help understand and resolve problems;

4.7.1.2.6. performance of regular audits.

4.7.1.3. Assessment of the performance of equipment should occur in the following situations:

4.7.1.3.1. upon commissioning of new equipment, which must include design, installation, operational and performance qualifications, and full validation data from the manufacturer;

4.7.1.3.2. after any relocation, repairs or adjustments that might potentially alter equipment functioning;

4.7.1.3.3. if ever a doubt arises that the equipment is not functioning appropriately.

4.7.1.4. Consideration should be given to the quality, safety and efficacy of any blood components prepared before discovery of the fault adjustment.

4.7.2. Calibration and Monitoring of Equipment

4.7.2.1. It is necessary to establish a mechanism to ensure the adequacy of the calibration and monitoring programmes, and that qualified personnel are available for their implementation. A calibration and monitoring plan should be used to define the requirements for establishing and implementing a calibration programme that includes the frequency of monitoring.

4.7.2.2. Trending and analyses of calibration and monitoring results should be a continuous process. Intervals of calibration and monitoring should be determined for each item of equipment to achieve and maintain a desired level of accuracy and quality. The calibration and monitoring procedure should be based on a recognised international standard. The calibration
status of all equipment that requires calibration should be readily available.

4.7.2.3. To ensure appropriate performance of a system or equipment, a monitoring plan should be developed and implemented. The plan should take into account the criticality of the system or equipment, and should outline monitoring, user-notification and problem-resolution mechanisms. If an unusual event is observed, personnel should follow the standard response described in the monitoring plan. The standard response should involve notifying affected personnel and, possibly, initiation of a resolution response to the problem and risk assessment of the affected blood components. Depending on the severity of the problem and the criticality of the system or equipment, a back-up plan may need to be implemented to keep the process or system operating.

4.7.2.4. In addition to testing that evaluates the suitability of the implemented changes, sufficient validation should be conducted on the entire system to demonstrate that portions of the system not involved in the change are not adversely impacted.

4.7.2.5. The training programme should be re-assessed for any critical change in environment, equipment or processes. Training records (including plans and protocols of training status) must ensure that training needs are identified, planned, delivered and documented appropriately for maintenance of validated systems and equipment.

4.7.2.6. The ability of a supplier to maintain its activities relating to a system or equipment must be re-qualified on a regular basis; notably to anticipate weaknesses in services or to manage changes in the system, equipment or supplier. The periodicity and detail of
the re-qualification process depends on the level of risk of using the system or equipment, and should be planned for each supplier.

4.7.2.7. A periodic review process should be established to ensure that documentation for the system or equipment is complete, current and accurate. A report of the review process should be produced. When deviations or problems are found, actions should be identified, prioritised, planned and implemented.

5. Documentation

5.1. General Principles

5.1.1. Good documentation constitutes an essential part of the Quality System and is key to operating in compliance with Good Practice requirements. Various types of documents and media used should be defined fully in the Quality Management System of the organisation.

5.1.2. Documentation may exist in various forms: paper-based, electronic or photographic. The main objective of the system of documentation utilised must be to establish, control, monitor and record all activities that directly or indirectly impact on all aspects of the quality and safety of blood and blood components as well as any derived medicinal products. The Quality Management System should include sufficient instructional detail to facilitate common understanding of the requirements, in addition to providing for adequate recording of the various processes and evaluation of any observations, so that ongoing application of the requirements may be demonstrated.

5.1.3. There are two primary types of documentation used to manage and record Good Practice compliance:
instructions (directions, requirements) and records/reports. Appropriate practices should be applied with respect to the type of document. Suitable controls should be implemented to ensure the accuracy, integrity, availability and legibility of documents. Instruction documents should be free from errors and available in writing. The term ‘written’ means recorded or documented on media from which data may be rendered in a readable form for humans.

5.2. **Required Good Practice documentation (by type)**

Documents setting out specifications, procedures and records covering each activity undertaken by a blood establishment must be in place and kept up-to-date (Directive/2005/62/EC/Annex 5.1).

5.2.1. Instructions (directions or requirements).

5.2.1.1. Specifications describe in detail the requirements with which the blood and blood components or materials used or obtained during preparation and distribution must conform (see Standards – Chapter 5: Component Monographs). They serve as a basis for quality evaluation.

5.2.1.2. Testing Instructions detail all the starting materials, equipment and computerised systems (if any) to be used and specify all sampling and testing instructions. If applied, in-process controls should be specified, together with their acceptance criteria.

5.2.1.3. Procedures (otherwise known as Standard Operating Procedures or SOPs) give directions for performing certain operations.

5.2.1.4. Protocols give instructions for performing certain discreet operations, and may record the outcome (e.g. qualification and validation protocols).
5.2.1.5. Technical Agreements are agreed between contract givers and acceptors for outsourced activities.

5.2.2. Records/Reports.

5.2.2.1. Records provide evidence of various actions taken to demonstrate compliance with instructions, e.g. activities, events, investigations and, in the case of processed blood and blood components, a history of each unit (including its distribution). Records include the raw data that is used to generate other records. For electronic records, regulated users should define which data are to be used as raw data. All data on which quality decisions are based should be defined as ‘raw data’.

5.2.2.2. Certificates of Analysis provide a summary of testing results on samples of reagents, products or materials, together with the evaluation for compliance with a stated specification.

5.2.2.3. Reports document the carrying out of particular exercises, projects or investigations, together with results, conclusions and recommendations.

5.3. *Generation and Control of Documentation*

5.3.1. All types of documents should be defined and adhered to. Requirements apply equally to all forms of document media types. Complex systems need to be understood, well documented and validated, and adequate controls should be in place. Many documents (instructions and/or records) may exist in hybrid forms (i.e. some elements are electronic and others are paper-based). Relationships and control measures for master documents, official copies, data handling and records need to be stated for both hybrid and homogenous systems.
5.3.2. A document control system, defined in a written procedure, must be established for the review, revision history and archiving of documents, including SOPs. Appropriate controls for electronic documents, such as templates, forms and master documents, should be implemented. Appropriate controls should be in place to ensure the integrity of the record throughout the retention period.

5.3.3. Documents should be designed, prepared, reviewed, and distributed with care. Reproduction of working documents from master documents should not allow errors to be introduced through the reproduction process.

5.3.4. Documents containing instructions should be approved, signed and dated by appropriate and authorised persons. This may also be undertaken electronically. Documents should have unambiguous content and be uniquely identifiable. The effective date should be defined.

5.3.4. Documents containing instructions should be laid out in an orderly fashion and be easy to check. The style and language of documents should fit with their intended use. Standard Operating Procedures, Work Instructions and Methods should be written in an imperative mandatory style.

5.3.6. Documents within the Quality Management System should be regularly reviewed and kept up-to-date.

5.3.7. All significant changes to documents must be acted upon promptly, and must be reviewed, dated and signed by a person authorised to undertake this task (Directive/2005/62/EC/Annex 5.3).
5.3.8. Instructional documents should not be hand-written; although, where documents require the entry of data, sufficient space should be provided for such entries.

5.4. **Good Documentation Practices**

5.4.1. Records must be legible and may be handwritten, transferred to another medium such as microfilm, or documented in a computerised system (Directive/2005/62/EC/Annex 5.2).

5.4.2. Records should be made or completed at the time each action is taken and in such a way that all significant activities concerning the donation, collection, processing, testing and distribution of blood and blood components are traceable.

5.4.3. The record system must ensure continuous documentation of the procedures performed from the blood donor to the recipient. That is, each significant step must be recorded in a manner that permits a component or procedure to be traced, in either direction, from the first step to final use/disposal.

5.4.4. Any alteration made to the entry on a document should be signed and dated; the alteration should permit reading of the original information. Where appropriate, the reason for the alteration should be recorded.

5.5. **Retention of Documents**

5.5.1. It should be clearly defined which record is related to each activity and where this record is located. Secure controls must be in place to ensure the integrity of the record throughout the retention period. These controls must be validated if appropriate.

5.5.2. Specific retention requirements for certain documentation applies.
5.5.2.1. Records must be retained for a period according to local, national or EU requirements, as appropriate.

5.5.2.2. Traceability data (that allow tracing from donor to recipient and \textit{vice versa}) should be retained for a minimum of 30 years (Directive 2002/98 Article 14.3).

5.5.2.3. Documentation regarding investigations into Serious Adverse Events and Serious Adverse Reactions should be retained for a minimum of 15 years.

5.5.2.4. Quality System documentation and associated records should be retained for a minimum of 10 years.

5.5.2.5. For other types of documentation, the retention period must be defined on the basis of the business activity that the documentation supports. These retention periods should be specified.

5.6. \textit{Specifications}

5.6.1. There should be appropriately authorised and dated specifications for starting and packaging materials, as well as finished blood and blood components.

5.6.2. Specifications for starting and primary or printed packaging materials should include or provide reference to, if applicable:

5.6.2.1. A description of the materials, including:
5.6.2.1.1. the designated name and the internal code reference;
5.6.2.1.2. the approved suppliers and, if reasonable, the original producer of the material;
5.6.2.1.3. a sample of printed materials.

5.6.2.2. Directions for sampling and testing.

5.6.2.3. Qualitative and quantitative requirements with acceptance limits.

5.6.2.4. Storage conditions and precautions.
5.6.2.5. The maximum period of storage before re-examination.

5.6.3. Specifications for in-process and finished components should be available (see Standards – Chapter 5: Component Monographs). Components must be labelled in accordance with Directive 2002/98/EC.

5.7. Preparation Instructions

5.7.1. Approved, written instructions for preparation should exist for each type of component that is produced. These should include:

5.7.1.1. A process flow for each stage in the preparation of the component, including where it is undertaken and any critical equipment used.

5.7.1.2. Methods (or reference to the methods) to be used for starting up and maintaining critical equipment (e.g. cleaning, assembly, calibration).

5.7.1.3. The requirement to check that the equipment and work station are clear of previous blood components, documents or materials not required for the planned process, and that equipment is clean and suitable for use.

5.7.1.4. Detailed stepwise processing instructions (e.g. checks on materials, pre-treatments, sequence for adding materials, and critical process parameters such as time and temperature).

5.7.1.5. The instructions for any in-process controls with their limits.

5.7.1.6. Requirements for storage of the components and any critical materials and consumables.

5.7.1.7. Any special precautions to be observed.
5.8. *Labelling*

At all stages of the preparation, labelling should identify the individual components and their nature clearly.

5.8.1. Requirements for in-process labelling. The label on an intermediate component should always allow the stage of processing to be determined and should always include the:

5.8.1.1. Name of the component.

5.8.1.2. Unique numeric or alpha-numeric donation identification.

5.8.1.3. Name of the producing blood establishment.

5.8.2 Preparation record. Each unit is considered to be a unique batch, but preparation records should provide sufficient information to build the history and traceability of a prepared component. Usually this information is captured in the computerised systems of the blood establishment. In general, the blood establishment should have access to the following processing records for each unit:

5.8.2.1. The name and unique identifier of the component.

5.8.2.2. Dates and times of commencement of significant intermediate stages and of completion of processing.

5.8.2.3. Identification (initials) of the operator(s) who performed each critical step of the process (including the process controls) and, where appropriate, the name of any person who verified such steps.

5.8.2.4. Batch number of any relevant consumables and/or analytical control number of each consumable.

5.8.2.5. A record of the in-process controls and identity of the person(s) carrying them out, as well as the results obtained.
5.8.2.6. Results of testing undertaken on the donation and/or the component (excluding quality monitoring).

5.8.2.7. Notes on any deviation, including details of the procedures with signed authorisation.

5.8.2.8. Information on the processing of non-standard components with signed authorisation.

5.9. Procedures and records

5.9.1. Receipt

5.9.1.1. There should be written procedures and records for the receipt of each delivery of materials and reagents that can impact on the quality and safety of blood and blood components. Records of the receipts should include:

5.9.1.1.1. the name of the material on the delivery note and the containers;

5.9.1.1.2. the ‘in-house’ code (if any) of the material;

5.9.1.1.3. date of receipt;

5.9.1.1.4. names of the supplier and manufacturer;

5.9.1.1.5. batch or reference number of the manufacturer;

5.9.1.1.6. total quantity and number of items received;

5.9.1.1.7. the batch number assigned after receipt (as applicable);

5.9.1.1.8. the name/ID of the person who received the shipment;

5.9.1.1.9. any relevant comments.

5.9.1.2. There should be written procedures for the internal labelling, quarantine and storage of starting materials, packaging materials and other materials, as appropriate.
5.10. **Sampling**

5.10.1. There should be written procedures for sampling, which include the methods and equipment to be used, the amounts to be taken, and any precautions to be observed to avoid contamination of the material or any deterioration in its quality.

5.10.2. Quality monitoring of blood components should be consistent with those specified in the relevant blood component monographs of the Council of Europe *Guide to the preparation, use and quality assurance of blood components*.

5.10.3. There should be written procedures for testing materials and blood components at different stages of processing, describing the methods and equipment to be used. The tests performed should be recorded.

5.11. **Other**

5.11.1. Written release and rejection procedures should be available.

5.11.2. Records should be maintained of the distribution of blood components to facilitate recall of any unit, if necessary.

5.11.3. There should be written policies, procedures, protocols, reports and the associated records of actions taken or conclusions reached (if appropriate) for the following issues:

5.11.3.1. Validation and qualification of processes, equipment and systems.

5.11.3.2. Equipment assembly and calibration.

5.11.3.3. Maintenance, cleaning and sanitation.

5.11.3.4. Personnel matters, including signature lists, training in Good Practice and technical matters, clothing
and hygiene, and verification of the effectiveness of training.

5.11.3.5. Environmental monitoring.
5.11.3.6. Pest control.
5.11.3.7. Complaints.
5.11.3.8. Recalls.
5.11.3.9. Returns.
5.11.3.10. Change control.
5.11.3.11. Investigations of deviations and non-conformances.
5.11.3.12. Audits of compliance with internal quality/Good Practice.
5.11.3.13. Summaries of records, where appropriate (e.g. review of the quality of blood components).
5.11.3.14. Supplier audits.

5.11.4. Records should be kept for major or critical analytical testing, processing equipment, and areas where blood components have been processed. They should be used to record in chronological order (as appropriate) any use of the area, equipment/method, calibrations, maintenance, cleaning or repair operations (including the dates and identity of people who carried out these operations).

6. Blood collection, testing and processing

6.1. Donor Eligibility

6.1.1. Procedures for safe identification of donors, suitability interview, and eligibility assessment must be implemented and maintained. They must take place before each donation and comply with the requirements set out in Annex II and Annex III to

6.1.2. There must be secure and unique identification, as well as recording of the contact details, of donors. Robust mechanisms must link donors to each of their donations.

6.1.3. Upon arrival at the blood establishment, donors must provide evidence of their identity. All donors must undergo a systematic screening process to assess their suitability.

6.1.4. Only healthy persons with a good medical history can be accepted as donors of blood or blood components.

6.1.5. The selection process must include assessment of each donor carried out by a suitably qualified individual who has been trained to use accepted guidelines and who works under the direction of a physician. This assessment involves an interview, a questionnaire and further direct questions, if necessary.

6.1.6. The questionnaire must be designed to elicit information relevant to the health and lifestyle of the donor. It must be designed to be understandable by the donor and given to all donors each time they attend. On completion, it must be signed by the donor.

6.1.7. Relevant acceptance/deferral criteria must be in place at the blood establishment to control acceptance and deferral of donors.

6.1.8. The donor interview must be conducted in such a way as to ensure confidentiality (Directive/2005/62/EC/Annex 6.1.2).

6.1.9. The confidential interview must be conducted by specifically-trained staff to ask further direct questions to supplement the information in the questionnaire. The person who carries out the

6.1.11. Records should be kept for each activity associated with the selection of the donor. The record should reflect the decision to accept the donor by taking into consideration the medical history, history of deferral, donor interview, and results of the physical examination. Rejection of a donor and the reason for deferral should be recorded. A system must be in place to ensure that the donor is prevented from making future donations during a permanent or temporary deferral period (including for the duration of a temporary deferral).

6.1.12. Donors must be instructed to inform the blood establishment if signs or symptoms occur after a donation. This scenario indicates that the donation may have been infectious or that any other information not disclosed during the health screening may render prior donation unsuitable for transfusion.

6.1.13. Procedures must be in place to ensure that any abnormal findings arising from the donor selection process are properly reviewed by a qualified health professional and that appropriate action is taken.

6.2. Collection of Blood and Blood Components

6.2.1. The procedure for blood collection must be designed to ensure that the identity of the donor is verified and recorded securely, and that the link between the donor and blood, blood components and blood samples is established clearly (Directive/2005/62/EC/Annex 6.2.1).
6.2.2. Donor identity must be confirmed before each critical step in the process but, at the very least, before donor selection and venipuncture.

6.2.3. A system of unique donation numbers should be used to identify each donor and the related donation and all of its associated components, samples and records, as well as to link each one to each of the others.

6.2.4. During or following the donation, all records, blood bags and laboratory samples should be checked for the issued donation number. Donation number labels that have not been used should be discarded using a controlled procedure.

6.2.5. Systems of sterile blood bags used for the collection of blood and blood components and their processing must be CE-marked or comply with equivalent standards if the blood and blood components are collected in third countries. The batch number of the bag must be traceable for each blood component (Directive/2005/62/EC/Annex 6.2.2).

6.2.6. All handling of materials and reagents, such as receipt and quarantine, sampling, storage, labelling, processing, packaging and distribution, should be done in accordance with written procedures or instructions and, if necessary, recorded.

6.2.7. Only reagents and materials from approved suppliers that meet documented requirements and specifications should be used.


6.2.8.1. Sterile collection and processing systems for blood should be used for blood and blood components.
Collection systems should be used in accordance with manufacturer instructions.

6.2.8.2. Before venipuncture, a check should be made to ensure that the collection system to be used is not damaged or contaminated, and that it is appropriate for the intended collection. Abnormal moisture or discolouration could suggest a defect.

6.2.8.3. Appropriate procedures for hand disinfection and personal hygiene should be in place, and should be performed by personnel before each donation.

6.2.8.4. The skin at the venipuncture site must be free from lesions, including eczema.

6.2.8.5. The venipuncture site must be prepared using a defined and validated disinfection procedure. The antiseptic solution must be allowed to dry completely before venipuncture. The prepared area must not be touched with fingers before needle insertion.

6.2.8.6. The effectiveness of the disinfection procedure must be monitored and corrective action taken where it is indicated to be defective.

6.2.8.7. The expiry date of the disinfectant should be checked. The date of manufacture and the date of opening of in-house disinfectants should be stated on their labels.

6.2.8.8. The blood container must be checked after donation for any defect. The integral blood bag collection tubing should be sealed off at the end as close as possible to the blood bag and then removed.

6.2.8.9. A standard operating procedure should be in place describing the actions to be taken following an unsuccessful donation. It should specify how to handle already labelled material and the circumstances under which a repeat venipuncture might be possible.
6.2.9. Laboratory samples must be taken at the time of donation and be appropriately stored prior to testing (Directive/2005/62/EC/Annex 6.2.4).

6.2.10. The procedure used for the labelling of records, blood bags, and laboratory samples with donation numbers must be designed to avoid any risk of identification error and mix-up (Directive/2005/62/EC/Annex 6.2.5).

6.2.11. After blood collection, blood bags must be handled in a way that maintains the quality of the blood and at a storage temperature and transport temperature appropriate to the requirements for further processing (Directive/2005/62/EC/Annex 6.2.6).

6.2.12. Blood and blood components should be placed in controlled and validated conditions as soon as possible after venipuncture. Donations and samples should be transported to the processing site in accordance with procedures that ensure a constant approved temperature and secure confinement. There should be validation data to demonstrate that the method of transport maintains the blood within the specified temperature range throughout the period of transportation. Alternatively, portable temperature loggers may be used to record the temperature during transportation of blood to the processing site.

6.2.13. If a deviation occurs, it should be approved in writing by a competent person.

6.2.14. Where the blood is not transported by the processing establishment itself, the responsibilities of the transport company should be clearly defined and periodic audits should be conducted to ensure compliance.

6.2.15. There must be a system in place to ensure that each donation can be linked to the collection and
6.3. **Laboratory Testing**

6.3.1. All blood donations should be tested to ensure that they meet specifications and to ensure a high level of safety to the recipient.

6.3.2. All laboratory testing procedures must be validated before use (Directive 2005/762/EC/Annex 6.3.1).

6.3.3. In addition to the validation of the test system by the manufacturer, an on-site validation of the test system in the laboratory is required prior to its use in routine testing. This validation should demonstrate, that:

6.3.3.1. The performance specifications of the system established by the kit manufacturer are met by the laboratory.

6.3.3.2. Laboratory personnel are thoroughly instructed, trained and competent to operate the test system.

6.3.4. All donation testing activities, handling of donor specimens, sampling, analysis and data processing should be undertaken independently of diagnostic testing of patients.

6.3.5. Each step of the handling and processing of samples should be described, as should the conditions of pre-analytical treatment of specimens (e.g. centrifugation), storage and transportation (duration, temperature, type of container, storage after testing).

6.3.6. Upon receipt of samples at the laboratory, positive identification of the samples received against those expected should be carried out.

6.3.7. There must be data confirming the suitability of any laboratory reagents used in testing of donor samples.

6.3.8. Testing of blood components should be carried out in accordance with the recommendations of the manufacturer of reagents and test kits (unless an alternative method has been validated before their use) before release of the blood component.

6.3.9. Pre-acceptance testing must be performed on samples before purchasing batches of commercial reagents. Prospective purchasers must require potential suppliers to provide them with full validation data for all lots of reagents. Each lot of reagent must be qualified by the purchaser to demonstrate suitability for its intended purpose within the system used for testing.

6.3.10. There must be a reliable process in place for transcribing, collating and interpreting results.

6.3.11. The quality of the laboratory testing must be assessed regularly by participation in a formal system of proficiency testing, such as an external quality-assurance programme (Directive/2005/62/EC/Annex 6.3.5).

6.4. **Testing for infectious markers**

6.4.1. Testing of donations for infectious agents is a key factor in ensuring that the risk of disease transmission is minimised and that blood components are suitable for their intended purpose.

6.4.3. Additional testing for other agents or markers may be required, taking into account the epidemiological situation in any given region or country.

6.4.4. Serological testing should be performed on samples transferred directly into the analyser from the original sample tube. Secondary aliquot samples may be used for NAT testing of mini-pools of individual samples.

6.4.5. If NAT testing is performed by assembling various samples in mini-pools, a thoroughly validated system of labelling/identification of samples, a validated strategy and pooling process, and a validated algorithm to re-assign pool results to individual donations should be in place.

6.4.6. There must be clearly defined procedures to resolve discrepant results. Blood and blood components that have a repeatedly reactive result in a serological screening test for infection with the viruses mentioned in Annex IV to Directive 2002/98/EC must be excluded from therapeutic use and must be stored separately in a dedicated environment. Appropriate confirmatory testing must take place. In the case of confirmed positive results, appropriate donor management must take place, including the provision of information to the donor and follow-up procedures (Directive 2005/62/EC/Annex 6.3.3).

6.4.7. Screening algorithms should be defined precisely in writing (i.e. standard operating procedures) to deal with initially reactive specimens, and to resolve discrepancies in results after re-testing.

6.5. **Blood Group Serological Testing of Donors and Donations**

6.5.1. Blood group serology testing must include procedures for testing specific groups of donors (e.g. first-

6.5.2. Each donation should be tested for ABO and RhD blood groups and at least all first-time donors should be tested for clinically-significant irregular red-cell antibodies.

6.5.3. ABO and RhD blood groups should be verified on each subsequent donation.

6.5.5. Comparison should be made with the historically determined blood group. If a discrepancy is found, the applicable blood components should not be released until the discrepancy has been resolved unequivocally.

6.5.6. Donors with a history of transfusions or pregnancy since their last donation should be tested for clinically-significant irregular red-cell antibodies. If clinically significant red-cell antibodies are detected and, if applicable, the blood or blood component should be labelled accordingly.

6.5.7. Only test reagents that have been licensed or evaluated and considered to be suitable by a responsible National Health Authority/Competent Authority must be used. In the EU, these reagents are considered as in vitro diagnostic devices and must be CE-marked.

6.5.8. EU Directive 98/79/EC classifies ABO, Rh (C, c, D, E, e) anti-Kell reagents in list A of Annex II. The manufacturer of such reagents must have a full Quality System certified by an authorised body, and must submit an application containing all the control results for each lot.

6.5.9. Quality-control procedures must be implemented for the equipment, reagents and techniques used for ABO and RhD blood grouping, phenotyping as well as detection and identification of allo-antibodies. The
frequency of the control is dependent on the method used.

6.6. Processing and Validation

6.6.1. All equipment and technical devices must be used in accordance with validated procedures (Directive/2005/62/EC/Annex 6.4.1).

6.6.2. The processing of blood components must be carried out using appropriate and validated procedures, including measures to avoid the risk of contamination and microbial growth in the prepared blood components (Directive/2005/62/EC/Annex 6.4.2).

6.6.3. The use of closed systems is strongly recommended for all steps in component processing. Open systems may exceptionally be necessary due to local constraints and should be undertaken in an environment specifically designed to minimize the risk of bacterial contamination. When open systems are used, careful attention should be given to the use of aseptic procedures.

6.6.4. Validation of freezing processes should consider worst-case scenarios that take into account minimum and maximum loads and positions in the freezer.

6.6.5. Sterile connecting devices must be used in accordance with a validated procedure. When validated, connections made using sterile connecting devices are regarded as closed system processing. The resulting weld must be checked for satisfactory alignment and its integrity must be confirmed.

6.7. Labelling

6.7.1. At all stages, all containers must be labelled with relevant information on their identity. In the absence of a validated computerised system for status control,
the labelling must clearly distinguish released from non-released units of blood and blood components (Directive 2005/62/EC/Annex 6.5.1).

6.7.2 Type of label to be used, as well as the labelling methodology, should be defined and established in written standard operating procedures.

6.7.3 Labels applied to containers, equipment or premises should be clear, unambiguous and in the agreed format of the blood establishment.


6.7.5 Blood establishments responsible for the preparation of blood components must provide clinical users of blood components with information on their use, composition, and any special conditions that do not appear on the component label.

6.7.6 For autologous blood and blood components, the label must also comply with Article 7 of Directive 2004/33/EC and the additional requirements for autologous donations specified in Annex IV to that Directive (Directive 2005/62/EC/Annex 6.5.3).

6.8. Release of Blood and Blood Components

6.8.1 There must be a safe and secure system to prevent any single blood sample and blood component from being released before all mandatory requirements set out in Directive 2005/62/EC have been fulfilled. Each blood
establishment must be able to demonstrate that each blood or blood component has been formally released by an authorised person. Records must demonstrate that before a blood component has been released, all current declaration forms, relevant medical records, and test results have met all acceptance criteria (Directive 2005/62/EC/Annex 6.6.1).

6.8.2. There should be a standard operating procedure that details the actions and criteria that determine whether the blood or blood component can be released. The release criteria and specifications of blood components should be defined, validated, documented and approved.

6.8.3. There should be a defined procedure for exceptional release of non-standard blood and blood components under a planned non-conformance system. The decision to allow such release should be documented clearly and traceability should be ensured.

6.8.4. Before release, blood and blood components must be kept administratively and physically segregated from released blood and blood components. In the absence of a validated computerised system for status control, the label of a unit of blood or blood component must identify the release status in accordance with point 6.5.1. stated above (Directive 2005/62/EC/Annex 6.5.1 and 6.6.2).

6.8.5. There should be a system of administrative and physical quarantine for blood and blood components to ensure that components cannot be released until all mandatory requirements have been met.

6.8.6. In the event that the final component fails to be released due to a confirmed positive test result for infection for an agent mentioned in Annex IV of Directive 2002/98/EC, a check must be made to ensure
that other components from the same donation and components prepared from previous donations given by the donor have been identified. An immediate update must be made to the donor record (Directive 2005/62/EC Annex 6.3.2, 6.3.3 and 6.6.3).

6.8.7. In the event that a final component fails release due to a potential impact on patient safety, the donor record must be immediately updated to ensure, where appropriate, that the donor(s) cannot make a further donation.

7. **Storage and distribution**


7.2. Procedures for storage and distribution must be validated to ensure the quality of blood and blood components during the entire storage period, and to exclude mix-ups of blood components. All transportation and storage actions, including receipt and distribution, must be defined by written procedures and specifications (Directive 2005/62/EC/Annex 7.2).

7.3. Storage conditions must be controlled, monitored and checked. Appropriate alarms must be present and checked regularly; all checks must be recorded. Appropriate actions on alarms must be defined.

7.4. There should be a system to ensure stock rotation with regular and frequent checks that the system is operating correctly. Blood and blood components
beyond their expiry date or shelf-life should be separated from usable stock.

7.5. Before distribution, blood components must be visually inspected.

7.6. Autologous blood and blood components, as well as blood components collected and prepared for specific purposes, must be stored separately (Directive 2005/62/EC/Annex 7.3).


7.8. Records should be kept of the distribution of blood components between blood establishments, blood establishments and hospital blood banks and between hospital blood banks. These records should show the date of supply, unique component identifier and name of the blood component, the quantity received or supplied, name and address of the supplier or consignee.

7.9. Packaging must maintain the integrity and storage temperature of blood and blood components during distribution and transportation (Directive 2005/62/EC/Annex 7.5).

7.10. Return of blood and blood components into inventories for subsequent re-issue must be allowed only if all requirements and procedures relating to quality as laid down by the blood establishment to ensure the integrity of blood components are fulfilled (Directive 2005/62/EC/Annex 7.6).

7.11. Blood components must not be returned to the blood establishment for subsequent distribution unless there is a procedure for the return of blood components that is regulated by a contract, and if there is documented evidence for each returned blood component that
the agreed storage conditions have been met. Before subsequent distribution, records must identify that the blood component has been inspected before re-issue.

8. Contract management

8.1. General Principles

8.1.1. Tasks that are performed externally must be defined in a specific written contract (Directive 2005/62/EC/Annex 8).

8.1.2. Tasks that are performed externally and that may impact on the quality, safety or efficacy of the blood components must be defined in a specific written contract or agreement, including any technical arrangements made in connection with it.

8.1.3. All outsourced arrangements for the collection, processing and testing of blood, including any proposed changes, must be in accordance with a written contract, with reference to the specification for the blood or blood component(s) concerned.

8.1.4. Responsibilities of each party in the distribution chain must be documented to ensure that the principles of Good Practice are maintained.

8.1.5. The Contract Giver is the establishment or institution that sub-contracts particular work or services to a different institution and is responsible for setting up a contract defining the duties and responsibilities of each side.

8.1.6. The Contract Acceptor is the establishment or institution that performs particular work or services under a contract for a different institution.
8.2. The Contract Giver

8.2.1. The Contract Giver is responsible for assessing the competence of the Contract Acceptor to successfully carry out the work being outsourced and for ensuring, by means of the contract, that the principles and guidelines of Good Practice are followed.

8.2.2. The Contract Giver should provide the Contract Acceptor with all the information necessary to carry out the contracted operations correctly and in accordance with the specification and any other legal requirements. The Contract Giver should ensure that the Contract Acceptor is fully aware of any problems associated with the materials, samples or the contracted operations that might pose a hazard to the premises, equipment, personnel, other materials or other blood components of the Contract Acceptor.

8.2.3. The Contract Giver should ensure that all blood and blood components, analytical results, and materials delivered by the Contract Acceptor comply with their specifications, and that they have been released under a Quality System approved by the Responsible Person or other authorised person.

8.3. The Contract Acceptor

8.3.1. The Contract Acceptor should have adequate premises, equipment, knowledge, experience and competent personnel to satisfactorily carry out the work requested by the Contract Giver.

8.3.2. The Contract Acceptor should ensure that all products, materials or test results delivered by the Contract Giver are suitable for their intended purpose.

8.3.3. The Contract Acceptor should not pass to a third party any of the work entrusted under the contract without the Contract Giver’s prior evaluation and
approval of the arrangements. Arrangements made between the Contract Acceptor and any third party should ensure that the relevant collection, processing and testing information relating to blood is made available in the same way as between the original Contract Giver and Contract Acceptor.

8.3.4. The Contract Acceptor should refrain from any activity that may adversely affect the quality of the blood and blood components prepared and/or analysed for the Contract Giver.

8.4. The Contract

8.4.1. A contract should be drawn up between the Contract Giver and the Contract Acceptor that specifies their respective responsibilities in relation to contracted operations.

8.4.2. The contract should specify the procedure, including the necessary requirements to be provided by the Contract Acceptor, by which the Responsible Person or other authorised person releasing the blood and blood components for sale or supply can ensure that each component has been prepared and/or distributed in compliance with the requirements of Good Practice and regulatory requirements.

8.4.3. The contract should clearly describe who is responsible for purchasing materials, testing and releasing materials, undertaking blood collection, and for processing and testing (including in-process controls). In the case of subcontracted analyses, the contract should state the arrangements for the collection of samples, and the Contract Acceptor should understand that he/she may be subject to inspections by the Competent Authorities.
8.4.4. Records of preparation and distribution, including reference samples (if relevant) should be kept by, or be available to, the Contract Giver. Any records relevant to assessment of the quality of the blood or a blood component in the event of complaints or a suspected defect must be accessible and specified in the defect/recall procedures of the Contract Giver.

8.4.5. The contract should permit the Contract Giver to audit the facilities of the Contract Acceptor.

9. **Non-conformance**

9.1. **Deviations**

9.1.1. Blood components deviating from the quality and safety standards set out in the Standards section of *Chapter 5 – Component Monographs* and, if appropriate, Annex V to Directive 2004/33/EC, must be released for transfusion only in exceptional circumstances and with the recorded agreement of the prescribing physician and the physician at the blood establishment (Directive 2005/62/EC/Annex 9.1).

9.1.2. There must be a defined procedure for the release of non-standard blood and blood components under a planned non-conformance system. The decision for such release must be documented clearly and authorised by a designated person, and traceability must be ensured.

9.1.3. There must be systems in place to ensure that deviations, adverse events, adverse reactions and non-conformances are documented, carefully investigated for causative factors of any defect and, if necessary, followed up by implementation of corrective actions to prevent recurrence.
9.1.4. The Corrective and Preventive Actions (CAPAs) system must ensure that existing non-conformity or quality problems of components are corrected, and that recurrence of the problem is prevented.

9.1.5. Deviations from established procedures should be avoided as much as possible and must be documented and explained. Any errors, accidents or significant deviations that may affect the quality or safety of blood and blood components must be fully recorded and investigated in order to identify systematic problems that require corrective action. Appropriate Corrective and Preventative Actions (CAPAs) must be defined and implemented.

9.1.6. Investigations relating to serious deficiencies, significant deviations and serious component defects must include an assessment of component impact, including a review and evaluation of relevant operational documentation and an assessment of deviations from specified procedures.

9.1.7. There must be procedures for notifying the management responsible in a timely manner of deficiencies, deviations or non-compliances with regulatory commitments (e.g. in submissions and responses to regulatory inspections), component or product defects, or testing errors and related actions (e.g. quality-related complaints, recalls, regulatory actions).

9.1.8. Executive management and the Responsible Person should be notified in a timely manner of serious deficiencies, significant deviations and serious defects in components or products, and adequate resource must be made available for their timely resolution.

9.1.9. Regular review of all significant deviations or non-conformances should be conducted, including their
related investigations, to verify the effectiveness of the corrective and preventative actions taken.

9.2. Complaints

9.2.1. All complaints and other information (including serious adverse reactions and serious adverse events that may suggest that defective blood components have been issued) must be documented, carefully investigated for causative factors of the defect and, if necessary, followed up by recall and implementation of corrective actions to prevent recurrence. Procedures must be in place to ensure that Competent Authorities are notified, as appropriate, of serious adverse reactions or serious adverse events in accordance with regulatory requirements (Directive 2005/62/EC/Annex 9.2).

9.2.2. A person should be designated as responsible for handling complaints and deciding the measures to be taken. This person should have sufficient support staff. If this individual is not the Responsible Person, then the Responsible Person should be made aware of any complaint, investigation or recall.

9.2.3. If a defect or testing error in blood or a blood component is discovered or suspected, consideration should be given to checking related blood and blood components to determine whether they have also been affected.

9.2.4. All the decisions and measures taken as a result of a complaint should be recorded. Complaint records should be reviewed regularly for any indication of specific or recurring problems necessitating attention, and possible recall of distributed blood and blood components.
9.2.5. The Competent Authorities should be informed in the case of complaints resulting from possible faulty processing, component deterioration or any other serious quality problems, including the detection of counterfeiting.

9.3. **Recall**

9.3.1. There must be personnel authorised within the blood establishment to assess the need for recalls of blood and blood components as well as to initiate and co-ordinate necessary actions (Directive 2005/62/EC/Annex 9.3.1).

9.3.2. An effective recall procedure must be in place, including description of the responsibilities and actions to be taken. This must include notification of the Competent Authority (Directive 2005/62/EC/Annex 9.3.2).

9.3.3. Actions must be taken within pre-defined periods of time and must include tracing all relevant blood components and, if applicable, must include trace-back. The purpose of the investigation is to identify any donor who might have contributed to causing the transfusion reaction and to retrieve available blood components from that donor, as well as to notify consignees and recipients of components collected from the same donor in the event that they might have been put at risk (Directive 2005/62/EC/Annex 9.3.3).

9.3.4. The personnel authorised to initiate and co-ordinate recall actions should be independent of the commercial management within the organisation. If these personnel are not the Executive Management or Responsible Person (Blood), the latter should be made aware of any recall operation.
9.3.5. Recalled blood components or products should be identified and stored separately in a secure area while awaiting a decision on their fate.

9.3.6. Progress of the recall process should be recorded and a final report issued, including reconciliation of the delivered and recovered quantities of blood and blood components or products.

9.3.7. Effectiveness of the arrangements for recalls should be evaluated regularly.

9.4. Corrective and Preventive Actions (CAPAs)

9.4.1. A system to ensure corrective and preventive actions for blood component non-conformity and quality problems must be in place (Directive 2005/62/EC/Annex 9.4.1).

9.4.2. Data must be analysed routinely to identify quality problems that may require corrective action, or to identify unfavourable trends that may require preventive action (Directive 2005/62/EC/Annex 9.4.2).

9.4.3. All errors and accidents must be documented and investigated in order to identify problems for correction (Directive 2005/62/EC/Annex 9.4.3).

9.4.4. Deviations that have the potential to affect quality should be investigated, and the investigation and its conclusions must be documented. Where appropriate, corrective actions should be taken prior to distribution of blood and blood components or reporting of a test result. The potential impact of the source of the deviation on other components or results should also be considered, and preventive action should be taken to eliminate the root cause of the deviation to avoid recurrences.
9.4.5. Processes and relevant data should be monitored with a view to taking preventive action to avoid potential deviations occurring in the future. Where appropriate, statistical or other tools should be used to assess and monitor process capabilities.

9.4.6. As part of periodic Quality System reviews, an assessment should be made of whether CAPAs or any re-validation should be undertaken. The reasons for such corrective actions should be documented. Agreed CAPAs should be completed in a timely and effective manner. There should be procedures for the ongoing management and review of these actions. The effectiveness of these procedures should be verified during self-inspection.

10. **Self-inspection, audits and improvements**

10.1. Self-inspection or audit systems must be in place for all elements of operations to verify compliance with the standards set out in the Annex to Directive 2005/62/EC. They must be carried out regularly by trained and competent persons, in an independent way, and according to approved procedures (Directive 2005/62/EC/Annex 10.1).

10.2. All results must be documented and appropriate corrective and preventive actions must be taken in a timely and effective manner (Directive 2005/62/EC/Annex 10.2).

11. **Quality monitoring and control**

11.1. **Quality Monitoring**

11.1.1. Acceptance criteria must be based on a defined specification (see Standards, Chapter 5 – Component Monographs) for each blood donation and blood component.
11.2. Quality Control

11.2.1. All quality control procedures must be validated before use.

11.2.2. Results of quality-control testing must be evaluated continuously and steps taken to correct defective procedures or equipment.

11.2.3. Standard procedures for the quality control of blood components must be in place. The suitability of each analytical method to provide the intended information must be validated.

11.2.4. Quality control of blood and blood components must be carried out according to a sampling plan designed to provide the intended information.

11.2.5. Testing must be done in accordance with the instructions recommended by the manufacturer of the reagents and/or test kits.

11.2.6. The performance of the testing procedures must be regularly assessed by participation in a formal system of proficiency testing.

11.2.7. Records of quality-control procedures must include identification of the person(s) undertaking the tests or procedures. Any corrective action taken must also be recorded. If corrections in records are necessary, the original recording must not be obliterated, but must remain legible.
APPENDIX 1.
KEY CRITERIA FOR DONOR ELIGIBILITY
The Standards require medical assessment to be undertaken on all prospective donors using a combination of interview, questionnaire and, if necessary, further direct questions. The questionnaire must be designed to elicit information on the health and lifestyle on the donor that may adversely affect the safety of both the recipient and the donor.

Blood establishments should develop a questionnaire that is appropriate for local circumstances. Therefore, it is not possible to provide a generic questionnaire in this *Guide*.

Instead, key eligibility topics for donor inclusion in the questionnaire or direct questions in an interview have been developed and are included in the table below.

Key eligibility topics identified as being critical for the safety of donors and recipients are labelled as ‘core’. It is recommended that countries include a question which meets the described intent of the core topics for donor eligibility in their donor questionnaire. Examples of such questions are included, but the wording may be changed provided the question still meets the described intent.

A number of key eligibility topics have also been identified that may be considered to be important for the safety of donors and recipients dependent on local arrangements and circumstances in blood establishments. These are labelled as ‘optional’. The blood establishment may choose to include or not include such questions.

Core and optional sample questions have been categorised into those which apply only to first-time and repeat donors, and those which also apply to regular donors.

Blood establishments may also choose to include additional questions. These recommendations are intended as a guide. Final responsibility for the content of the donor questionnaire lies with the blood establishment and Competent Authorities.
## Appendix 1. Key criteria for donor eligibility

<table>
<thead>
<tr>
<th>Key evaluative topic for donor eligibility</th>
<th>Intent of question</th>
<th>Core sample question</th>
<th>Optional sample question</th>
<th>First-time &amp; repeat donors</th>
<th>Regular donors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GENERAL</strong> — health</td>
<td>To assess general health and provide the donor with an opportunity to volunteer health issues that may not be addressed by specific questions.</td>
<td>Are you in good health?</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td><strong>GENERAL</strong> — previous donation history</td>
<td>A donor who has previously volunteered to donate should have a record, which may contain important information regarding their ongoing eligibility. Countries with more than one blood establishment could also have donors who present at different establishments.</td>
<td>Have you ever volunteered to donate blood before?</td>
<td>Y</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td><strong>GENERAL</strong> — previous deferral</td>
<td>To identify people who have been permanently deferred from donating blood previously.</td>
<td>Have you previously been told not to give blood?</td>
<td>Y</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Key evaluative topic for donor eligibility</td>
<td>Intent of question</td>
<td>Core sample question</td>
<td>Optional sample question</td>
<td>First-time &amp; repeat donors</td>
<td>Regular donors</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>GENERAL – weight</td>
<td>Total blood volume is proportional to donor weight. Donors must weigh at least 50 kg to safely donate blood.</td>
<td>Is your weight over 50 kg?</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>GENERAL – donor comprehension</td>
<td>Efficacy of the donor interview process requires the donor to firstly understand the questions being asked of him/her and then to truthfully and accurately complete the questionnaire to the best of his/her knowledge. NOTE: If not included as an optional question, then Blood Establishments should include as part of the donor declaration to assist gaining written informed consent.</td>
<td>Have you read and understood the above questions and do you affirm that you have answered the questions truthfully and to the best of your knowledge?</td>
<td>Y</td>
<td>Y</td>
<td></td>
</tr>
</tbody>
</table>
### Appendix 1. Key criteria for donor eligibility

<table>
<thead>
<tr>
<th>Key evaluative topic for donor eligibility</th>
<th>Intent of question</th>
<th>Core sample question</th>
<th>Optional sample question</th>
<th>First-time &amp; repeat donors</th>
<th>Regular donors</th>
</tr>
</thead>
</table>
| SERIOUS ILLNESS — examples                | To capture any history of serious illness, using examples of common and important serious illnesses that have implications for donor and/or recipient safety. Each example listed would require deferral or further assessment of eligibility. | Have you ever suffered from any serious illness? Examples include:  
  - jaundice, malaria, tuberculosis, rheumatic fever?  
  - heart disease, high or low blood pressure?  
  - severe allergy, asthma?  
  - convulsions or diseases of the nervous system?  
  - chronic diseases such as diabetes or malignancies? | Y | N |
<p>| SERIOUS ILLNESS — physician and hospital visits | Illness that is serious enough to require medical consultation may be relevant to donor selection. | Since your last donation, have you been to see a doctor or to hospital? | N | Y |</p>
<table>
<thead>
<tr>
<th>Key evaluative topic for donor eligibility</th>
<th>Intent of question</th>
<th>Core sample question</th>
<th>Optional sample question</th>
<th>First-time &amp; repeat donors</th>
<th>Regular donors</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAZARDOUS OCCUPATIONS &amp; HOBBIES</td>
<td>To identify donors with occupations or hobbies that may put them or other people at risk in the event of a delayed vasovagal reaction following blood donation.</td>
<td>Do you have a hazardous occupation or hobby such as driving public transport, operating heavy machinery, underwater diving and piloting a plane or other activities?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
## Appendix 1. Key criteria for donor eligibility

<table>
<thead>
<tr>
<th>Key evaluative topic for donor eligibility</th>
<th>Intent of question</th>
<th>Core sample question</th>
<th>Optional sample question</th>
<th>First-time &amp; repeat donors</th>
<th>Regular donors</th>
</tr>
</thead>
<tbody>
<tr>
<td>PREGNANCY</td>
<td>To protect donors from iron depletion +/- risk of vasovagal reaction in late pregnancy. Donors who have recently become pregnant should be deferred temporarily to allow time for iron stores to replenish.</td>
<td>For women: Are you or have you become pregnant in the previous 6 months?</td>
<td>Have you ever been pregnant?</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>To identify donors whose blood donations may contain HLA or granulocyte antibodies and thereby pose a higher risk of TRALI. These antibodies may develop in response to exposure to foetal antigens during pregnancy.</td>
<td></td>
<td></td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Key evaluative topic for donor eligibility</td>
<td>Intent of question</td>
<td>Core sample question</td>
<td>Optional sample question</td>
<td>First-time &amp; repeat donors</td>
<td>Regular donors</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Medications – general</td>
<td>Medications may render blood donations partly or completely unsuitable for use. This question also serves as an additional prompt for underlying disease, and therefore the indications for each medication should also be determined.</td>
<td>Have you taken any medications recently?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Medications Platelet affecting drugs</td>
<td>Some medications affect platelet function. This question can also serve to capture chronic pain or inflammation.</td>
<td>In the last 48 hours have you taken any aspirin, pain killers or anti-inflammatory medications?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
### Key evaluative topic for donor eligibility

<table>
<thead>
<tr>
<th>Key evaluative topic for donor eligibility</th>
<th>Intent of question</th>
<th>Core sample question</th>
<th>Optional sample question</th>
<th>First-time &amp; repeat donors</th>
<th>Regular donors</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEDICATIONS – teratogenic</td>
<td>Medications with known teratogenic potential require donor deferral to cover the maximum potential period that the drug will circulate in the donor’s peripheral blood, with a subsequent risk if the donation is transfused to a pregnant recipient.</td>
<td>Have you ever had medication with:</td>
<td></td>
<td></td>
<td>Y Y</td>
</tr>
<tr>
<td></td>
<td>- isotretinoin (eg Accutane R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- etretinate (eg Tigason R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- acitretin (eg Neotigason R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- finasteride (eg Proscar R, Propecia R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- dutasteride (eg Avodart R)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEDICATIONS – vaccinations</td>
<td>Recent vaccination may harm immunocompromised blood recipients through the transmission of live/attenuated pathogens, and may also interfere with the interpretation of donor screening tests, such as HBsAg.</td>
<td>Have you had any vaccinations in the last 8 weeks?</td>
<td></td>
<td></td>
<td>Y Y</td>
</tr>
<tr>
<td>BLOODBORNE RISKS – intravenous use of drugs</td>
<td>Injecting drug use is an important route of transmission for blood-borne infections including HIV, hepatitis B and C.</td>
<td>Have you ever used needles to take drugs, steroids, or anything not prescribed by your doctor?</td>
<td></td>
<td></td>
<td>Y Y</td>
</tr>
<tr>
<td>Key evaluative topic for donor eligibility</td>
<td>Intent of question</td>
<td>Core sample question</td>
<td>Optional sample question</td>
<td>First-time &amp; repeat donors</td>
<td>Regular donors</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>-------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>SEXUAL ACTIVITY – sex worker</td>
<td>In many countries, sex workers have a significantly higher prevalence of blood-borne and sexually transmitted infections than the general population.</td>
<td>Have you ever received payment (gifts, money or drugs) for sex?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>SEXUAL ACTIVITY – male to male sex</td>
<td>Male to male sex is associated with a higher risk of HIV. This group also has a higher risk of syphilis, gonorrhoea, as well as infection by hepatitis B and hepatitis A viruses.</td>
<td>For men: have you had male to male sex in the [specified time period]? (For the purpose of this question, sex is defined as oral or anal intercourse with or without a condom.)</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>SEXUAL ACTIVITY – female partner of man who has sex with men</td>
<td>Men who have sex with men have a higher risk of HIV infection and other sexually transmitted diseases. Therefore, women who have sexual contact with men in this group have a higher risk of such diseases than other women.</td>
<td>For women: to the best of your knowledge, has any man with whom you have had sex in the [specified time period] ever had sex with another man? (For the purpose of this question, sex is defined as oral, vaginal or anal intercourse with or without a condom.)</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
### Appendix 1. Key criteria for donor eligibility

<table>
<thead>
<tr>
<th>Key evaluative topic for donor eligibility</th>
<th>Intent of question</th>
<th>Core sample question</th>
<th>Optional sample question</th>
<th>First-time &amp; repeat donors</th>
<th>Regular donors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SEXUAL ACTIVITY – at-risk sexual partner</strong></td>
<td>A donor with a known history of sexual contact with persons in these risk groups has a higher risk of infection by HIV and/or hepatitis.</td>
<td>In the past [specified time period] have you had sexual contact with someone who:</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• is HIV positive or has hepatitis?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• has ever used needles to take drugs, steroids, or anything not prescribed by his/her doctor?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• receives or has received payment (gifts, money or drugs) for sex?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Donors who have had sex with a new sexual partner may be at higher risk of infection by HIV and other sexually transmitted diseases.</td>
<td>Have you had sex with a new partner within the past 4 months?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Some countries have a high prevalence of HIV. Sexual contact with residents or former residents of those countries is a risk factor for HIV exposure.</td>
<td>Since your last donation (or, if a new donor, in the last 12 months) have you had sex with a new partner who currently lives or previously lived in another country?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Key evaluative topic for donor eligibility</td>
<td>Intent of question</td>
<td>Core sample question</td>
<td>Optional sample question</td>
<td>First-time &amp; repeat donors</td>
<td>Regular donors</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>TRAVEL – entry question</td>
<td>Several infectious diseases relevant to blood safety are restricted to certain geographical regions. These include variant Creutzfeldt-Jakob disease (vCJD), malaria, Chagas disease, and other vector-borne diseases such as West Nile virus, dengue fever and chikungunya.</td>
<td>Were you born or have you lived and/or travelled abroad?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>TRAVEL – malaria semi-immunity</td>
<td>A country without endemic malaria can use this question to flag for possible malaria semi-immunity.</td>
<td>Have you ever spent a continuous period of 6 months or more abroad? If so, check whether the donor spent any continuous period of 6 months or more in a malaria-endemic area.</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>TRAVEL – malaria exposure</td>
<td>A donor who visits a malaria risk area could harbour asymptomatic infection after returning to their country of residence.</td>
<td>Have you been abroad since your last donation (or, for new donors, in the last 12 months)? If so, check whether the donor visited any malaria-endemic areas.</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
## Appendix 1. Key criteria for donor eligibility

<table>
<thead>
<tr>
<th>Key evaluative topic for donor eligibility</th>
<th>Intent of question</th>
<th>Core sample question</th>
<th>Optional sample question</th>
<th>First-time &amp; repeat donors</th>
<th>Regular donors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TRAVEL – unexplained fever</strong></td>
<td>A donor who visits a malaria risk area could harbour asymptomatic infection after returning to their country of residence.</td>
<td>Have you ever had an unexplained fever after travelling abroad? If so, check whether it was within 6 months of visiting a malaria-endemic area.</td>
<td></td>
<td><strong>Y</strong></td>
<td><strong>Y</strong></td>
</tr>
<tr>
<td><strong>TRAVEL – Chagas’ exposure</strong></td>
<td>To identify donors who were born in a Chagas-endemic country, and hence are suitable only for plasma derivative production.</td>
<td>What was your country of birth?</td>
<td></td>
<td><strong>Y</strong></td>
<td><strong>N</strong></td>
</tr>
<tr>
<td><strong>TRAVEL – vCJD exposure</strong></td>
<td>The core geographical risk of variant Creutzfeldt-Jakob disease (vCJD) has been defined as extending from 1980 to 1996 in the United Kingdom. In each individual blood establishment, risk assessment should define the appropriate cumulative period and whether additional countries should be added to the risk zone.</td>
<td>From 1980 to 1996 inclusive, did you spend 6 months or more (cumulative) in the UK?</td>
<td></td>
<td><strong>Y</strong></td>
<td><strong>N</strong></td>
</tr>
<tr>
<td>Key evaluative topic for donor eligibility</td>
<td>Intent of question</td>
<td>Core sample question</td>
<td>Optional sample question</td>
<td>First-time &amp; repeat donors</td>
<td>Regular donors</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>--------------------</td>
<td>---------------------</td>
<td>--------------------------</td>
<td>----------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>OTHER BLOOD-BORNE RISKS — hepatitis</td>
<td>To identify donors with occupational or household exposure to hepatitis, and trigger appropriate clearance/immunity testing.</td>
<td>Have you been exposed to hepatitis or jaundice (via family, household or occupation) in the past 6 months?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>OTHER BLOOD-BORNE RISKS — flexible endoscopy</td>
<td>Some countries have reported an association between procedures employing flexible endoscopy and hepatitis C infection.</td>
<td>Have you had an endoscopy or gastroscopy in the last 4 months? If so, was a flexible instrument used and was any biopsy performed?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>OTHER BLOOD-BORNE RISKS — dental</td>
<td>Tooth extraction and other dental procedures can be associated with transient bacteraemia, which can theoretically cause bacterial contamination of fresh blood components.</td>
<td>Have you had any dental treatment in the last week?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
## Appendix 1. Key criteria for donor eligibility

<table>
<thead>
<tr>
<th>Key evaluative topic for donor eligibility</th>
<th>Intent of question</th>
<th>Core sample question</th>
<th>Optional sample question</th>
<th>First-time &amp; repeat donors</th>
<th>Regular donors</th>
</tr>
</thead>
</table>
| OTHER BLOOD-BORNE RISKS – invasive procedures | Invasive procedures can be a source of blood-borne infection. The donor may require temporary deferral to exclude window period transmission of infectious disease. | Since your last donation or in the previous 6 months have you had:  
- an operation or medical investigations?  
- any body piercing and/or tattoo?  
- acupuncture treatment by anyone other than a registered practitioner?  
- an accidental injury involving a needle and/or mucous membrane exposure to human blood? | | Y | Y |
<p>| OTHER BLOOD-BORNE RISKS – familial CJD | Classical CJD (CJD) may potentially be transmitted by blood transfusion. | Have you been told of a family history of Creutzfeldt-Jakob disease (CJD)? | | Y | Y |
| OTHER BLOOD-BORNE RISKS – pituitary extracts | Most reported cases of iatrogenic CJD have been associated with human-derived pituitary hormone treatment. | Have you ever had treatment with human pituitary extracts? | | Y | N |</p>
<table>
<thead>
<tr>
<th>Key evaluative topic for donor eligibility</th>
<th>Intent of question</th>
<th>Core sample question</th>
<th>Optional sample question</th>
<th>First-time &amp; repeat donors</th>
<th>Regular donors</th>
</tr>
</thead>
<tbody>
<tr>
<td>OTHER BLOOD-BORNE RISKS – transplantation</td>
<td>Transplantation may result in the transmission of a range of infectious diseases, and corneal transplantation and dura mater grafts have been reported as causes of iatrogenic CJD?</td>
<td>Have you ever had a transplant or graft (organ, bone marrow, cornea, dura mater, bone, etc)?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>OTHER BLOOD-BORNE RISKS – cuts and abrasions</td>
<td>Broken or inflamed skin is a potential source of bacterial contamination. A rash may be a sign of underlying disease.</td>
<td>Do you have any cuts, abrasions or sores?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>OTHER BLOOD-BORNE RISKS – gastrointestinal symptoms</td>
<td>Gastrointestinal symptoms could be associated with conditions which impact both recipient safety (e.g. Yersinia enterocolitica) and donor safety (e.g. hypokalaemia secondary to vomiting and diarrhoea).</td>
<td>In the past week, have you had any diarrhoea, abdominal pain or vomiting?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Key evaluative topic for donor eligibility</td>
<td>Intent of question</td>
<td>Core sample question</td>
<td>Optional sample question</td>
<td>First-time &amp; repeat donors</td>
<td>Regular donors</td>
</tr>
<tr>
<td>------------------------------------------</td>
<td>--------------------</td>
<td>----------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>OTHER BLOOD-BORNE RISKS – transfusion</td>
<td>Blood transfusion may cause transmission of blood-borne infections, including geographically restricted infections such as vCJD and Chagas’ disease.</td>
<td>Have you ever received a blood transfusion or injection of blood products? If so, where and when?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>OTHER BLOOD-BORNE RISKS – positive infectious disease testing</td>
<td>HIV, hepatitis B, hepatitis C and HTLV are transfusion-transmissible infectious agents, and all may be transmitted between partners by sexual or blood contact.</td>
<td>Are you or is your partner positive for HIV, hepatitis B, hepatitis C or HTLV?</td>
<td></td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
APPENDIX 2.
TABLES FOR CALCULATION OF BLOOD VOLUMES
Table 1. Blood volume of women in mL as calculated according to the ICSH formula

The weights and heights corresponding to the minimum acceptable blood volumes of 3,233 mL, 3,400 mL and 3,567 mL are indicated with grey backgrounds.

<table>
<thead>
<tr>
<th>kg</th>
<th>50</th>
<th>51</th>
<th>52</th>
<th>53</th>
<th>54</th>
<th>55</th>
<th>56</th>
<th>57</th>
<th>58</th>
<th>59</th>
</tr>
</thead>
<tbody>
<tr>
<td>145 cm</td>
<td>3141</td>
<td>3167</td>
<td>3193</td>
<td>3219</td>
<td>3244</td>
<td>3269</td>
<td>3294</td>
<td>3319</td>
<td>3343</td>
<td>3367</td>
</tr>
<tr>
<td>146 cm</td>
<td>3157</td>
<td>3183</td>
<td>3209</td>
<td>3235</td>
<td>3260</td>
<td>3285</td>
<td>3310</td>
<td>3335</td>
<td>3359</td>
<td>3384</td>
</tr>
<tr>
<td>147 cm</td>
<td>3172</td>
<td>3199</td>
<td>3225</td>
<td>3251</td>
<td>3276</td>
<td>3301</td>
<td>3327</td>
<td>3351</td>
<td>3376</td>
<td>3400</td>
</tr>
<tr>
<td>148 cm</td>
<td>3187</td>
<td>3214</td>
<td>3240</td>
<td>3266</td>
<td>3292</td>
<td>3318</td>
<td>3343</td>
<td>3368</td>
<td>3392</td>
<td>3417</td>
</tr>
<tr>
<td>149 cm</td>
<td>3203</td>
<td>3230</td>
<td>3256</td>
<td>3282</td>
<td>3308</td>
<td>3334</td>
<td>3359</td>
<td>3384</td>
<td>3409</td>
<td>3433</td>
</tr>
<tr>
<td>150 cm</td>
<td>3218</td>
<td>3245</td>
<td>3272</td>
<td>3298</td>
<td>3324</td>
<td>3350</td>
<td>3375</td>
<td>3400</td>
<td>3425</td>
<td>3450</td>
</tr>
<tr>
<td>151 cm</td>
<td>3234</td>
<td>3261</td>
<td>3287</td>
<td>3314</td>
<td>3340</td>
<td>3366</td>
<td>3391</td>
<td>3416</td>
<td>3441</td>
<td>3466</td>
</tr>
<tr>
<td>152 cm</td>
<td>3249</td>
<td>3276</td>
<td>3303</td>
<td>3329</td>
<td>3356</td>
<td>3381</td>
<td>3407</td>
<td>3433</td>
<td>3458</td>
<td>3483</td>
</tr>
<tr>
<td>153 cm</td>
<td>3264</td>
<td>3291</td>
<td>3318</td>
<td>3345</td>
<td>3371</td>
<td>3397</td>
<td>3423</td>
<td>3449</td>
<td>3474</td>
<td>3499</td>
</tr>
<tr>
<td>154 cm</td>
<td>3279</td>
<td>3307</td>
<td>3334</td>
<td>3361</td>
<td>3387</td>
<td>3413</td>
<td>3439</td>
<td>3465</td>
<td>3490</td>
<td>3515</td>
</tr>
<tr>
<td>155 cm</td>
<td>3295</td>
<td>3322</td>
<td>3349</td>
<td>3376</td>
<td>3403</td>
<td>3429</td>
<td>3455</td>
<td>3481</td>
<td>3506</td>
<td>3532</td>
</tr>
<tr>
<td>156 cm</td>
<td>3310</td>
<td>3337</td>
<td>3365</td>
<td>3392</td>
<td>3418</td>
<td>3445</td>
<td>3471</td>
<td>3497</td>
<td>3523</td>
<td>3548</td>
</tr>
<tr>
<td>157 cm</td>
<td>3325</td>
<td>3353</td>
<td>3380</td>
<td>3407</td>
<td>3434</td>
<td>3461</td>
<td>3487</td>
<td>3513</td>
<td>3539</td>
<td>3564</td>
</tr>
<tr>
<td>158 cm</td>
<td>3340</td>
<td>3368</td>
<td>3396</td>
<td>3423</td>
<td>3450</td>
<td>3476</td>
<td>3503</td>
<td>3529</td>
<td>3555</td>
<td>3581</td>
</tr>
<tr>
<td>159 cm</td>
<td>3355</td>
<td>3383</td>
<td>3411</td>
<td>3438</td>
<td>3465</td>
<td>3492</td>
<td>3519</td>
<td>3545</td>
<td>3571</td>
<td>3597</td>
</tr>
<tr>
<td>160 cm</td>
<td>3370</td>
<td>3399</td>
<td>3426</td>
<td>3454</td>
<td>3481</td>
<td>3508</td>
<td>3535</td>
<td>3561</td>
<td>3587</td>
<td>3613</td>
</tr>
<tr>
<td>161 cm</td>
<td>3385</td>
<td>3414</td>
<td>3442</td>
<td>3469</td>
<td>3497</td>
<td>3524</td>
<td>3550</td>
<td>3577</td>
<td>3603</td>
<td>3629</td>
</tr>
<tr>
<td>162 cm</td>
<td>3400</td>
<td>3429</td>
<td>3457</td>
<td>3485</td>
<td>3512</td>
<td>3539</td>
<td>3566</td>
<td>3593</td>
<td>3619</td>
<td>3645</td>
</tr>
<tr>
<td>163 cm</td>
<td>3416</td>
<td>3444</td>
<td>3472</td>
<td>3500</td>
<td>3528</td>
<td>3555</td>
<td>3582</td>
<td>3609</td>
<td>3635</td>
<td>3661</td>
</tr>
<tr>
<td>164 cm</td>
<td>3430</td>
<td>3459</td>
<td>3487</td>
<td>3515</td>
<td>3543</td>
<td>3571</td>
<td>3598</td>
<td>3625</td>
<td>3651</td>
<td>3677</td>
</tr>
<tr>
<td>165 cm</td>
<td>3445</td>
<td>3474</td>
<td>3503</td>
<td>3531</td>
<td>3559</td>
<td>3586</td>
<td>3613</td>
<td>3640</td>
<td>3667</td>
<td>3693</td>
</tr>
<tr>
<td>166 cm</td>
<td>3460</td>
<td>3489</td>
<td>3518</td>
<td>3546</td>
<td>3574</td>
<td>3602</td>
<td>3629</td>
<td>3656</td>
<td>3683</td>
<td>3709</td>
</tr>
<tr>
<td>167 cm</td>
<td>3475</td>
<td>3504</td>
<td>3533</td>
<td>3561</td>
<td>3589</td>
<td>3617</td>
<td>3645</td>
<td>3672</td>
<td>3699</td>
<td>3726</td>
</tr>
<tr>
<td>168 cm</td>
<td>3490</td>
<td>3519</td>
<td>3548</td>
<td>3577</td>
<td>3605</td>
<td>3633</td>
<td>3660</td>
<td>3688</td>
<td>3715</td>
<td>3741</td>
</tr>
</tbody>
</table>

---

Appendix 2. Tables for calculation of blood volumes

<table>
<thead>
<tr>
<th>kg</th>
<th>50</th>
<th>51</th>
<th>52</th>
<th>53</th>
<th>54</th>
<th>55</th>
<th>56</th>
<th>57</th>
<th>58</th>
<th>59</th>
</tr>
</thead>
<tbody>
<tr>
<td>169 cm</td>
<td>3505</td>
<td>3534</td>
<td>3563</td>
<td>3592</td>
<td>3620</td>
<td>3648</td>
<td>3676</td>
<td>3703</td>
<td>3731</td>
<td>3757</td>
</tr>
<tr>
<td>170 cm</td>
<td>3520</td>
<td>3549</td>
<td>3578</td>
<td>3607</td>
<td>3636</td>
<td>3664</td>
<td>3692</td>
<td>3719</td>
<td>3746</td>
<td>3773</td>
</tr>
<tr>
<td>171 cm</td>
<td>3535</td>
<td>3564</td>
<td>3593</td>
<td>3622</td>
<td>3651</td>
<td>3679</td>
<td>3707</td>
<td>3735</td>
<td>3762</td>
<td>3789</td>
</tr>
<tr>
<td>172 cm</td>
<td>3550</td>
<td>3579</td>
<td>3608</td>
<td>3637</td>
<td>3666</td>
<td>3695</td>
<td>3723</td>
<td>3750</td>
<td>3778</td>
<td>3805</td>
</tr>
<tr>
<td>173 cm</td>
<td>3564</td>
<td>3594</td>
<td>3624</td>
<td>3653</td>
<td>3681</td>
<td>3710</td>
<td>3738</td>
<td>3766</td>
<td>3794</td>
<td>3821</td>
</tr>
<tr>
<td>174 cm</td>
<td>3579</td>
<td>3609</td>
<td>3638</td>
<td>3668</td>
<td>3697</td>
<td>3725</td>
<td>3754</td>
<td>3782</td>
<td>3809</td>
<td>3837</td>
</tr>
<tr>
<td>175 cm</td>
<td>3594</td>
<td>3624</td>
<td>3653</td>
<td>3683</td>
<td>3712</td>
<td>3741</td>
<td>3769</td>
<td>3797</td>
<td>3825</td>
<td>3853</td>
</tr>
<tr>
<td>176 cm</td>
<td>3608</td>
<td>3639</td>
<td>3668</td>
<td>3698</td>
<td>3727</td>
<td>3756</td>
<td>3784</td>
<td>3813</td>
<td>3841</td>
<td>3868</td>
</tr>
<tr>
<td>177 cm</td>
<td>3623</td>
<td>3653</td>
<td>3683</td>
<td>3713</td>
<td>3742</td>
<td>3771</td>
<td>3800</td>
<td>3828</td>
<td>3856</td>
<td>3884</td>
</tr>
<tr>
<td>178 cm</td>
<td>3638</td>
<td>3668</td>
<td>3698</td>
<td>3728</td>
<td>3757</td>
<td>3786</td>
<td>3815</td>
<td>3844</td>
<td>3872</td>
<td>3900</td>
</tr>
<tr>
<td>179 cm</td>
<td>3652</td>
<td>3683</td>
<td>3713</td>
<td>3743</td>
<td>3772</td>
<td>3802</td>
<td>3831</td>
<td>3859</td>
<td>3887</td>
<td>3916</td>
</tr>
<tr>
<td>180 cm</td>
<td>3667</td>
<td>3698</td>
<td>3728</td>
<td>3758</td>
<td>3788</td>
<td>3817</td>
<td>3846</td>
<td>3875</td>
<td>3903</td>
<td>3931</td>
</tr>
<tr>
<td>181 cm</td>
<td>3682</td>
<td>3712</td>
<td>3743</td>
<td>3773</td>
<td>3803</td>
<td>3832</td>
<td>3861</td>
<td>3890</td>
<td>3919</td>
<td>3947</td>
</tr>
<tr>
<td>182 cm</td>
<td>3696</td>
<td>3727</td>
<td>3758</td>
<td>3788</td>
<td>3818</td>
<td>3847</td>
<td>3877</td>
<td>3905</td>
<td>3934</td>
<td>3962</td>
</tr>
<tr>
<td>183 cm</td>
<td>3711</td>
<td>3742</td>
<td>3772</td>
<td>3803</td>
<td>3833</td>
<td>3862</td>
<td>3892</td>
<td>3921</td>
<td>3950</td>
<td>3978</td>
</tr>
<tr>
<td>184 cm</td>
<td>3725</td>
<td>3756</td>
<td>3787</td>
<td>3818</td>
<td>3848</td>
<td>3878</td>
<td>3907</td>
<td>3936</td>
<td>3965</td>
<td>3994</td>
</tr>
<tr>
<td>185 cm</td>
<td>3740</td>
<td>3771</td>
<td>3802</td>
<td>3832</td>
<td>3863</td>
<td>3893</td>
<td>3922</td>
<td>3952</td>
<td>3981</td>
<td>4009</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>kg</th>
<th>60</th>
<th>61</th>
<th>62</th>
<th>63</th>
<th>64</th>
<th>65</th>
<th>66</th>
<th>67</th>
<th>68</th>
<th>69</th>
</tr>
</thead>
<tbody>
<tr>
<td>145 cm</td>
<td>3391</td>
<td>3414</td>
<td>3438</td>
<td>3461</td>
<td>3484</td>
<td>3507</td>
<td>3529</td>
<td>3552</td>
<td>3574</td>
<td>3596</td>
</tr>
<tr>
<td>146 cm</td>
<td>3408</td>
<td>3431</td>
<td>3455</td>
<td>3478</td>
<td>3501</td>
<td>3524</td>
<td>3547</td>
<td>3569</td>
<td>3591</td>
<td>3613</td>
</tr>
<tr>
<td>147 cm</td>
<td>3424</td>
<td>3448</td>
<td>3472</td>
<td>3495</td>
<td>3518</td>
<td>3541</td>
<td>3564</td>
<td>3587</td>
<td>3609</td>
<td>3631</td>
</tr>
<tr>
<td>148 cm</td>
<td>3441</td>
<td>3465</td>
<td>3489</td>
<td>3512</td>
<td>3535</td>
<td>3558</td>
<td>3581</td>
<td>3604</td>
<td>3627</td>
<td>3649</td>
</tr>
<tr>
<td>149 cm</td>
<td>3458</td>
<td>3482</td>
<td>3505</td>
<td>3529</td>
<td>3552</td>
<td>3576</td>
<td>3599</td>
<td>3622</td>
<td>3644</td>
<td>3667</td>
</tr>
<tr>
<td>150 cm</td>
<td>3474</td>
<td>3498</td>
<td>3522</td>
<td>3546</td>
<td>3570</td>
<td>3593</td>
<td>3616</td>
<td>3639</td>
<td>3662</td>
<td>3684</td>
</tr>
<tr>
<td>151 cm</td>
<td>3491</td>
<td>3515</td>
<td>3539</td>
<td>3563</td>
<td>3587</td>
<td>3610</td>
<td>3633</td>
<td>3656</td>
<td>3679</td>
<td>3702</td>
</tr>
<tr>
<td>152 cm</td>
<td>3507</td>
<td>3532</td>
<td>3556</td>
<td>3580</td>
<td>3604</td>
<td>3627</td>
<td>3650</td>
<td>3674</td>
<td>3697</td>
<td>3719</td>
</tr>
<tr>
<td>153 cm</td>
<td>3524</td>
<td>3548</td>
<td>3573</td>
<td>3597</td>
<td>3621</td>
<td>3644</td>
<td>3668</td>
<td>3691</td>
<td>3714</td>
<td>3737</td>
</tr>
<tr>
<td>154 cm</td>
<td>3540</td>
<td>3565</td>
<td>3589</td>
<td>3614</td>
<td>3638</td>
<td>3661</td>
<td>3685</td>
<td>3708</td>
<td>3731</td>
<td>3754</td>
</tr>
<tr>
<td>155 cm</td>
<td>3557</td>
<td>3581</td>
<td>3606</td>
<td>3630</td>
<td>3654</td>
<td>3678</td>
<td>3702</td>
<td>3725</td>
<td>3749</td>
<td>3772</td>
</tr>
<tr>
<td>156 cm</td>
<td>3573</td>
<td>3598</td>
<td>3623</td>
<td>3647</td>
<td>3671</td>
<td>3695</td>
<td>3719</td>
<td>3743</td>
<td>3766</td>
<td>3789</td>
</tr>
<tr>
<td>157 cm</td>
<td>3590</td>
<td>3615</td>
<td>3639</td>
<td>3664</td>
<td>3688</td>
<td>3712</td>
<td>3736</td>
<td>3760</td>
<td>3783</td>
<td>3807</td>
</tr>
<tr>
<td>158 cm</td>
<td>3606</td>
<td>3631</td>
<td>3656</td>
<td>3681</td>
<td>3705</td>
<td>3729</td>
<td>3753</td>
<td>3777</td>
<td>3801</td>
<td>3824</td>
</tr>
<tr>
<td>159 cm</td>
<td>3622</td>
<td>3647</td>
<td>3672</td>
<td>3697</td>
<td>3722</td>
<td>3746</td>
<td>3770</td>
<td>3794</td>
<td>3818</td>
<td>3841</td>
</tr>
</tbody>
</table>
Guide to the preparation, use and quality assurance of blood components

<table>
<thead>
<tr>
<th>cm</th>
<th>60</th>
<th>61</th>
<th>62</th>
<th>63</th>
<th>64</th>
<th>65</th>
<th>66</th>
<th>67</th>
<th>68</th>
<th>69</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>3639</td>
<td>3664</td>
<td>3689</td>
<td>3714</td>
<td>3739</td>
<td>3763</td>
<td>3787</td>
<td>3811</td>
<td>3835</td>
<td>3859</td>
</tr>
<tr>
<td>161</td>
<td>3655</td>
<td>3680</td>
<td>3705</td>
<td>3730</td>
<td>3755</td>
<td>3780</td>
<td>3804</td>
<td>3828</td>
<td>3852</td>
<td>3876</td>
</tr>
<tr>
<td>162</td>
<td>3671</td>
<td>3697</td>
<td>3722</td>
<td>3747</td>
<td>3772</td>
<td>3797</td>
<td>3821</td>
<td>3845</td>
<td>3869</td>
<td>3893</td>
</tr>
<tr>
<td>163</td>
<td>3687</td>
<td>3713</td>
<td>3738</td>
<td>3764</td>
<td>3789</td>
<td>3813</td>
<td>3838</td>
<td>3862</td>
<td>3886</td>
<td>3910</td>
</tr>
<tr>
<td>164</td>
<td>3703</td>
<td>3729</td>
<td>3755</td>
<td>3780</td>
<td>3805</td>
<td>3830</td>
<td>3855</td>
<td>3879</td>
<td>3903</td>
<td>3928</td>
</tr>
<tr>
<td>165</td>
<td>3720</td>
<td>3746</td>
<td>3771</td>
<td>3797</td>
<td>3822</td>
<td>3847</td>
<td>3872</td>
<td>3896</td>
<td>3921</td>
<td>3945</td>
</tr>
<tr>
<td>166</td>
<td>3736</td>
<td>3762</td>
<td>3788</td>
<td>3813</td>
<td>3838</td>
<td>3864</td>
<td>3888</td>
<td>3913</td>
<td>3938</td>
<td>3962</td>
</tr>
<tr>
<td>167</td>
<td>3752</td>
<td>3778</td>
<td>3804</td>
<td>3830</td>
<td>3855</td>
<td>3880</td>
<td>3905</td>
<td>3930</td>
<td>3955</td>
<td>3979</td>
</tr>
<tr>
<td>168</td>
<td>3768</td>
<td>3794</td>
<td>3820</td>
<td>3846</td>
<td>3872</td>
<td>3897</td>
<td>3922</td>
<td>3947</td>
<td>3972</td>
<td>3996</td>
</tr>
<tr>
<td>169</td>
<td>3784</td>
<td>3810</td>
<td>3837</td>
<td>3862</td>
<td>3888</td>
<td>3914</td>
<td>3939</td>
<td>3964</td>
<td>3988</td>
<td>4013</td>
</tr>
<tr>
<td>170</td>
<td>3800</td>
<td>3827</td>
<td>3853</td>
<td>3879</td>
<td>3905</td>
<td>3930</td>
<td>3955</td>
<td>3981</td>
<td>4005</td>
<td>4030</td>
</tr>
<tr>
<td>171</td>
<td>3816</td>
<td>3843</td>
<td>3869</td>
<td>3895</td>
<td>3921</td>
<td>3947</td>
<td>3972</td>
<td>3997</td>
<td>4022</td>
<td>4047</td>
</tr>
<tr>
<td>172</td>
<td>3832</td>
<td>3859</td>
<td>3885</td>
<td>3911</td>
<td>3937</td>
<td>3963</td>
<td>3989</td>
<td>4014</td>
<td>4039</td>
<td>4064</td>
</tr>
<tr>
<td>173</td>
<td>3848</td>
<td>3875</td>
<td>3901</td>
<td>3928</td>
<td>3954</td>
<td>3980</td>
<td>4005</td>
<td>4031</td>
<td>4056</td>
<td>4081</td>
</tr>
<tr>
<td>174</td>
<td>3864</td>
<td>3891</td>
<td>3918</td>
<td>3944</td>
<td>3970</td>
<td>3996</td>
<td>4022</td>
<td>4047</td>
<td>4073</td>
<td>4098</td>
</tr>
<tr>
<td>175</td>
<td>3880</td>
<td>3907</td>
<td>3934</td>
<td>3960</td>
<td>3987</td>
<td>4013</td>
<td>4039</td>
<td>4064</td>
<td>4090</td>
<td>4115</td>
</tr>
<tr>
<td>176</td>
<td>3896</td>
<td>3923</td>
<td>3950</td>
<td>3977</td>
<td>4003</td>
<td>4029</td>
<td>4055</td>
<td>4081</td>
<td>4106</td>
<td>4132</td>
</tr>
<tr>
<td>177</td>
<td>3912</td>
<td>3939</td>
<td>3966</td>
<td>3993</td>
<td>4019</td>
<td>4046</td>
<td>4072</td>
<td>4097</td>
<td>4123</td>
<td>4148</td>
</tr>
<tr>
<td>178</td>
<td>3927</td>
<td>3955</td>
<td>3982</td>
<td>4009</td>
<td>4036</td>
<td>4062</td>
<td>4088</td>
<td>4114</td>
<td>4140</td>
<td>4165</td>
</tr>
<tr>
<td>179</td>
<td>3943</td>
<td>3971</td>
<td>3998</td>
<td>4025</td>
<td>4052</td>
<td>4078</td>
<td>4105</td>
<td>4131</td>
<td>4156</td>
<td>4182</td>
</tr>
<tr>
<td>180</td>
<td>3959</td>
<td>3987</td>
<td>4014</td>
<td>4041</td>
<td>4068</td>
<td>4095</td>
<td>4121</td>
<td>4147</td>
<td>4173</td>
<td>4199</td>
</tr>
<tr>
<td>181</td>
<td>3975</td>
<td>4003</td>
<td>4030</td>
<td>4057</td>
<td>4084</td>
<td>4111</td>
<td>4137</td>
<td>4164</td>
<td>4190</td>
<td>4216</td>
</tr>
<tr>
<td>182</td>
<td>3991</td>
<td>4018</td>
<td>4046</td>
<td>4073</td>
<td>4100</td>
<td>4127</td>
<td>4154</td>
<td>4180</td>
<td>4206</td>
<td>4232</td>
</tr>
<tr>
<td>183</td>
<td>4006</td>
<td>4034</td>
<td>4062</td>
<td>4089</td>
<td>4117</td>
<td>4143</td>
<td>4170</td>
<td>4197</td>
<td>4223</td>
<td>4249</td>
</tr>
<tr>
<td>184</td>
<td>4022</td>
<td>4050</td>
<td>4078</td>
<td>4105</td>
<td>4133</td>
<td>4160</td>
<td>4187</td>
<td>4213</td>
<td>4239</td>
<td>4266</td>
</tr>
<tr>
<td>185</td>
<td>4038</td>
<td>4066</td>
<td>4094</td>
<td>4121</td>
<td>4149</td>
<td>4176</td>
<td>4203</td>
<td>4229</td>
<td>4256</td>
<td>4282</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>cm</th>
<th>70</th>
<th>71</th>
<th>72</th>
<th>73</th>
<th>74</th>
<th>75</th>
<th>76</th>
<th>77</th>
<th>78</th>
<th>79</th>
</tr>
</thead>
<tbody>
<tr>
<td>145</td>
<td>3618</td>
<td>3639</td>
<td>3661</td>
<td>3682</td>
<td>3703</td>
<td>3724</td>
<td>3745</td>
<td>3765</td>
<td>3786</td>
<td>3806</td>
</tr>
<tr>
<td>146</td>
<td>3635</td>
<td>3657</td>
<td>3679</td>
<td>3700</td>
<td>3721</td>
<td>3742</td>
<td>3763</td>
<td>3784</td>
<td>3804</td>
<td>3825</td>
</tr>
<tr>
<td>147</td>
<td>3653</td>
<td>3675</td>
<td>3697</td>
<td>3718</td>
<td>3739</td>
<td>3761</td>
<td>3782</td>
<td>3802</td>
<td>3823</td>
<td>3844</td>
</tr>
<tr>
<td>148</td>
<td>3671</td>
<td>3693</td>
<td>3715</td>
<td>3736</td>
<td>3758</td>
<td>3779</td>
<td>3800</td>
<td>3821</td>
<td>3842</td>
<td>3862</td>
</tr>
<tr>
<td>149</td>
<td>3689</td>
<td>3711</td>
<td>3733</td>
<td>3754</td>
<td>3776</td>
<td>3797</td>
<td>3818</td>
<td>3839</td>
<td>3860</td>
<td>3881</td>
</tr>
<tr>
<td>150</td>
<td>3706</td>
<td>3729</td>
<td>3751</td>
<td>3772</td>
<td>3794</td>
<td>3816</td>
<td>3837</td>
<td>3858</td>
<td>3879</td>
<td>3900</td>
</tr>
</tbody>
</table>
Appendix 2. Tables for calculation of blood volumes

<table>
<thead>
<tr>
<th>kg</th>
<th>70</th>
<th>71</th>
<th>72</th>
<th>73</th>
<th>74</th>
<th>75</th>
<th>76</th>
<th>77</th>
<th>78</th>
<th>79</th>
</tr>
</thead>
<tbody>
<tr>
<td>151 cm</td>
<td>3724</td>
<td>3746</td>
<td>3769</td>
<td>3790</td>
<td>3812</td>
<td>3834</td>
<td>3855</td>
<td>3876</td>
<td>3897</td>
<td>3918</td>
</tr>
<tr>
<td>152 cm</td>
<td>3742</td>
<td>3764</td>
<td>3786</td>
<td>3808</td>
<td>3830</td>
<td>3852</td>
<td>3873</td>
<td>3895</td>
<td>3916</td>
<td>3937</td>
</tr>
<tr>
<td>153 cm</td>
<td>3759</td>
<td>3782</td>
<td>3804</td>
<td>3826</td>
<td>3848</td>
<td>3870</td>
<td>3892</td>
<td>3913</td>
<td>3934</td>
<td>3956</td>
</tr>
<tr>
<td>154 cm</td>
<td>3777</td>
<td>3800</td>
<td>3822</td>
<td>3844</td>
<td>3866</td>
<td>3888</td>
<td>3910</td>
<td>3931</td>
<td>3953</td>
<td>3974</td>
</tr>
<tr>
<td>155 cm</td>
<td>3795</td>
<td>3817</td>
<td>3840</td>
<td>3862</td>
<td>3884</td>
<td>3906</td>
<td>3928</td>
<td>3950</td>
<td>3971</td>
<td>3993</td>
</tr>
<tr>
<td>156 cm</td>
<td>3812</td>
<td>3835</td>
<td>3858</td>
<td>3880</td>
<td>3902</td>
<td>3924</td>
<td>3946</td>
<td>3968</td>
<td>3990</td>
<td>4011</td>
</tr>
<tr>
<td>157 cm</td>
<td>3830</td>
<td>3853</td>
<td>3875</td>
<td>3898</td>
<td>3920</td>
<td>3942</td>
<td>3964</td>
<td>3986</td>
<td>4008</td>
<td>4029</td>
</tr>
<tr>
<td>158 cm</td>
<td>3847</td>
<td>3870</td>
<td>3893</td>
<td>3916</td>
<td>3938</td>
<td>3960</td>
<td>3982</td>
<td>4004</td>
<td>4026</td>
<td>4048</td>
</tr>
<tr>
<td>159 cm</td>
<td>3865</td>
<td>3888</td>
<td>3911</td>
<td>3933</td>
<td>3956</td>
<td>3978</td>
<td>4001</td>
<td>4023</td>
<td>4044</td>
<td>4066</td>
</tr>
<tr>
<td>160 cm</td>
<td>3882</td>
<td>3905</td>
<td>3928</td>
<td>3951</td>
<td>3974</td>
<td>3996</td>
<td>4019</td>
<td>4041</td>
<td>4063</td>
<td>4085</td>
</tr>
<tr>
<td>161 cm</td>
<td>3899</td>
<td>3923</td>
<td>3946</td>
<td>3969</td>
<td>3992</td>
<td>4014</td>
<td>4037</td>
<td>4059</td>
<td>4081</td>
<td>4103</td>
</tr>
<tr>
<td>162 cm</td>
<td>3917</td>
<td>3940</td>
<td>3963</td>
<td>3986</td>
<td>4009</td>
<td>4032</td>
<td>4055</td>
<td>4077</td>
<td>4099</td>
<td>4121</td>
</tr>
<tr>
<td>163 cm</td>
<td>3934</td>
<td>3958</td>
<td>3981</td>
<td>4004</td>
<td>4027</td>
<td>4050</td>
<td>4072</td>
<td>4095</td>
<td>4117</td>
<td>4139</td>
</tr>
<tr>
<td>164 cm</td>
<td>3951</td>
<td>3975</td>
<td>3998</td>
<td>4022</td>
<td>4045</td>
<td>4068</td>
<td>4090</td>
<td>4113</td>
<td>4135</td>
<td>4158</td>
</tr>
<tr>
<td>165 cm</td>
<td>3969</td>
<td>3992</td>
<td>4016</td>
<td>4039</td>
<td>4062</td>
<td>4085</td>
<td>4108</td>
<td>4131</td>
<td>4153</td>
<td>4176</td>
</tr>
<tr>
<td>166 cm</td>
<td>3986</td>
<td>4010</td>
<td>4033</td>
<td>4057</td>
<td>4080</td>
<td>4103</td>
<td>4126</td>
<td>4149</td>
<td>4171</td>
<td>4194</td>
</tr>
<tr>
<td>167 cm</td>
<td>4003</td>
<td>4027</td>
<td>4051</td>
<td>4074</td>
<td>4098</td>
<td>4121</td>
<td>4144</td>
<td>4167</td>
<td>4189</td>
<td>4212</td>
</tr>
<tr>
<td>168 cm</td>
<td>4020</td>
<td>4044</td>
<td>4068</td>
<td>4092</td>
<td>4115</td>
<td>4139</td>
<td>4162</td>
<td>4185</td>
<td>4207</td>
<td>4230</td>
</tr>
<tr>
<td>169 cm</td>
<td>4037</td>
<td>4062</td>
<td>4086</td>
<td>4109</td>
<td>4133</td>
<td>4156</td>
<td>4179</td>
<td>4203</td>
<td>4225</td>
<td>4248</td>
</tr>
<tr>
<td>170 cm</td>
<td>4055</td>
<td>4079</td>
<td>4103</td>
<td>4127</td>
<td>4150</td>
<td>4174</td>
<td>4197</td>
<td>4220</td>
<td>4243</td>
<td>4266</td>
</tr>
<tr>
<td>171 cm</td>
<td>4072</td>
<td>4096</td>
<td>4120</td>
<td>4144</td>
<td>4168</td>
<td>4192</td>
<td>4215</td>
<td>4238</td>
<td>4261</td>
<td>4284</td>
</tr>
<tr>
<td>172 cm</td>
<td>4089</td>
<td>4113</td>
<td>4137</td>
<td>4162</td>
<td>4185</td>
<td>4209</td>
<td>4233</td>
<td>4256</td>
<td>4279</td>
<td>4302</td>
</tr>
<tr>
<td>173 cm</td>
<td>4106</td>
<td>4130</td>
<td>4155</td>
<td>4179</td>
<td>4203</td>
<td>4227</td>
<td>4250</td>
<td>4274</td>
<td>4297</td>
<td>4320</td>
</tr>
<tr>
<td>174 cm</td>
<td>4123</td>
<td>4147</td>
<td>4172</td>
<td>4196</td>
<td>4220</td>
<td>4244</td>
<td>4268</td>
<td>4291</td>
<td>4315</td>
<td>4338</td>
</tr>
<tr>
<td>175 cm</td>
<td>4140</td>
<td>4165</td>
<td>4189</td>
<td>4213</td>
<td>4238</td>
<td>4262</td>
<td>4285</td>
<td>4309</td>
<td>4333</td>
<td>4356</td>
</tr>
<tr>
<td>176 cm</td>
<td>4157</td>
<td>4182</td>
<td>4206</td>
<td>4231</td>
<td>4255</td>
<td>4279</td>
<td>4303</td>
<td>4327</td>
<td>4350</td>
<td>4374</td>
</tr>
<tr>
<td>177 cm</td>
<td>4174</td>
<td>4199</td>
<td>4223</td>
<td>4248</td>
<td>4272</td>
<td>4297</td>
<td>4321</td>
<td>4344</td>
<td>4368</td>
<td>4392</td>
</tr>
<tr>
<td>178 cm</td>
<td>4191</td>
<td>4216</td>
<td>4241</td>
<td>4265</td>
<td>4290</td>
<td>4314</td>
<td>4338</td>
<td>4362</td>
<td>4386</td>
<td>4409</td>
</tr>
<tr>
<td>179 cm</td>
<td>4207</td>
<td>4233</td>
<td>4258</td>
<td>4282</td>
<td>4307</td>
<td>4331</td>
<td>4356</td>
<td>4380</td>
<td>4403</td>
<td>4427</td>
</tr>
<tr>
<td>180 cm</td>
<td>4224</td>
<td>4250</td>
<td>4275</td>
<td>4300</td>
<td>4324</td>
<td>4349</td>
<td>4373</td>
<td>4397</td>
<td>4421</td>
<td>4445</td>
</tr>
<tr>
<td>181 cm</td>
<td>4241</td>
<td>4266</td>
<td>4292</td>
<td>4317</td>
<td>4341</td>
<td>4366</td>
<td>4390</td>
<td>4415</td>
<td>4439</td>
<td>4463</td>
</tr>
<tr>
<td>182 cm</td>
<td>4258</td>
<td>4283</td>
<td>4309</td>
<td>4334</td>
<td>4359</td>
<td>4383</td>
<td>4408</td>
<td>4432</td>
<td>4456</td>
<td>4480</td>
</tr>
<tr>
<td>183 cm</td>
<td>4275</td>
<td>4300</td>
<td>4326</td>
<td>4351</td>
<td>4376</td>
<td>4401</td>
<td>4425</td>
<td>4450</td>
<td>4474</td>
<td>4498</td>
</tr>
<tr>
<td>184 cm</td>
<td>4291</td>
<td>4317</td>
<td>4343</td>
<td>4368</td>
<td>4393</td>
<td>4418</td>
<td>4443</td>
<td>4467</td>
<td>4491</td>
<td>4516</td>
</tr>
<tr>
<td>185 cm</td>
<td>4308</td>
<td>4334</td>
<td>4360</td>
<td>4385</td>
<td>4410</td>
<td>4435</td>
<td>4460</td>
<td>4485</td>
<td>4509</td>
<td>4533</td>
</tr>
</tbody>
</table>
Guide to the preparation, use and quality assurance of blood components

<table>
<thead>
<tr>
<th>kg</th>
<th>80</th>
<th>81</th>
<th>82</th>
<th>83</th>
<th>84</th>
<th>85</th>
<th>86</th>
<th>87</th>
<th>88</th>
<th>89</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>145 cm</td>
<td>3826</td>
<td>3846</td>
<td>3866</td>
<td>3886</td>
<td>3906</td>
<td>3925</td>
<td>3944</td>
<td>3964</td>
<td>3983</td>
<td>4002</td>
<td>4021</td>
</tr>
<tr>
<td>146 cm</td>
<td>3845</td>
<td>3865</td>
<td>3885</td>
<td>3905</td>
<td>3925</td>
<td>3944</td>
<td>3964</td>
<td>3983</td>
<td>4002</td>
<td>4021</td>
<td>4040</td>
</tr>
<tr>
<td>147 cm</td>
<td>3864</td>
<td>3884</td>
<td>3904</td>
<td>3924</td>
<td>3944</td>
<td>3964</td>
<td>3983</td>
<td>4003</td>
<td>4022</td>
<td>4041</td>
<td>4060</td>
</tr>
<tr>
<td>148 cm</td>
<td>3883</td>
<td>3903</td>
<td>3923</td>
<td>3943</td>
<td>3963</td>
<td>3983</td>
<td>4003</td>
<td>4022</td>
<td>4042</td>
<td>4061</td>
<td>4080</td>
</tr>
<tr>
<td>149 cm</td>
<td>3902</td>
<td>3922</td>
<td>3942</td>
<td>3963</td>
<td>3983</td>
<td>4002</td>
<td>4022</td>
<td>4042</td>
<td>4061</td>
<td>4081</td>
<td>4100</td>
</tr>
<tr>
<td>150 cm</td>
<td>3920</td>
<td>3941</td>
<td>3961</td>
<td>3982</td>
<td>4002</td>
<td>4022</td>
<td>4041</td>
<td>4061</td>
<td>4081</td>
<td>4100</td>
<td>4119</td>
</tr>
<tr>
<td>151 cm</td>
<td>3939</td>
<td>3960</td>
<td>3980</td>
<td>4001</td>
<td>4021</td>
<td>4041</td>
<td>4061</td>
<td>4081</td>
<td>4100</td>
<td>4120</td>
<td>4139</td>
</tr>
<tr>
<td>152 cm</td>
<td>3958</td>
<td>3979</td>
<td>3999</td>
<td>4020</td>
<td>4040</td>
<td>4060</td>
<td>4080</td>
<td>4100</td>
<td>4120</td>
<td>4139</td>
<td>4159</td>
</tr>
<tr>
<td>153 cm</td>
<td>3977</td>
<td>3997</td>
<td>4018</td>
<td>4039</td>
<td>4059</td>
<td>4079</td>
<td>4099</td>
<td>4119</td>
<td>4139</td>
<td>4159</td>
<td>4178</td>
</tr>
<tr>
<td>154 cm</td>
<td>3995</td>
<td>4016</td>
<td>4037</td>
<td>4057</td>
<td>4078</td>
<td>4098</td>
<td>4119</td>
<td>4139</td>
<td>4159</td>
<td>4178</td>
<td>4198</td>
</tr>
<tr>
<td>155 cm</td>
<td>4014</td>
<td>4035</td>
<td>4056</td>
<td>4076</td>
<td>4097</td>
<td>4117</td>
<td>4138</td>
<td>4158</td>
<td>4178</td>
<td>4198</td>
<td>4218</td>
</tr>
<tr>
<td>156 cm</td>
<td>4032</td>
<td>4053</td>
<td>4074</td>
<td>4095</td>
<td>4116</td>
<td>4136</td>
<td>4157</td>
<td>4177</td>
<td>4197</td>
<td>4217</td>
<td>4237</td>
</tr>
<tr>
<td>157 cm</td>
<td>4051</td>
<td>4072</td>
<td>4093</td>
<td>4114</td>
<td>4135</td>
<td>4155</td>
<td>4176</td>
<td>4196</td>
<td>4217</td>
<td>4237</td>
<td>4257</td>
</tr>
<tr>
<td>158 cm</td>
<td>4069</td>
<td>4091</td>
<td>4112</td>
<td>4133</td>
<td>4154</td>
<td>4174</td>
<td>4195</td>
<td>4215</td>
<td>4236</td>
<td>4256</td>
<td>4276</td>
</tr>
<tr>
<td>159 cm</td>
<td>4088</td>
<td>4109</td>
<td>4130</td>
<td>4152</td>
<td>4173</td>
<td>4193</td>
<td>4214</td>
<td>4235</td>
<td>4255</td>
<td>4275</td>
<td>4295</td>
</tr>
<tr>
<td>160 cm</td>
<td>4106</td>
<td>4128</td>
<td>4149</td>
<td>4170</td>
<td>4191</td>
<td>4212</td>
<td>4233</td>
<td>4254</td>
<td>4274</td>
<td>4295</td>
<td>4315</td>
</tr>
<tr>
<td>161 cm</td>
<td>4125</td>
<td>4146</td>
<td>4168</td>
<td>4189</td>
<td>4210</td>
<td>4231</td>
<td>4252</td>
<td>4273</td>
<td>4293</td>
<td>4314</td>
<td>4334</td>
</tr>
<tr>
<td>162 cm</td>
<td>4143</td>
<td>4165</td>
<td>4186</td>
<td>4208</td>
<td>4229</td>
<td>4250</td>
<td>4271</td>
<td>4292</td>
<td>4312</td>
<td>4333</td>
<td>4353</td>
</tr>
<tr>
<td>163 cm</td>
<td>4161</td>
<td>4183</td>
<td>4205</td>
<td>4226</td>
<td>4248</td>
<td>4269</td>
<td>4290</td>
<td>4311</td>
<td>4332</td>
<td>4352</td>
<td>4373</td>
</tr>
<tr>
<td>164 cm</td>
<td>4180</td>
<td>4202</td>
<td>4223</td>
<td>4245</td>
<td>4266</td>
<td>4288</td>
<td>4309</td>
<td>4330</td>
<td>4351</td>
<td>4371</td>
<td>4392</td>
</tr>
<tr>
<td>165 cm</td>
<td>4198</td>
<td>4220</td>
<td>4242</td>
<td>4263</td>
<td>4285</td>
<td>4306</td>
<td>4328</td>
<td>4349</td>
<td>4370</td>
<td>4390</td>
<td>4411</td>
</tr>
<tr>
<td>166 cm</td>
<td>4216</td>
<td>4238</td>
<td>4260</td>
<td>4282</td>
<td>4304</td>
<td>4325</td>
<td>4346</td>
<td>4368</td>
<td>4389</td>
<td>4410</td>
<td>4430</td>
</tr>
<tr>
<td>167 cm</td>
<td>4234</td>
<td>4257</td>
<td>4279</td>
<td>4300</td>
<td>4322</td>
<td>4344</td>
<td>4365</td>
<td>4386</td>
<td>4408</td>
<td>4429</td>
<td>4450</td>
</tr>
<tr>
<td>168 cm</td>
<td>4253</td>
<td>4275</td>
<td>4297</td>
<td>4319</td>
<td>4341</td>
<td>4362</td>
<td>4384</td>
<td>4405</td>
<td>4427</td>
<td>4448</td>
<td>4469</td>
</tr>
<tr>
<td>169 cm</td>
<td>4271</td>
<td>4293</td>
<td>4315</td>
<td>4337</td>
<td>4359</td>
<td>4381</td>
<td>4403</td>
<td>4424</td>
<td>4445</td>
<td>4467</td>
<td>4488</td>
</tr>
<tr>
<td>170 cm</td>
<td>4289</td>
<td>4311</td>
<td>4334</td>
<td>4356</td>
<td>4378</td>
<td>4400</td>
<td>4421</td>
<td>4443</td>
<td>4464</td>
<td>4486</td>
<td>4507</td>
</tr>
<tr>
<td>171 cm</td>
<td>4307</td>
<td>4329</td>
<td>4352</td>
<td>4374</td>
<td>4396</td>
<td>4418</td>
<td>4440</td>
<td>4462</td>
<td>4483</td>
<td>4505</td>
<td>4526</td>
</tr>
<tr>
<td>172 cm</td>
<td>4325</td>
<td>4348</td>
<td>4370</td>
<td>4392</td>
<td>4415</td>
<td>4437</td>
<td>4459</td>
<td>4480</td>
<td>4502</td>
<td>4523</td>
<td>4545</td>
</tr>
<tr>
<td>173 cm</td>
<td>4343</td>
<td>4366</td>
<td>4388</td>
<td>4411</td>
<td>4433</td>
<td>4455</td>
<td>4477</td>
<td>4499</td>
<td>4521</td>
<td>4542</td>
<td>4564</td>
</tr>
<tr>
<td>174 cm</td>
<td>4361</td>
<td>4384</td>
<td>4407</td>
<td>4429</td>
<td>4451</td>
<td>4474</td>
<td>4496</td>
<td>4518</td>
<td>4540</td>
<td>4561</td>
<td>4583</td>
</tr>
<tr>
<td>175 cm</td>
<td>4379</td>
<td>4402</td>
<td>4425</td>
<td>4447</td>
<td>4470</td>
<td>4492</td>
<td>4514</td>
<td>4536</td>
<td>4558</td>
<td>4580</td>
<td>4602</td>
</tr>
<tr>
<td>176 cm</td>
<td>4397</td>
<td>4420</td>
<td>4443</td>
<td>4466</td>
<td>4488</td>
<td>4511</td>
<td>4533</td>
<td>4555</td>
<td>4577</td>
<td>4599</td>
<td>4620</td>
</tr>
<tr>
<td>177 cm</td>
<td>4415</td>
<td>4438</td>
<td>4461</td>
<td>4484</td>
<td>4506</td>
<td>4529</td>
<td>4551</td>
<td>4574</td>
<td>4596</td>
<td>4618</td>
<td>4639</td>
</tr>
<tr>
<td>178 cm</td>
<td>4433</td>
<td>4456</td>
<td>4479</td>
<td>4502</td>
<td>4525</td>
<td>4547</td>
<td>4570</td>
<td>4592</td>
<td>4614</td>
<td>4636</td>
<td>4658</td>
</tr>
<tr>
<td>179 cm</td>
<td>4451</td>
<td>4474</td>
<td>4497</td>
<td>4520</td>
<td>4543</td>
<td>4566</td>
<td>4588</td>
<td>4611</td>
<td>4633</td>
<td>4655</td>
<td>4677</td>
</tr>
</tbody>
</table>
Appendix 2. Tables for calculation of blood volumes

<table>
<thead>
<tr>
<th>kg</th>
<th>80</th>
<th>81</th>
<th>82</th>
<th>83</th>
<th>84</th>
<th>85</th>
<th>86</th>
<th>87</th>
<th>88</th>
<th>89</th>
<th>90</th>
</tr>
</thead>
<tbody>
<tr>
<td>180 cm</td>
<td>4468</td>
<td>4492</td>
<td>4515</td>
<td>4538</td>
<td>4561</td>
<td>4584</td>
<td>4607</td>
<td>4629</td>
<td>4651</td>
<td>4674</td>
<td>4696</td>
</tr>
<tr>
<td>181 cm</td>
<td>4486</td>
<td>4510</td>
<td>4533</td>
<td>4556</td>
<td>4579</td>
<td>4602</td>
<td>4625</td>
<td>4648</td>
<td>4670</td>
<td>4692</td>
<td>4714</td>
</tr>
<tr>
<td>182 cm</td>
<td>4504</td>
<td>4528</td>
<td>4551</td>
<td>4574</td>
<td>4598</td>
<td>4621</td>
<td>4643</td>
<td>4666</td>
<td>4689</td>
<td>4711</td>
<td>4733</td>
</tr>
<tr>
<td>183 cm</td>
<td>4522</td>
<td>4546</td>
<td>4569</td>
<td>4592</td>
<td>4616</td>
<td>4639</td>
<td>4662</td>
<td>4684</td>
<td>4707</td>
<td>4729</td>
<td>4752</td>
</tr>
<tr>
<td>184 cm</td>
<td>4540</td>
<td>4563</td>
<td>4587</td>
<td>4610</td>
<td>4634</td>
<td>4657</td>
<td>4680</td>
<td>4703</td>
<td>4725</td>
<td>4748</td>
<td>4770</td>
</tr>
<tr>
<td>185 cm</td>
<td>4557</td>
<td>4581</td>
<td>4605</td>
<td>4628</td>
<td>4652</td>
<td>4675</td>
<td>4698</td>
<td>4721</td>
<td>4744</td>
<td>4767</td>
<td>4789</td>
</tr>
</tbody>
</table>

Table 2. Blood volume of men in mL as calculated according to the ICSH formula

<table>
<thead>
<tr>
<th>kg</th>
<th>50</th>
<th>51</th>
<th>52</th>
<th>53</th>
<th>54</th>
<th>55</th>
<th>56</th>
<th>57</th>
<th>58</th>
<th>59</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 cm</td>
<td>3774</td>
<td>3813</td>
<td>3852</td>
<td>3890</td>
<td>3927</td>
<td>3965</td>
<td>4001</td>
<td>4038</td>
<td>4074</td>
<td>4110</td>
</tr>
<tr>
<td>161 cm</td>
<td>3795</td>
<td>3834</td>
<td>3873</td>
<td>3911</td>
<td>3949</td>
<td>3986</td>
<td>4023</td>
<td>4060</td>
<td>4096</td>
<td>4132</td>
</tr>
<tr>
<td>162 cm</td>
<td>3816</td>
<td>3855</td>
<td>3894</td>
<td>3932</td>
<td>3970</td>
<td>4008</td>
<td>4045</td>
<td>4082</td>
<td>4118</td>
<td>4154</td>
</tr>
<tr>
<td>163 cm</td>
<td>3837</td>
<td>3876</td>
<td>3915</td>
<td>3954</td>
<td>3992</td>
<td>4030</td>
<td>4067</td>
<td>4104</td>
<td>4140</td>
<td>4177</td>
</tr>
<tr>
<td>164 cm</td>
<td>3858</td>
<td>3897</td>
<td>3936</td>
<td>3975</td>
<td>4013</td>
<td>4051</td>
<td>4089</td>
<td>4126</td>
<td>4162</td>
<td>4199</td>
</tr>
<tr>
<td>165 cm</td>
<td>3878</td>
<td>3918</td>
<td>3957</td>
<td>3996</td>
<td>4035</td>
<td>4073</td>
<td>4110</td>
<td>4148</td>
<td>4184</td>
<td>4221</td>
</tr>
<tr>
<td>166 cm</td>
<td>3899</td>
<td>3939</td>
<td>3978</td>
<td>4017</td>
<td>4056</td>
<td>4094</td>
<td>4132</td>
<td>4169</td>
<td>4206</td>
<td>4243</td>
</tr>
<tr>
<td>167 cm</td>
<td>3919</td>
<td>3960</td>
<td>3999</td>
<td>4038</td>
<td>4077</td>
<td>4116</td>
<td>4154</td>
<td>4191</td>
<td>4228</td>
<td>4265</td>
</tr>
<tr>
<td>168 cm</td>
<td>3940</td>
<td>3980</td>
<td>4020</td>
<td>4060</td>
<td>4098</td>
<td>4137</td>
<td>4175</td>
<td>4213</td>
<td>4250</td>
<td>4287</td>
</tr>
<tr>
<td>169 cm</td>
<td>3961</td>
<td>4001</td>
<td>4041</td>
<td>4081</td>
<td>4120</td>
<td>4158</td>
<td>4197</td>
<td>4235</td>
<td>4272</td>
<td>4309</td>
</tr>
<tr>
<td>170 cm</td>
<td>3981</td>
<td>4022</td>
<td>4062</td>
<td>4102</td>
<td>4141</td>
<td>4180</td>
<td>4218</td>
<td>4256</td>
<td>4294</td>
<td>4331</td>
</tr>
<tr>
<td>171 cm</td>
<td>4002</td>
<td>4042</td>
<td>4083</td>
<td>4123</td>
<td>4162</td>
<td>4201</td>
<td>4240</td>
<td>4278</td>
<td>4316</td>
<td>4353</td>
</tr>
<tr>
<td>172 cm</td>
<td>4022</td>
<td>4063</td>
<td>4103</td>
<td>4144</td>
<td>4183</td>
<td>4222</td>
<td>4261</td>
<td>4300</td>
<td>4338</td>
<td>4375</td>
</tr>
<tr>
<td>173 cm</td>
<td>4042</td>
<td>4084</td>
<td>4124</td>
<td>4164</td>
<td>4204</td>
<td>4244</td>
<td>4283</td>
<td>4321</td>
<td>4359</td>
<td>4397</td>
</tr>
<tr>
<td>174 cm</td>
<td>4063</td>
<td>4104</td>
<td>4145</td>
<td>4185</td>
<td>4225</td>
<td>4265</td>
<td>4304</td>
<td>4343</td>
<td>4381</td>
<td>4419</td>
</tr>
<tr>
<td>175 cm</td>
<td>4083</td>
<td>4125</td>
<td>4166</td>
<td>4206</td>
<td>4246</td>
<td>4286</td>
<td>4325</td>
<td>4364</td>
<td>4403</td>
<td>4441</td>
</tr>
<tr>
<td>176 cm</td>
<td>4103</td>
<td>4145</td>
<td>4186</td>
<td>4227</td>
<td>4267</td>
<td>4307</td>
<td>4347</td>
<td>4386</td>
<td>4424</td>
<td>4463</td>
</tr>
<tr>
<td>177 cm</td>
<td>4124</td>
<td>4166</td>
<td>4207</td>
<td>4248</td>
<td>4288</td>
<td>4328</td>
<td>4368</td>
<td>4407</td>
<td>4446</td>
<td>4484</td>
</tr>
<tr>
<td>178 cm</td>
<td>4144</td>
<td>4186</td>
<td>4228</td>
<td>4269</td>
<td>4309</td>
<td>4349</td>
<td>4389</td>
<td>4429</td>
<td>4468</td>
<td>4506</td>
</tr>
<tr>
<td>179 cm</td>
<td>4164</td>
<td>4206</td>
<td>4248</td>
<td>4289</td>
<td>4330</td>
<td>4371</td>
<td>4410</td>
<td>4450</td>
<td>4489</td>
<td>4528</td>
</tr>
<tr>
<td>180 cm</td>
<td>4184</td>
<td>4227</td>
<td>4269</td>
<td>4310</td>
<td>4351</td>
<td>4392</td>
<td>4432</td>
<td>4471</td>
<td>4511</td>
<td>4550</td>
</tr>
<tr>
<td>181 cm</td>
<td>4205</td>
<td>4247</td>
<td>4289</td>
<td>4331</td>
<td>4372</td>
<td>4413</td>
<td>4453</td>
<td>4493</td>
<td>4532</td>
<td>4571</td>
</tr>
<tr>
<td>182 cm</td>
<td>4225</td>
<td>4267</td>
<td>4310</td>
<td>4351</td>
<td>4393</td>
<td>4433</td>
<td>4474</td>
<td>4514</td>
<td>4554</td>
<td>4593</td>
</tr>
</tbody>
</table>
Guide to the preparation, use and quality assurance of blood components

<table>
<thead>
<tr>
<th>kg</th>
<th>50</th>
<th>51</th>
<th>52</th>
<th>53</th>
<th>54</th>
<th>55</th>
<th>56</th>
<th>57</th>
<th>58</th>
<th>59</th>
</tr>
</thead>
<tbody>
<tr>
<td>183 cm</td>
<td>4245</td>
<td>4288</td>
<td>4330</td>
<td>4372</td>
<td>4413</td>
<td>4454</td>
<td>4495</td>
<td>4535</td>
<td>4575</td>
<td>4614</td>
</tr>
<tr>
<td>184 cm</td>
<td>4265</td>
<td>4308</td>
<td>4350</td>
<td>4393</td>
<td>4434</td>
<td>4475</td>
<td>4516</td>
<td>4556</td>
<td>4596</td>
<td>4636</td>
</tr>
<tr>
<td>185 cm</td>
<td>4285</td>
<td>4328</td>
<td>4371</td>
<td>4413</td>
<td>4455</td>
<td>4496</td>
<td>4537</td>
<td>4578</td>
<td>4618</td>
<td>4657</td>
</tr>
<tr>
<td>186 cm</td>
<td>4305</td>
<td>4348</td>
<td>4391</td>
<td>4434</td>
<td>4476</td>
<td>4517</td>
<td>4558</td>
<td>4599</td>
<td>4639</td>
<td>4679</td>
</tr>
<tr>
<td>187 cm</td>
<td>4325</td>
<td>4368</td>
<td>4412</td>
<td>4454</td>
<td>4496</td>
<td>4538</td>
<td>4579</td>
<td>4620</td>
<td>4660</td>
<td>4700</td>
</tr>
<tr>
<td>188 cm</td>
<td>4345</td>
<td>4389</td>
<td>4432</td>
<td>4475</td>
<td>4517</td>
<td>4559</td>
<td>4600</td>
<td>4641</td>
<td>4682</td>
<td>4722</td>
</tr>
<tr>
<td>189 cm</td>
<td>4365</td>
<td>4409</td>
<td>4452</td>
<td>4495</td>
<td>4537</td>
<td>4579</td>
<td>4621</td>
<td>4662</td>
<td>4703</td>
<td>4743</td>
</tr>
<tr>
<td>190 cm</td>
<td>4385</td>
<td>4429</td>
<td>4472</td>
<td>4515</td>
<td>4558</td>
<td>4600</td>
<td>4642</td>
<td>4683</td>
<td>4724</td>
<td>4764</td>
</tr>
<tr>
<td>191 cm</td>
<td>4405</td>
<td>4449</td>
<td>4492</td>
<td>4536</td>
<td>4578</td>
<td>4621</td>
<td>4663</td>
<td>4704</td>
<td>4745</td>
<td>4786</td>
</tr>
<tr>
<td>192 cm</td>
<td>4424</td>
<td>4469</td>
<td>4513</td>
<td>4556</td>
<td>4599</td>
<td>4641</td>
<td>4683</td>
<td>4725</td>
<td>4766</td>
<td>4807</td>
</tr>
<tr>
<td>193 cm</td>
<td>4444</td>
<td>4489</td>
<td>4533</td>
<td>4576</td>
<td>4619</td>
<td>4662</td>
<td>4704</td>
<td>4746</td>
<td>4787</td>
<td>4828</td>
</tr>
<tr>
<td>194 cm</td>
<td>4464</td>
<td>4509</td>
<td>4553</td>
<td>4597</td>
<td>4640</td>
<td>4683</td>
<td>4725</td>
<td>4767</td>
<td>4808</td>
<td>4849</td>
</tr>
<tr>
<td>195 cm</td>
<td>4484</td>
<td>4529</td>
<td>4573</td>
<td>4617</td>
<td>4660</td>
<td>4703</td>
<td>4746</td>
<td>4788</td>
<td>4829</td>
<td>4871</td>
</tr>
<tr>
<td>196 cm</td>
<td>4503</td>
<td>4549</td>
<td>4593</td>
<td>4637</td>
<td>4681</td>
<td>4724</td>
<td>4766</td>
<td>4809</td>
<td>4850</td>
<td>4892</td>
</tr>
<tr>
<td>197 cm</td>
<td>4523</td>
<td>4568</td>
<td>4613</td>
<td>4657</td>
<td>4701</td>
<td>4744</td>
<td>4787</td>
<td>4829</td>
<td>4871</td>
<td>4913</td>
</tr>
<tr>
<td>198 cm</td>
<td>4543</td>
<td>4588</td>
<td>4633</td>
<td>4677</td>
<td>4721</td>
<td>4765</td>
<td>4808</td>
<td>4850</td>
<td>4892</td>
<td>4934</td>
</tr>
<tr>
<td>199 cm</td>
<td>4562</td>
<td>4608</td>
<td>4653</td>
<td>4698</td>
<td>4742</td>
<td>4785</td>
<td>4828</td>
<td>4871</td>
<td>4913</td>
<td>4955</td>
</tr>
<tr>
<td>200 cm</td>
<td>4582</td>
<td>4628</td>
<td>4673</td>
<td>4718</td>
<td>4762</td>
<td>4806</td>
<td>4849</td>
<td>4892</td>
<td>4934</td>
<td>4976</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>kg</th>
<th>60</th>
<th>61</th>
<th>62</th>
<th>63</th>
<th>64</th>
<th>65</th>
<th>66</th>
<th>67</th>
<th>68</th>
<th>69</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 cm</td>
<td>4145</td>
<td>4180</td>
<td>4215</td>
<td>4249</td>
<td>4283</td>
<td>4317</td>
<td>4350</td>
<td>4384</td>
<td>4417</td>
<td>4449</td>
</tr>
<tr>
<td>161 cm</td>
<td>4168</td>
<td>4203</td>
<td>4238</td>
<td>4272</td>
<td>4306</td>
<td>4340</td>
<td>4374</td>
<td>4407</td>
<td>4440</td>
<td>4473</td>
</tr>
<tr>
<td>162 cm</td>
<td>4190</td>
<td>4225</td>
<td>4260</td>
<td>4295</td>
<td>4329</td>
<td>4363</td>
<td>4397</td>
<td>4431</td>
<td>4464</td>
<td>4497</td>
</tr>
<tr>
<td>163 cm</td>
<td>4212</td>
<td>4248</td>
<td>4283</td>
<td>4318</td>
<td>4352</td>
<td>4387</td>
<td>4421</td>
<td>4454</td>
<td>4488</td>
<td>4521</td>
</tr>
<tr>
<td>164 cm</td>
<td>4235</td>
<td>4270</td>
<td>4306</td>
<td>4341</td>
<td>4375</td>
<td>4410</td>
<td>4444</td>
<td>4478</td>
<td>4511</td>
<td>4544</td>
</tr>
<tr>
<td>165 cm</td>
<td>4257</td>
<td>4293</td>
<td>4328</td>
<td>4364</td>
<td>4398</td>
<td>4433</td>
<td>4467</td>
<td>4501</td>
<td>4535</td>
<td>4568</td>
</tr>
<tr>
<td>166 cm</td>
<td>4279</td>
<td>4315</td>
<td>4351</td>
<td>4386</td>
<td>4421</td>
<td>4456</td>
<td>4490</td>
<td>4525</td>
<td>4558</td>
<td>4592</td>
</tr>
<tr>
<td>167 cm</td>
<td>4302</td>
<td>4338</td>
<td>4374</td>
<td>4409</td>
<td>4444</td>
<td>4479</td>
<td>4514</td>
<td>4548</td>
<td>4582</td>
<td>4615</td>
</tr>
<tr>
<td>168 cm</td>
<td>4324</td>
<td>4360</td>
<td>4396</td>
<td>4432</td>
<td>4467</td>
<td>4502</td>
<td>4537</td>
<td>4571</td>
<td>4605</td>
<td>4639</td>
</tr>
<tr>
<td>169 cm</td>
<td>4346</td>
<td>4383</td>
<td>4419</td>
<td>4454</td>
<td>4490</td>
<td>4525</td>
<td>4560</td>
<td>4594</td>
<td>4629</td>
<td>4663</td>
</tr>
<tr>
<td>170 cm</td>
<td>4368</td>
<td>4405</td>
<td>4441</td>
<td>4477</td>
<td>4513</td>
<td>4548</td>
<td>4583</td>
<td>4618</td>
<td>4652</td>
<td>4686</td>
</tr>
<tr>
<td>171 cm</td>
<td>4390</td>
<td>4427</td>
<td>4464</td>
<td>4500</td>
<td>4535</td>
<td>4571</td>
<td>4606</td>
<td>4641</td>
<td>4675</td>
<td>4710</td>
</tr>
<tr>
<td>172 cm</td>
<td>4413</td>
<td>4449</td>
<td>4486</td>
<td>4522</td>
<td>4558</td>
<td>4594</td>
<td>4629</td>
<td>4664</td>
<td>4699</td>
<td>4733</td>
</tr>
<tr>
<td>kg</td>
<td>60</td>
<td>61</td>
<td>62</td>
<td>63</td>
<td>64</td>
<td>65</td>
<td>66</td>
<td>67</td>
<td>68</td>
<td>69</td>
</tr>
<tr>
<td>------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>173 cm</td>
<td>4435</td>
<td>4472</td>
<td>4508</td>
<td>4545</td>
<td>4581</td>
<td>4617</td>
<td>4652</td>
<td>4687</td>
<td>4722</td>
<td>4756</td>
</tr>
<tr>
<td>174 cm</td>
<td>4457</td>
<td>4494</td>
<td>4531</td>
<td>4567</td>
<td>4603</td>
<td>4639</td>
<td>4675</td>
<td>4710</td>
<td>4745</td>
<td>4780</td>
</tr>
<tr>
<td>175 cm</td>
<td>4479</td>
<td>4516</td>
<td>4553</td>
<td>4590</td>
<td>4626</td>
<td>4662</td>
<td>4698</td>
<td>4733</td>
<td>4768</td>
<td>4803</td>
</tr>
<tr>
<td>176 cm</td>
<td>4501</td>
<td>4538</td>
<td>4575</td>
<td>4612</td>
<td>4649</td>
<td>4685</td>
<td>4721</td>
<td>4756</td>
<td>4792</td>
<td>4826</td>
</tr>
<tr>
<td>177 cm</td>
<td>4522</td>
<td>4560</td>
<td>4598</td>
<td>4635</td>
<td>4671</td>
<td>4708</td>
<td>4744</td>
<td>4779</td>
<td>4815</td>
<td>4850</td>
</tr>
<tr>
<td>178 cm</td>
<td>4544</td>
<td>4582</td>
<td>4620</td>
<td>4657</td>
<td>4694</td>
<td>4730</td>
<td>4766</td>
<td>4802</td>
<td>4838</td>
<td>4873</td>
</tr>
<tr>
<td>179 cm</td>
<td>4566</td>
<td>4604</td>
<td>4642</td>
<td>4679</td>
<td>4716</td>
<td>4753</td>
<td>4789</td>
<td>4825</td>
<td>4861</td>
<td>4896</td>
</tr>
<tr>
<td>180 cm</td>
<td>4588</td>
<td>4626</td>
<td>4664</td>
<td>4701</td>
<td>4739</td>
<td>4775</td>
<td>4812</td>
<td>4848</td>
<td>4884</td>
<td>4919</td>
</tr>
<tr>
<td>181 cm</td>
<td>4610</td>
<td>4648</td>
<td>4686</td>
<td>4724</td>
<td>4761</td>
<td>4798</td>
<td>4835</td>
<td>4871</td>
<td>4907</td>
<td>4942</td>
</tr>
<tr>
<td>182 cm</td>
<td>4632</td>
<td>4670</td>
<td>4708</td>
<td>4746</td>
<td>4783</td>
<td>4820</td>
<td>4857</td>
<td>4894</td>
<td>4930</td>
<td>4966</td>
</tr>
<tr>
<td>183 cm</td>
<td>4653</td>
<td>4692</td>
<td>4730</td>
<td>4768</td>
<td>4806</td>
<td>4843</td>
<td>4880</td>
<td>4916</td>
<td>4953</td>
<td>4989</td>
</tr>
<tr>
<td>184 cm</td>
<td>4675</td>
<td>4714</td>
<td>4752</td>
<td>4790</td>
<td>4828</td>
<td>4865</td>
<td>4902</td>
<td>4939</td>
<td>4975</td>
<td>5012</td>
</tr>
<tr>
<td>185 cm</td>
<td>4697</td>
<td>4736</td>
<td>4774</td>
<td>4812</td>
<td>4850</td>
<td>4888</td>
<td>4925</td>
<td>4962</td>
<td>4998</td>
<td>5035</td>
</tr>
<tr>
<td>186 cm</td>
<td>4718</td>
<td>4757</td>
<td>4796</td>
<td>4834</td>
<td>4872</td>
<td>4910</td>
<td>4947</td>
<td>4984</td>
<td>5021</td>
<td>5058</td>
</tr>
<tr>
<td>187 cm</td>
<td>4740</td>
<td>4779</td>
<td>4818</td>
<td>4856</td>
<td>4895</td>
<td>4932</td>
<td>4970</td>
<td>5007</td>
<td>5044</td>
<td>5080</td>
</tr>
<tr>
<td>188 cm</td>
<td>4761</td>
<td>4801</td>
<td>4840</td>
<td>4878</td>
<td>4917</td>
<td>4955</td>
<td>4992</td>
<td>5030</td>
<td>5067</td>
<td>5103</td>
</tr>
<tr>
<td>189 cm</td>
<td>4783</td>
<td>4822</td>
<td>4862</td>
<td>4900</td>
<td>4939</td>
<td>4977</td>
<td>5015</td>
<td>5052</td>
<td>5089</td>
<td>5126</td>
</tr>
<tr>
<td>190 cm</td>
<td>4804</td>
<td>4844</td>
<td>4883</td>
<td>4922</td>
<td>4961</td>
<td>4999</td>
<td>5037</td>
<td>5075</td>
<td>5112</td>
<td>5149</td>
</tr>
<tr>
<td>191 cm</td>
<td>4826</td>
<td>4866</td>
<td>4905</td>
<td>4944</td>
<td>4983</td>
<td>5021</td>
<td>5060</td>
<td>5097</td>
<td>5135</td>
<td>5172</td>
</tr>
<tr>
<td>192 cm</td>
<td>4847</td>
<td>4887</td>
<td>4927</td>
<td>4966</td>
<td>5005</td>
<td>5044</td>
<td>5082</td>
<td>5120</td>
<td>5157</td>
<td>5194</td>
</tr>
<tr>
<td>193 cm</td>
<td>4869</td>
<td>4909</td>
<td>4949</td>
<td>4988</td>
<td>5027</td>
<td>5066</td>
<td>5104</td>
<td>5142</td>
<td>5180</td>
<td>5217</td>
</tr>
<tr>
<td>194 cm</td>
<td>4890</td>
<td>4930</td>
<td>4970</td>
<td>5010</td>
<td>5049</td>
<td>5088</td>
<td>5126</td>
<td>5165</td>
<td>5202</td>
<td>5240</td>
</tr>
<tr>
<td>195 cm</td>
<td>4911</td>
<td>4952</td>
<td>4992</td>
<td>5032</td>
<td>5071</td>
<td>5110</td>
<td>5149</td>
<td>5187</td>
<td>5225</td>
<td>5263</td>
</tr>
<tr>
<td>196 cm</td>
<td>4933</td>
<td>4973</td>
<td>5014</td>
<td>5053</td>
<td>5093</td>
<td>5132</td>
<td>5171</td>
<td>5209</td>
<td>5247</td>
<td>5285</td>
</tr>
<tr>
<td>197 cm</td>
<td>4954</td>
<td>4995</td>
<td>5035</td>
<td>5075</td>
<td>5115</td>
<td>5154</td>
<td>5193</td>
<td>5232</td>
<td>5270</td>
<td>5308</td>
</tr>
<tr>
<td>198 cm</td>
<td>4975</td>
<td>5016</td>
<td>5057</td>
<td>5097</td>
<td>5137</td>
<td>5176</td>
<td>5215</td>
<td>5254</td>
<td>5292</td>
<td>5330</td>
</tr>
<tr>
<td>199 cm</td>
<td>4997</td>
<td>5038</td>
<td>5078</td>
<td>5119</td>
<td>5158</td>
<td>5198</td>
<td>5237</td>
<td>5276</td>
<td>5315</td>
<td>5353</td>
</tr>
<tr>
<td>200 cm</td>
<td>5018</td>
<td>5059</td>
<td>5100</td>
<td>5140</td>
<td>5180</td>
<td>5220</td>
<td>5259</td>
<td>5298</td>
<td>5337</td>
<td>5375</td>
</tr>
<tr>
<td>kg</td>
<td>70</td>
<td>71</td>
<td>72</td>
<td>73</td>
<td>74</td>
<td>75</td>
<td>76</td>
<td>77</td>
<td>78</td>
<td>79</td>
</tr>
<tr>
<td>160 cm</td>
<td>4482</td>
<td>4514</td>
<td>4545</td>
<td>4577</td>
<td>4608</td>
<td>4639</td>
<td>4670</td>
<td>4701</td>
<td>4731</td>
<td>4761</td>
</tr>
<tr>
<td>161 cm</td>
<td>4506</td>
<td>4538</td>
<td>4570</td>
<td>4601</td>
<td>4633</td>
<td>4664</td>
<td>4695</td>
<td>4726</td>
<td>4756</td>
<td>4787</td>
</tr>
<tr>
<td>162 cm</td>
<td>4530</td>
<td>4562</td>
<td>4594</td>
<td>4626</td>
<td>4657</td>
<td>4689</td>
<td>4720</td>
<td>4751</td>
<td>4782</td>
<td>4812</td>
</tr>
<tr>
<td>163 cm</td>
<td>4553</td>
<td>4586</td>
<td>4618</td>
<td>4650</td>
<td>4682</td>
<td>4713</td>
<td>4745</td>
<td>4776</td>
<td>4807</td>
<td>4837</td>
</tr>
</tbody>
</table>
Guide to the preparation, use and quality assurance of blood components

<table>
<thead>
<tr>
<th>kg</th>
<th>70</th>
<th>71</th>
<th>72</th>
<th>73</th>
<th>74</th>
<th>75</th>
<th>76</th>
<th>77</th>
<th>78</th>
<th>79</th>
</tr>
</thead>
<tbody>
<tr>
<td>164 cm</td>
<td>4577</td>
<td>4610</td>
<td>4642</td>
<td>4675</td>
<td>4706</td>
<td>4738</td>
<td>4770</td>
<td>4801</td>
<td>4832</td>
<td>4862</td>
</tr>
<tr>
<td>165 cm</td>
<td>4601</td>
<td>4634</td>
<td>4667</td>
<td>4699</td>
<td>4731</td>
<td>4763</td>
<td>4794</td>
<td>4826</td>
<td>4857</td>
<td>4887</td>
</tr>
<tr>
<td>166 cm</td>
<td>4625</td>
<td>4658</td>
<td>4691</td>
<td>4723</td>
<td>4755</td>
<td>4787</td>
<td>4819</td>
<td>4850</td>
<td>4882</td>
<td>4913</td>
</tr>
<tr>
<td>167 cm</td>
<td>4649</td>
<td>4682</td>
<td>4715</td>
<td>4747</td>
<td>4780</td>
<td>4812</td>
<td>4844</td>
<td>4875</td>
<td>4906</td>
<td>4938</td>
</tr>
<tr>
<td>168 cm</td>
<td>4673</td>
<td>4706</td>
<td>4739</td>
<td>4772</td>
<td>4804</td>
<td>4836</td>
<td>4868</td>
<td>4900</td>
<td>4931</td>
<td>4963</td>
</tr>
<tr>
<td>169 cm</td>
<td>4696</td>
<td>4730</td>
<td>4763</td>
<td>4796</td>
<td>4828</td>
<td>4861</td>
<td>4893</td>
<td>4925</td>
<td>4956</td>
<td>4988</td>
</tr>
<tr>
<td>170 cm</td>
<td>4720</td>
<td>4753</td>
<td>4787</td>
<td>4820</td>
<td>4852</td>
<td>4885</td>
<td>4917</td>
<td>4949</td>
<td>4981</td>
<td>5012</td>
</tr>
<tr>
<td>171 cm</td>
<td>4744</td>
<td>4777</td>
<td>4811</td>
<td>4844</td>
<td>4877</td>
<td>4909</td>
<td>4942</td>
<td>4974</td>
<td>5006</td>
<td>5037</td>
</tr>
<tr>
<td>172 cm</td>
<td>4767</td>
<td>4801</td>
<td>4835</td>
<td>4868</td>
<td>4901</td>
<td>4934</td>
<td>4966</td>
<td>4998</td>
<td>5030</td>
<td>5062</td>
</tr>
<tr>
<td>173 cm</td>
<td>4791</td>
<td>4825</td>
<td>4858</td>
<td>4892</td>
<td>4925</td>
<td>4958</td>
<td>4990</td>
<td>5023</td>
<td>5055</td>
<td>5087</td>
</tr>
<tr>
<td>174 cm</td>
<td>4814</td>
<td>4848</td>
<td>4882</td>
<td>4916</td>
<td>4949</td>
<td>4982</td>
<td>5015</td>
<td>5047</td>
<td>5080</td>
<td>5112</td>
</tr>
<tr>
<td>175 cm</td>
<td>4838</td>
<td>4872</td>
<td>4906</td>
<td>4940</td>
<td>4973</td>
<td>5006</td>
<td>5039</td>
<td>5072</td>
<td>5104</td>
<td>5136</td>
</tr>
<tr>
<td>176 cm</td>
<td>4861</td>
<td>4896</td>
<td>4930</td>
<td>4963</td>
<td>4997</td>
<td>5030</td>
<td>5063</td>
<td>5096</td>
<td>5129</td>
<td>5161</td>
</tr>
<tr>
<td>177 cm</td>
<td>4885</td>
<td>4919</td>
<td>4953</td>
<td>4987</td>
<td>5021</td>
<td>5054</td>
<td>5088</td>
<td>5121</td>
<td>5153</td>
<td>5186</td>
</tr>
<tr>
<td>178 cm</td>
<td>4908</td>
<td>4943</td>
<td>4977</td>
<td>5011</td>
<td>5045</td>
<td>5079</td>
<td>5112</td>
<td>5145</td>
<td>5178</td>
<td>5210</td>
</tr>
<tr>
<td>179 cm</td>
<td>4931</td>
<td>4966</td>
<td>5001</td>
<td>5035</td>
<td>5069</td>
<td>5103</td>
<td>5136</td>
<td>5169</td>
<td>5202</td>
<td>5235</td>
</tr>
<tr>
<td>180 cm</td>
<td>4955</td>
<td>4990</td>
<td>5024</td>
<td>5059</td>
<td>5093</td>
<td>5127</td>
<td>5160</td>
<td>5193</td>
<td>5227</td>
<td>5259</td>
</tr>
<tr>
<td>181 cm</td>
<td>4978</td>
<td>5013</td>
<td>5048</td>
<td>5082</td>
<td>5116</td>
<td>5150</td>
<td>5184</td>
<td>5218</td>
<td>5251</td>
<td>5284</td>
</tr>
<tr>
<td>182 cm</td>
<td>5001</td>
<td>5036</td>
<td>5071</td>
<td>5106</td>
<td>5140</td>
<td>5174</td>
<td>5208</td>
<td>5242</td>
<td>5275</td>
<td>5308</td>
</tr>
<tr>
<td>183 cm</td>
<td>5024</td>
<td>5060</td>
<td>5095</td>
<td>5129</td>
<td>5164</td>
<td>5198</td>
<td>5232</td>
<td>5266</td>
<td>5300</td>
<td>5333</td>
</tr>
<tr>
<td>184 cm</td>
<td>5047</td>
<td>5083</td>
<td>5118</td>
<td>5153</td>
<td>5188</td>
<td>5222</td>
<td>5256</td>
<td>5290</td>
<td>5324</td>
<td>5357</td>
</tr>
<tr>
<td>185 cm</td>
<td>5071</td>
<td>5106</td>
<td>5142</td>
<td>5177</td>
<td>5211</td>
<td>5246</td>
<td>5280</td>
<td>5314</td>
<td>5348</td>
<td>5381</td>
</tr>
<tr>
<td>186 cm</td>
<td>5094</td>
<td>5129</td>
<td>5165</td>
<td>5200</td>
<td>5235</td>
<td>5270</td>
<td>5304</td>
<td>5338</td>
<td>5372</td>
<td>5406</td>
</tr>
<tr>
<td>187 cm</td>
<td>5117</td>
<td>5153</td>
<td>5188</td>
<td>5224</td>
<td>5259</td>
<td>5293</td>
<td>5328</td>
<td>5362</td>
<td>5396</td>
<td>5430</td>
</tr>
<tr>
<td>188 cm</td>
<td>5140</td>
<td>5176</td>
<td>5212</td>
<td>5247</td>
<td>5282</td>
<td>5317</td>
<td>5352</td>
<td>5386</td>
<td>5420</td>
<td>5454</td>
</tr>
<tr>
<td>189 cm</td>
<td>5163</td>
<td>5199</td>
<td>5235</td>
<td>5270</td>
<td>5306</td>
<td>5341</td>
<td>5376</td>
<td>5410</td>
<td>5444</td>
<td>5478</td>
</tr>
<tr>
<td>190 cm</td>
<td>5186</td>
<td>5222</td>
<td>5258</td>
<td>5294</td>
<td>5329</td>
<td>5364</td>
<td>5399</td>
<td>5434</td>
<td>5468</td>
<td>5503</td>
</tr>
<tr>
<td>191 cm</td>
<td>5209</td>
<td>5245</td>
<td>5281</td>
<td>5317</td>
<td>5353</td>
<td>5388</td>
<td>5423</td>
<td>5458</td>
<td>5492</td>
<td>5527</td>
</tr>
<tr>
<td>192 cm</td>
<td>5231</td>
<td>5268</td>
<td>5304</td>
<td>5340</td>
<td>5376</td>
<td>5412</td>
<td>5447</td>
<td>5482</td>
<td>5516</td>
<td>5551</td>
</tr>
<tr>
<td>193 cm</td>
<td>5254</td>
<td>5291</td>
<td>5327</td>
<td>5364</td>
<td>5400</td>
<td>5435</td>
<td>5470</td>
<td>5506</td>
<td>5540</td>
<td>5575</td>
</tr>
<tr>
<td>194 cm</td>
<td>5277</td>
<td>5314</td>
<td>5351</td>
<td>5387</td>
<td>5423</td>
<td>5459</td>
<td>5494</td>
<td>5529</td>
<td>5564</td>
<td>5599</td>
</tr>
<tr>
<td>195 cm</td>
<td>5300</td>
<td>5337</td>
<td>5374</td>
<td>5410</td>
<td>5446</td>
<td>5482</td>
<td>5518</td>
<td>5553</td>
<td>5588</td>
<td>5623</td>
</tr>
<tr>
<td>196 cm</td>
<td>5323</td>
<td>5360</td>
<td>5397</td>
<td>5433</td>
<td>5470</td>
<td>5506</td>
<td>5541</td>
<td>5577</td>
<td>5612</td>
<td>5647</td>
</tr>
<tr>
<td>197 cm</td>
<td>5345</td>
<td>5383</td>
<td>5420</td>
<td>5456</td>
<td>5493</td>
<td>5529</td>
<td>5565</td>
<td>5600</td>
<td>5636</td>
<td>5671</td>
</tr>
<tr>
<td>198 cm</td>
<td>5368</td>
<td>5405</td>
<td>5443</td>
<td>5479</td>
<td>5516</td>
<td>5552</td>
<td>5588</td>
<td>5624</td>
<td>5660</td>
<td>5695</td>
</tr>
</tbody>
</table>
Appendix 2. Tables for calculation of blood volumes

<table>
<thead>
<tr>
<th>kg</th>
<th>70</th>
<th>71</th>
<th>72</th>
<th>73</th>
<th>74</th>
<th>75</th>
<th>76</th>
<th>77</th>
<th>78</th>
<th>79</th>
</tr>
</thead>
<tbody>
<tr>
<td>199 cm</td>
<td>5391</td>
<td>5428</td>
<td>5466</td>
<td>5503</td>
<td>5539</td>
<td>5576</td>
<td>5612</td>
<td>5648</td>
<td>5683</td>
<td>5719</td>
</tr>
<tr>
<td>200 cm</td>
<td>5413</td>
<td>5451</td>
<td>5488</td>
<td>5526</td>
<td>5562</td>
<td>5599</td>
<td>5635</td>
<td>5671</td>
<td>5707</td>
<td>5742</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>kg</th>
<th>80</th>
<th>81</th>
<th>82</th>
<th>83</th>
<th>84</th>
<th>85</th>
<th>86</th>
<th>87</th>
<th>88</th>
<th>89</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 cm</td>
<td>4791</td>
<td>4821</td>
<td>4851</td>
<td>4880</td>
<td>4909</td>
<td>4938</td>
<td>4967</td>
<td>4995</td>
<td>5024</td>
<td>5052</td>
</tr>
<tr>
<td>161 cm</td>
<td>4817</td>
<td>4847</td>
<td>4876</td>
<td>4906</td>
<td>4935</td>
<td>4964</td>
<td>4993</td>
<td>5022</td>
<td>5050</td>
<td>5078</td>
</tr>
<tr>
<td>162 cm</td>
<td>4842</td>
<td>4872</td>
<td>4902</td>
<td>4932</td>
<td>4961</td>
<td>4990</td>
<td>5019</td>
<td>5048</td>
<td>5076</td>
<td>5105</td>
</tr>
<tr>
<td>163 cm</td>
<td>4868</td>
<td>4898</td>
<td>4928</td>
<td>4957</td>
<td>4987</td>
<td>5016</td>
<td>5045</td>
<td>5074</td>
<td>5103</td>
<td>5131</td>
</tr>
<tr>
<td>164 cm</td>
<td>4893</td>
<td>4923</td>
<td>4953</td>
<td>4983</td>
<td>5013</td>
<td>5042</td>
<td>5071</td>
<td>5100</td>
<td>5129</td>
<td>5158</td>
</tr>
<tr>
<td>165 cm</td>
<td>4918</td>
<td>4948</td>
<td>4979</td>
<td>5009</td>
<td>5038</td>
<td>5068</td>
<td>5097</td>
<td>5127</td>
<td>5155</td>
<td>5184</td>
</tr>
<tr>
<td>166 cm</td>
<td>4943</td>
<td>4974</td>
<td>5004</td>
<td>5034</td>
<td>5064</td>
<td>5094</td>
<td>5123</td>
<td>5153</td>
<td>5182</td>
<td>5211</td>
</tr>
<tr>
<td>167 cm</td>
<td>4968</td>
<td>4999</td>
<td>5030</td>
<td>5060</td>
<td>5090</td>
<td>5120</td>
<td>5149</td>
<td>5179</td>
<td>5208</td>
<td>5237</td>
</tr>
<tr>
<td>168 cm</td>
<td>4994</td>
<td>5024</td>
<td>5055</td>
<td>5085</td>
<td>5116</td>
<td>5145</td>
<td>5175</td>
<td>5205</td>
<td>5234</td>
<td>5263</td>
</tr>
<tr>
<td>169 cm</td>
<td>5019</td>
<td>5050</td>
<td>5080</td>
<td>5111</td>
<td>5141</td>
<td>5171</td>
<td>5201</td>
<td>5231</td>
<td>5260</td>
<td>5290</td>
</tr>
<tr>
<td>170 cm</td>
<td>5044</td>
<td>5075</td>
<td>5106</td>
<td>5136</td>
<td>5167</td>
<td>5197</td>
<td>5227</td>
<td>5257</td>
<td>5286</td>
<td>5316</td>
</tr>
<tr>
<td>171 cm</td>
<td>5069</td>
<td>5100</td>
<td>5131</td>
<td>5162</td>
<td>5192</td>
<td>5223</td>
<td>5253</td>
<td>5283</td>
<td>5312</td>
<td>5342</td>
</tr>
<tr>
<td>172 cm</td>
<td>5094</td>
<td>5125</td>
<td>5156</td>
<td>5187</td>
<td>5218</td>
<td>5248</td>
<td>5278</td>
<td>5309</td>
<td>5338</td>
<td>5368</td>
</tr>
<tr>
<td>173 cm</td>
<td>5119</td>
<td>5150</td>
<td>5181</td>
<td>5212</td>
<td>5243</td>
<td>5274</td>
<td>5304</td>
<td>5334</td>
<td>5364</td>
<td>5394</td>
</tr>
<tr>
<td>174 cm</td>
<td>5144</td>
<td>5175</td>
<td>5206</td>
<td>5238</td>
<td>5269</td>
<td>5299</td>
<td>5330</td>
<td>5360</td>
<td>5390</td>
<td>5420</td>
</tr>
<tr>
<td>175 cm</td>
<td>5168</td>
<td>5200</td>
<td>5232</td>
<td>5263</td>
<td>5294</td>
<td>5325</td>
<td>5355</td>
<td>5386</td>
<td>5416</td>
<td>5446</td>
</tr>
<tr>
<td>176 cm</td>
<td>5193</td>
<td>5225</td>
<td>5257</td>
<td>5288</td>
<td>5319</td>
<td>5350</td>
<td>5381</td>
<td>5412</td>
<td>5442</td>
<td>5472</td>
</tr>
<tr>
<td>177 cm</td>
<td>5218</td>
<td>5250</td>
<td>5282</td>
<td>5313</td>
<td>5345</td>
<td>5376</td>
<td>5407</td>
<td>5437</td>
<td>5468</td>
<td>5498</td>
</tr>
<tr>
<td>178 cm</td>
<td>5243</td>
<td>5275</td>
<td>5307</td>
<td>5338</td>
<td>5370</td>
<td>5401</td>
<td>5432</td>
<td>5463</td>
<td>5494</td>
<td>5524</td>
</tr>
<tr>
<td>179 cm</td>
<td>5267</td>
<td>5300</td>
<td>5332</td>
<td>5363</td>
<td>5395</td>
<td>5426</td>
<td>5458</td>
<td>5488</td>
<td>5519</td>
<td>5550</td>
</tr>
<tr>
<td>180 cm</td>
<td>5292</td>
<td>5324</td>
<td>5357</td>
<td>5388</td>
<td>5420</td>
<td>5452</td>
<td>5483</td>
<td>5514</td>
<td>5545</td>
<td>5576</td>
</tr>
<tr>
<td>181 cm</td>
<td>5317</td>
<td>5349</td>
<td>5381</td>
<td>5414</td>
<td>5445</td>
<td>5477</td>
<td>5508</td>
<td>5540</td>
<td>5571</td>
<td>5601</td>
</tr>
<tr>
<td>182 cm</td>
<td>5341</td>
<td>5374</td>
<td>5406</td>
<td>5438</td>
<td>5470</td>
<td>5502</td>
<td>5534</td>
<td>5565</td>
<td>5596</td>
<td>5627</td>
</tr>
<tr>
<td>183 cm</td>
<td>5366</td>
<td>5399</td>
<td>5431</td>
<td>5463</td>
<td>5495</td>
<td>5527</td>
<td>5559</td>
<td>5590</td>
<td>5622</td>
<td>5653</td>
</tr>
<tr>
<td>184 cm</td>
<td>5390</td>
<td>5423</td>
<td>5456</td>
<td>5488</td>
<td>5521</td>
<td>5553</td>
<td>5584</td>
<td>5616</td>
<td>5647</td>
<td>5678</td>
</tr>
<tr>
<td>185 cm</td>
<td>5415</td>
<td>5448</td>
<td>5481</td>
<td>5513</td>
<td>5545</td>
<td>5578</td>
<td>5610</td>
<td>5641</td>
<td>5673</td>
<td>5704</td>
</tr>
<tr>
<td>186 cm</td>
<td>5439</td>
<td>5472</td>
<td>5505</td>
<td>5538</td>
<td>5570</td>
<td>5603</td>
<td>5635</td>
<td>5667</td>
<td>5698</td>
<td>5730</td>
</tr>
<tr>
<td>187 cm</td>
<td>5464</td>
<td>5497</td>
<td>5530</td>
<td>5563</td>
<td>5595</td>
<td>5628</td>
<td>5660</td>
<td>5692</td>
<td>5724</td>
<td>5755</td>
</tr>
<tr>
<td>188 cm</td>
<td>5488</td>
<td>5521</td>
<td>5555</td>
<td>5588</td>
<td>5620</td>
<td>5653</td>
<td>5685</td>
<td>5717</td>
<td>5749</td>
<td>5781</td>
</tr>
<tr>
<td>189 cm</td>
<td>5512</td>
<td>5546</td>
<td>5579</td>
<td>5612</td>
<td>5645</td>
<td>5678</td>
<td>5710</td>
<td>5742</td>
<td>5774</td>
<td>5806</td>
</tr>
</tbody>
</table>
Guide to the preparation, use and quality assurance of blood components

<table>
<thead>
<tr>
<th>kg</th>
<th>80</th>
<th>81</th>
<th>82</th>
<th>83</th>
<th>84</th>
<th>85</th>
<th>86</th>
<th>87</th>
<th>88</th>
<th>89</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td>5537</td>
<td>5570</td>
<td>5604</td>
<td>5637</td>
<td>5670</td>
<td>5703</td>
<td>5735</td>
<td>5767</td>
<td>5800</td>
<td>5831</td>
</tr>
<tr>
<td>191</td>
<td>5561</td>
<td>5595</td>
<td>5628</td>
<td>5662</td>
<td>5695</td>
<td>5728</td>
<td>5760</td>
<td>5793</td>
<td>5825</td>
<td>5857</td>
</tr>
<tr>
<td>192</td>
<td>5585</td>
<td>5619</td>
<td>5653</td>
<td>5686</td>
<td>5719</td>
<td>5752</td>
<td>5785</td>
<td>5818</td>
<td>5850</td>
<td>5882</td>
</tr>
<tr>
<td>193</td>
<td>5609</td>
<td>5643</td>
<td>5677</td>
<td>5711</td>
<td>5744</td>
<td>5777</td>
<td>5810</td>
<td>5843</td>
<td>5875</td>
<td>5907</td>
</tr>
<tr>
<td>194</td>
<td>5633</td>
<td>5668</td>
<td>5701</td>
<td>5735</td>
<td>5769</td>
<td>5802</td>
<td>5835</td>
<td>5868</td>
<td>5900</td>
<td>5933</td>
</tr>
<tr>
<td>195</td>
<td>5658</td>
<td>5692</td>
<td>5726</td>
<td>5760</td>
<td>5793</td>
<td>5827</td>
<td>5860</td>
<td>5893</td>
<td>5925</td>
<td>5958</td>
</tr>
<tr>
<td>196</td>
<td>5682</td>
<td>5716</td>
<td>5750</td>
<td>5784</td>
<td>5818</td>
<td>5851</td>
<td>5885</td>
<td>5918</td>
<td>5951</td>
<td>5983</td>
</tr>
<tr>
<td>197</td>
<td>5706</td>
<td>5740</td>
<td>5775</td>
<td>5809</td>
<td>5842</td>
<td>5876</td>
<td>5909</td>
<td>5943</td>
<td>5976</td>
<td>6008</td>
</tr>
<tr>
<td>198</td>
<td>5730</td>
<td>5764</td>
<td>5799</td>
<td>5833</td>
<td>5867</td>
<td>5901</td>
<td>5934</td>
<td>5968</td>
<td>6001</td>
<td>6033</td>
</tr>
<tr>
<td>199</td>
<td>5754</td>
<td>5788</td>
<td>5823</td>
<td>5857</td>
<td>5891</td>
<td>5925</td>
<td>5959</td>
<td>5992</td>
<td>6026</td>
<td>6059</td>
</tr>
<tr>
<td>200</td>
<td>5778</td>
<td>5813</td>
<td>5847</td>
<td>5882</td>
<td>5916</td>
<td>5950</td>
<td>5984</td>
<td>6017</td>
<td>6051</td>
<td>6084</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>kg</th>
<th>90</th>
<th>91</th>
<th>92</th>
<th>93</th>
<th>94</th>
<th>95</th>
<th>96</th>
<th>97</th>
<th>98</th>
<th>99</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>5080</td>
<td>5107</td>
<td>5135</td>
<td>5163</td>
<td>5190</td>
<td>5217</td>
<td>5244</td>
<td>5271</td>
<td>5297</td>
<td>5324</td>
</tr>
<tr>
<td>161</td>
<td>5106</td>
<td>5134</td>
<td>5162</td>
<td>5190</td>
<td>5217</td>
<td>5244</td>
<td>5271</td>
<td>5298</td>
<td>5325</td>
<td>5352</td>
</tr>
<tr>
<td>162</td>
<td>5133</td>
<td>5161</td>
<td>5189</td>
<td>5217</td>
<td>5244</td>
<td>5272</td>
<td>5299</td>
<td>5326</td>
<td>5353</td>
<td>5379</td>
</tr>
<tr>
<td>163</td>
<td>5160</td>
<td>5188</td>
<td>5216</td>
<td>5244</td>
<td>5271</td>
<td>5299</td>
<td>5326</td>
<td>5353</td>
<td>5380</td>
<td>5407</td>
</tr>
<tr>
<td>164</td>
<td>5186</td>
<td>5215</td>
<td>5243</td>
<td>5271</td>
<td>5298</td>
<td>5326</td>
<td>5353</td>
<td>5381</td>
<td>5408</td>
<td>5435</td>
</tr>
<tr>
<td>165</td>
<td>5213</td>
<td>5241</td>
<td>5270</td>
<td>5298</td>
<td>5325</td>
<td>5353</td>
<td>5381</td>
<td>5408</td>
<td>5435</td>
<td>5462</td>
</tr>
<tr>
<td>166</td>
<td>5239</td>
<td>5268</td>
<td>5296</td>
<td>5324</td>
<td>5353</td>
<td>5380</td>
<td>5408</td>
<td>5436</td>
<td>5463</td>
<td>5490</td>
</tr>
<tr>
<td>167</td>
<td>5266</td>
<td>5295</td>
<td>5323</td>
<td>5351</td>
<td>5379</td>
<td>5407</td>
<td>5435</td>
<td>5463</td>
<td>5490</td>
<td>5518</td>
</tr>
<tr>
<td>168</td>
<td>5292</td>
<td>5321</td>
<td>5350</td>
<td>5378</td>
<td>5406</td>
<td>5434</td>
<td>5462</td>
<td>5490</td>
<td>5518</td>
<td>5545</td>
</tr>
<tr>
<td>169</td>
<td>5319</td>
<td>5348</td>
<td>5376</td>
<td>5405</td>
<td>5433</td>
<td>5461</td>
<td>5489</td>
<td>5517</td>
<td>5545</td>
<td>5573</td>
</tr>
<tr>
<td>170</td>
<td>5345</td>
<td>5374</td>
<td>5403</td>
<td>5432</td>
<td>5460</td>
<td>5488</td>
<td>5517</td>
<td>5545</td>
<td>5572</td>
<td>5600</td>
</tr>
<tr>
<td>171</td>
<td>5371</td>
<td>5400</td>
<td>5429</td>
<td>5458</td>
<td>5487</td>
<td>5515</td>
<td>5544</td>
<td>5572</td>
<td>5600</td>
<td>5627</td>
</tr>
<tr>
<td>172</td>
<td>5398</td>
<td>5427</td>
<td>5456</td>
<td>5485</td>
<td>5514</td>
<td>5542</td>
<td>5571</td>
<td>5599</td>
<td>5627</td>
<td>5655</td>
</tr>
<tr>
<td>173</td>
<td>5424</td>
<td>5453</td>
<td>5482</td>
<td>5511</td>
<td>5540</td>
<td>5569</td>
<td>5597</td>
<td>5626</td>
<td>5654</td>
<td>5682</td>
</tr>
<tr>
<td>174</td>
<td>5450</td>
<td>5479</td>
<td>5509</td>
<td>5538</td>
<td>5567</td>
<td>5596</td>
<td>5624</td>
<td>5653</td>
<td>5681</td>
<td>5709</td>
</tr>
<tr>
<td>175</td>
<td>5476</td>
<td>5506</td>
<td>5535</td>
<td>5564</td>
<td>5594</td>
<td>5622</td>
<td>5651</td>
<td>5680</td>
<td>5708</td>
<td>5736</td>
</tr>
<tr>
<td>176</td>
<td>5502</td>
<td>5532</td>
<td>5561</td>
<td>5591</td>
<td>5620</td>
<td>5649</td>
<td>5678</td>
<td>5707</td>
<td>5735</td>
<td>5764</td>
</tr>
<tr>
<td>177</td>
<td>5528</td>
<td>5558</td>
<td>5588</td>
<td>5617</td>
<td>5647</td>
<td>5676</td>
<td>5705</td>
<td>5734</td>
<td>5762</td>
<td>5791</td>
</tr>
<tr>
<td>178</td>
<td>5554</td>
<td>5584</td>
<td>5614</td>
<td>5644</td>
<td>5673</td>
<td>5702</td>
<td>5732</td>
<td>5760</td>
<td>5789</td>
<td>5818</td>
</tr>
<tr>
<td>179</td>
<td>5580</td>
<td>5610</td>
<td>5640</td>
<td>5670</td>
<td>5700</td>
<td>5729</td>
<td>5758</td>
<td>5787</td>
<td>5816</td>
<td>5845</td>
</tr>
<tr>
<td>180</td>
<td>5606</td>
<td>5636</td>
<td>5666</td>
<td>5696</td>
<td>5726</td>
<td>5756</td>
<td>5785</td>
<td>5814</td>
<td>5843</td>
<td>5872</td>
</tr>
</tbody>
</table>
### Appendix 2. Tables for calculation of blood volumes

<table>
<thead>
<tr>
<th>kg</th>
<th>90</th>
<th>91</th>
<th>92</th>
<th>93</th>
<th>94</th>
<th>95</th>
<th>96</th>
<th>97</th>
<th>98</th>
<th>99</th>
</tr>
</thead>
<tbody>
<tr>
<td>181 cm</td>
<td>5632</td>
<td>5662</td>
<td>5693</td>
<td>5723</td>
<td>5752</td>
<td>5782</td>
<td>5811</td>
<td>5841</td>
<td>5870</td>
<td>5899</td>
</tr>
<tr>
<td>182 cm</td>
<td>5658</td>
<td>5688</td>
<td>5719</td>
<td>5749</td>
<td>5779</td>
<td>5808</td>
<td>5838</td>
<td>5867</td>
<td>5897</td>
<td>5926</td>
</tr>
<tr>
<td>183 cm</td>
<td>5684</td>
<td>5714</td>
<td>5745</td>
<td>5775</td>
<td>5805</td>
<td>5835</td>
<td>5865</td>
<td>5894</td>
<td>5923</td>
<td>5953</td>
</tr>
<tr>
<td>184 cm</td>
<td>5709</td>
<td>5740</td>
<td>5771</td>
<td>5801</td>
<td>5831</td>
<td>5861</td>
<td>5891</td>
<td>5921</td>
<td>5950</td>
<td>5979</td>
</tr>
<tr>
<td>185 cm</td>
<td>5735</td>
<td>5766</td>
<td>5797</td>
<td>5827</td>
<td>5857</td>
<td>5888</td>
<td>5917</td>
<td>5947</td>
<td>5977</td>
<td>6006</td>
</tr>
<tr>
<td>186 cm</td>
<td>5761</td>
<td>5792</td>
<td>5823</td>
<td>5853</td>
<td>5884</td>
<td>5914</td>
<td>5944</td>
<td>5974</td>
<td>6003</td>
<td>6033</td>
</tr>
<tr>
<td>187 cm</td>
<td>5786</td>
<td>5818</td>
<td>5848</td>
<td>5879</td>
<td>5910</td>
<td>5940</td>
<td>5970</td>
<td>6000</td>
<td>6030</td>
<td>6060</td>
</tr>
<tr>
<td>188 cm</td>
<td>5812</td>
<td>5843</td>
<td>5874</td>
<td>5905</td>
<td>5936</td>
<td>5966</td>
<td>5997</td>
<td>6027</td>
<td>6057</td>
<td>6086</td>
</tr>
<tr>
<td>189 cm</td>
<td>5838</td>
<td>5869</td>
<td>5900</td>
<td>5931</td>
<td>5962</td>
<td>5992</td>
<td>6023</td>
<td>6053</td>
<td>6083</td>
<td>6113</td>
</tr>
<tr>
<td>190 cm</td>
<td>5863</td>
<td>5895</td>
<td>5926</td>
<td>5957</td>
<td>5988</td>
<td>6019</td>
<td>6049</td>
<td>6079</td>
<td>6109</td>
<td>6140</td>
</tr>
<tr>
<td>191 cm</td>
<td>5889</td>
<td>5920</td>
<td>5952</td>
<td>5983</td>
<td>6014</td>
<td>6045</td>
<td>6075</td>
<td>6106</td>
<td>6136</td>
<td>6166</td>
</tr>
<tr>
<td>192 cm</td>
<td>5914</td>
<td>5946</td>
<td>5977</td>
<td>6008</td>
<td>6039</td>
<td>6070</td>
<td>6101</td>
<td>6132</td>
<td>6162</td>
<td>6193</td>
</tr>
<tr>
<td>193 cm</td>
<td>5940</td>
<td>5971</td>
<td>6003</td>
<td>6034</td>
<td>6066</td>
<td>6097</td>
<td>6128</td>
<td>6158</td>
<td>6189</td>
<td>6219</td>
</tr>
<tr>
<td>194 cm</td>
<td>5965</td>
<td>5997</td>
<td>6029</td>
<td>6060</td>
<td>6092</td>
<td>6123</td>
<td>6154</td>
<td>6185</td>
<td>6215</td>
<td>6246</td>
</tr>
<tr>
<td>195 cm</td>
<td>5990</td>
<td>6022</td>
<td>6054</td>
<td>6086</td>
<td>6117</td>
<td>6149</td>
<td>6180</td>
<td>6211</td>
<td>6241</td>
<td>6272</td>
</tr>
<tr>
<td>196 cm</td>
<td>6016</td>
<td>6048</td>
<td>6080</td>
<td>6112</td>
<td>6143</td>
<td>6175</td>
<td>6206</td>
<td>6237</td>
<td>6268</td>
<td>6298</td>
</tr>
<tr>
<td>197 cm</td>
<td>6041</td>
<td>6073</td>
<td>6105</td>
<td>6137</td>
<td>6169</td>
<td>6200</td>
<td>6232</td>
<td>6263</td>
<td>6294</td>
<td>6325</td>
</tr>
<tr>
<td>198 cm</td>
<td>6066</td>
<td>6099</td>
<td>6131</td>
<td>6163</td>
<td>6195</td>
<td>6226</td>
<td>6258</td>
<td>6289</td>
<td>6320</td>
<td>6351</td>
</tr>
<tr>
<td>199 cm</td>
<td>6091</td>
<td>6124</td>
<td>6156</td>
<td>6188</td>
<td>6220</td>
<td>6252</td>
<td>6284</td>
<td>6315</td>
<td>6346</td>
<td>6377</td>
</tr>
<tr>
<td>200 cm</td>
<td>6117</td>
<td>6149</td>
<td>6182</td>
<td>6214</td>
<td>6246</td>
<td>6278</td>
<td>6310</td>
<td>6341</td>
<td>6372</td>
<td>6403</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>kg</th>
<th>100</th>
<th>101</th>
<th>102</th>
<th>103</th>
<th>104</th>
<th>105</th>
<th>106</th>
<th>107</th>
<th>108</th>
<th>109</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 cm</td>
<td>5350</td>
<td>5376</td>
<td>5402</td>
<td>5428</td>
<td>5454</td>
<td>5479</td>
<td>5505</td>
<td>5530</td>
<td>5555</td>
<td>5580</td>
</tr>
<tr>
<td>161 cm</td>
<td>5378</td>
<td>5404</td>
<td>5430</td>
<td>5456</td>
<td>5482</td>
<td>5508</td>
<td>5534</td>
<td>5559</td>
<td>5584</td>
<td>5609</td>
</tr>
<tr>
<td>162 cm</td>
<td>5406</td>
<td>5432</td>
<td>5459</td>
<td>5485</td>
<td>5511</td>
<td>5536</td>
<td>5562</td>
<td>5588</td>
<td>5613</td>
<td>5638</td>
</tr>
<tr>
<td>163 cm</td>
<td>5434</td>
<td>5460</td>
<td>5487</td>
<td>5513</td>
<td>5539</td>
<td>5565</td>
<td>5591</td>
<td>5616</td>
<td>5642</td>
<td>5667</td>
</tr>
<tr>
<td>164 cm</td>
<td>5462</td>
<td>5488</td>
<td>5515</td>
<td>5541</td>
<td>5567</td>
<td>5593</td>
<td>5619</td>
<td>5645</td>
<td>5671</td>
<td>5696</td>
</tr>
<tr>
<td>165 cm</td>
<td>5489</td>
<td>5516</td>
<td>5543</td>
<td>5569</td>
<td>5596</td>
<td>5622</td>
<td>5648</td>
<td>5674</td>
<td>5699</td>
<td>5725</td>
</tr>
<tr>
<td>166 cm</td>
<td>5517</td>
<td>5544</td>
<td>5571</td>
<td>5597</td>
<td>5624</td>
<td>5650</td>
<td>5676</td>
<td>5702</td>
<td>5728</td>
<td>5754</td>
</tr>
<tr>
<td>167 cm</td>
<td>5545</td>
<td>5572</td>
<td>5599</td>
<td>5625</td>
<td>5652</td>
<td>5678</td>
<td>5704</td>
<td>5731</td>
<td>5757</td>
<td>5782</td>
</tr>
<tr>
<td>168 cm</td>
<td>5572</td>
<td>5600</td>
<td>5626</td>
<td>5653</td>
<td>5680</td>
<td>5706</td>
<td>5733</td>
<td>5759</td>
<td>5785</td>
<td>5811</td>
</tr>
<tr>
<td>169 cm</td>
<td>5600</td>
<td>5627</td>
<td>5654</td>
<td>5681</td>
<td>5708</td>
<td>5735</td>
<td>5761</td>
<td>5787</td>
<td>5814</td>
<td>5840</td>
</tr>
<tr>
<td>170 cm</td>
<td>5628</td>
<td>5655</td>
<td>5682</td>
<td>5709</td>
<td>5736</td>
<td>5763</td>
<td>5789</td>
<td>5816</td>
<td>5842</td>
<td>5868</td>
</tr>
<tr>
<td>171 cm</td>
<td>5655</td>
<td>5682</td>
<td>5710</td>
<td>5737</td>
<td>5764</td>
<td>5791</td>
<td>5818</td>
<td>5844</td>
<td>5870</td>
<td>5897</td>
</tr>
</tbody>
</table>
## Guide to the preparation, use and quality assurance of blood components

<table>
<thead>
<tr>
<th>kg</th>
<th>100</th>
<th>101</th>
<th>102</th>
<th>103</th>
<th>104</th>
<th>105</th>
<th>106</th>
<th>107</th>
<th>108</th>
<th>109</th>
</tr>
</thead>
<tbody>
<tr>
<td>172 cm</td>
<td>5682</td>
<td>5710</td>
<td>5737</td>
<td>5765</td>
<td>5792</td>
<td>5819</td>
<td>5846</td>
<td>5872</td>
<td>5899</td>
<td>5925</td>
</tr>
<tr>
<td>173 cm</td>
<td>5710</td>
<td>5738</td>
<td>5765</td>
<td>5793</td>
<td>5820</td>
<td>5847</td>
<td>5874</td>
<td>5901</td>
<td>5927</td>
<td>5954</td>
</tr>
<tr>
<td>174 cm</td>
<td>5737</td>
<td>5765</td>
<td>5793</td>
<td>5820</td>
<td>5848</td>
<td>5875</td>
<td>5902</td>
<td>5929</td>
<td>5955</td>
<td>5982</td>
</tr>
<tr>
<td>175 cm</td>
<td>5765</td>
<td>5793</td>
<td>5820</td>
<td>5848</td>
<td>5875</td>
<td>5903</td>
<td>5930</td>
<td>5957</td>
<td>5984</td>
<td>6010</td>
</tr>
<tr>
<td>176 cm</td>
<td>5792</td>
<td>5820</td>
<td>5848</td>
<td>5876</td>
<td>5903</td>
<td>5930</td>
<td>5958</td>
<td>5985</td>
<td>6012</td>
<td>6039</td>
</tr>
<tr>
<td>177 cm</td>
<td>5819</td>
<td>5847</td>
<td>5875</td>
<td>5903</td>
<td>5931</td>
<td>5958</td>
<td>5986</td>
<td>6013</td>
<td>6040</td>
<td>6067</td>
</tr>
<tr>
<td>178 cm</td>
<td>5846</td>
<td>5875</td>
<td>5903</td>
<td>5931</td>
<td>5958</td>
<td>5986</td>
<td>6014</td>
<td>6041</td>
<td>6068</td>
<td>6095</td>
</tr>
<tr>
<td>179 cm</td>
<td>5873</td>
<td>5902</td>
<td>5930</td>
<td>5958</td>
<td>5986</td>
<td>6014</td>
<td>6041</td>
<td>6069</td>
<td>6096</td>
<td>6123</td>
</tr>
<tr>
<td>180 cm</td>
<td>5901</td>
<td>5929</td>
<td>5957</td>
<td>5986</td>
<td>6014</td>
<td>6041</td>
<td>6069</td>
<td>6097</td>
<td>6124</td>
<td>6151</td>
</tr>
<tr>
<td>181 cm</td>
<td>5928</td>
<td>5956</td>
<td>5985</td>
<td>6013</td>
<td>6041</td>
<td>6069</td>
<td>6097</td>
<td>6125</td>
<td>6152</td>
<td>6180</td>
</tr>
<tr>
<td>182 cm</td>
<td>5955</td>
<td>5983</td>
<td>6012</td>
<td>6040</td>
<td>6069</td>
<td>6097</td>
<td>6125</td>
<td>6152</td>
<td>6180</td>
<td>6208</td>
</tr>
<tr>
<td>183 cm</td>
<td>5982</td>
<td>6010</td>
<td>6039</td>
<td>6068</td>
<td>6096</td>
<td>6124</td>
<td>6152</td>
<td>6180</td>
<td>6208</td>
<td>6236</td>
</tr>
<tr>
<td>184 cm</td>
<td>6009</td>
<td>6038</td>
<td>6066</td>
<td>6095</td>
<td>6123</td>
<td>6152</td>
<td>6180</td>
<td>6208</td>
<td>6236</td>
<td>6263</td>
</tr>
<tr>
<td>185 cm</td>
<td>6035</td>
<td>6065</td>
<td>6093</td>
<td>6122</td>
<td>6151</td>
<td>6179</td>
<td>6207</td>
<td>6236</td>
<td>6264</td>
<td>6291</td>
</tr>
<tr>
<td>186 cm</td>
<td>6062</td>
<td>6092</td>
<td>6121</td>
<td>6149</td>
<td>6178</td>
<td>6207</td>
<td>6235</td>
<td>6263</td>
<td>6291</td>
<td>6319</td>
</tr>
<tr>
<td>187 cm</td>
<td>6089</td>
<td>6118</td>
<td>6148</td>
<td>6177</td>
<td>6205</td>
<td>6234</td>
<td>6263</td>
<td>6291</td>
<td>6319</td>
<td>6347</td>
</tr>
<tr>
<td>188 cm</td>
<td>6116</td>
<td>6145</td>
<td>6175</td>
<td>6204</td>
<td>6233</td>
<td>6261</td>
<td>6290</td>
<td>6318</td>
<td>6347</td>
<td>6375</td>
</tr>
<tr>
<td>189 cm</td>
<td>6143</td>
<td>6172</td>
<td>6202</td>
<td>6231</td>
<td>6260</td>
<td>6289</td>
<td>6317</td>
<td>6346</td>
<td>6374</td>
<td>6403</td>
</tr>
<tr>
<td>190 cm</td>
<td>6169</td>
<td>6199</td>
<td>6229</td>
<td>6258</td>
<td>6287</td>
<td>6316</td>
<td>6345</td>
<td>6373</td>
<td>6402</td>
<td>6430</td>
</tr>
<tr>
<td>191 cm</td>
<td>6196</td>
<td>6226</td>
<td>6255</td>
<td>6285</td>
<td>6314</td>
<td>6343</td>
<td>6372</td>
<td>6401</td>
<td>6430</td>
<td>6458</td>
</tr>
<tr>
<td>192 cm</td>
<td>6223</td>
<td>6253</td>
<td>6282</td>
<td>6312</td>
<td>6341</td>
<td>6370</td>
<td>6399</td>
<td>6428</td>
<td>6457</td>
<td>6486</td>
</tr>
<tr>
<td>193 cm</td>
<td>6249</td>
<td>6279</td>
<td>6309</td>
<td>6339</td>
<td>6368</td>
<td>6398</td>
<td>6427</td>
<td>6456</td>
<td>6485</td>
<td>6513</td>
</tr>
<tr>
<td>194 cm</td>
<td>6276</td>
<td>6306</td>
<td>6336</td>
<td>6366</td>
<td>6395</td>
<td>6425</td>
<td>6454</td>
<td>6483</td>
<td>6512</td>
<td>6541</td>
</tr>
<tr>
<td>195 cm</td>
<td>6302</td>
<td>6333</td>
<td>6363</td>
<td>6392</td>
<td>6422</td>
<td>6452</td>
<td>6481</td>
<td>6510</td>
<td>6539</td>
<td>6568</td>
</tr>
<tr>
<td>196 cm</td>
<td>6329</td>
<td>6359</td>
<td>6389</td>
<td>6419</td>
<td>6449</td>
<td>6479</td>
<td>6508</td>
<td>6538</td>
<td>6567</td>
<td>6596</td>
</tr>
<tr>
<td>197 cm</td>
<td>6355</td>
<td>6386</td>
<td>6416</td>
<td>6446</td>
<td>6476</td>
<td>6506</td>
<td>6535</td>
<td>6565</td>
<td>6594</td>
<td>6623</td>
</tr>
<tr>
<td>198 cm</td>
<td>6382</td>
<td>6412</td>
<td>6443</td>
<td>6473</td>
<td>6503</td>
<td>6533</td>
<td>6562</td>
<td>6592</td>
<td>6621</td>
<td>6651</td>
</tr>
<tr>
<td>199 cm</td>
<td>6408</td>
<td>6439</td>
<td>6469</td>
<td>6500</td>
<td>6530</td>
<td>6560</td>
<td>6589</td>
<td>6619</td>
<td>6649</td>
<td>6678</td>
</tr>
<tr>
<td>200 cm</td>
<td>6434</td>
<td>6465</td>
<td>6496</td>
<td>6526</td>
<td>6556</td>
<td>6587</td>
<td>6616</td>
<td>6646</td>
<td>6676</td>
<td>6705</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>kg</th>
<th>110</th>
<th>111</th>
<th>112</th>
<th>113</th>
<th>114</th>
<th>115</th>
<th>116</th>
<th>117</th>
<th>118</th>
<th>119</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>160 cm</td>
<td>5605</td>
<td>5630</td>
<td>5655</td>
<td>5679</td>
<td>5704</td>
<td>5728</td>
<td>5752</td>
<td>5776</td>
<td>5800</td>
<td>5824</td>
<td>5848</td>
</tr>
<tr>
<td>161 cm</td>
<td>5634</td>
<td>5659</td>
<td>5684</td>
<td>5709</td>
<td>5733</td>
<td>5758</td>
<td>5782</td>
<td>5806</td>
<td>5830</td>
<td>5854</td>
<td>5878</td>
</tr>
<tr>
<td>162 cm</td>
<td>5664</td>
<td>5689</td>
<td>5713</td>
<td>5738</td>
<td>5763</td>
<td>5787</td>
<td>5812</td>
<td>5836</td>
<td>5860</td>
<td>5884</td>
<td>5908</td>
</tr>
</tbody>
</table>
Appendix 2. Tables for calculation of blood volumes

<table>
<thead>
<tr>
<th>kg</th>
<th>110</th>
<th>111</th>
<th>112</th>
<th>113</th>
<th>114</th>
<th>115</th>
<th>116</th>
<th>117</th>
<th>118</th>
<th>119</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>163 cm</td>
<td>5693</td>
<td>5718</td>
<td>5743</td>
<td>5767</td>
<td>5792</td>
<td>5817</td>
<td>5841</td>
<td>5866</td>
<td>5890</td>
<td>5914</td>
<td>5938</td>
</tr>
<tr>
<td>164 cm</td>
<td>5721</td>
<td>5747</td>
<td>5772</td>
<td>5797</td>
<td>5822</td>
<td>5846</td>
<td>5871</td>
<td>5895</td>
<td>5920</td>
<td>5944</td>
<td>5968</td>
</tr>
<tr>
<td>165 cm</td>
<td>5750</td>
<td>5776</td>
<td>5801</td>
<td>5826</td>
<td>5851</td>
<td>5876</td>
<td>5901</td>
<td>5925</td>
<td>5950</td>
<td>5974</td>
<td>5998</td>
</tr>
<tr>
<td>166 cm</td>
<td>5779</td>
<td>5805</td>
<td>5830</td>
<td>5855</td>
<td>5880</td>
<td>5905</td>
<td>5930</td>
<td>5955</td>
<td>5979</td>
<td>6004</td>
<td>6028</td>
</tr>
<tr>
<td>167 cm</td>
<td>5808</td>
<td>5834</td>
<td>5859</td>
<td>5884</td>
<td>5910</td>
<td>5935</td>
<td>5960</td>
<td>5984</td>
<td>6009</td>
<td>6034</td>
<td>6058</td>
</tr>
<tr>
<td>168 cm</td>
<td>5837</td>
<td>5863</td>
<td>5888</td>
<td>5913</td>
<td>5939</td>
<td>5964</td>
<td>5989</td>
<td>6014</td>
<td>6039</td>
<td>6063</td>
<td>6088</td>
</tr>
<tr>
<td>169 cm</td>
<td>5866</td>
<td>5891</td>
<td>5917</td>
<td>5943</td>
<td>5968</td>
<td>5993</td>
<td>6018</td>
<td>6043</td>
<td>6068</td>
<td>6093</td>
<td>6118</td>
</tr>
<tr>
<td>170 cm</td>
<td>5894</td>
<td>5920</td>
<td>5946</td>
<td>5972</td>
<td>5997</td>
<td>6022</td>
<td>6048</td>
<td>6073</td>
<td>6098</td>
<td>6123</td>
<td>6147</td>
</tr>
<tr>
<td>171 cm</td>
<td>5923</td>
<td>5949</td>
<td>5975</td>
<td>6001</td>
<td>6026</td>
<td>6052</td>
<td>6077</td>
<td>6102</td>
<td>6127</td>
<td>6152</td>
<td>6177</td>
</tr>
<tr>
<td>172 cm</td>
<td>5951</td>
<td>5978</td>
<td>6004</td>
<td>6029</td>
<td>6055</td>
<td>6081</td>
<td>6106</td>
<td>6132</td>
<td>6157</td>
<td>6182</td>
<td>6207</td>
</tr>
<tr>
<td>173 cm</td>
<td>5980</td>
<td>6006</td>
<td>6032</td>
<td>6058</td>
<td>6084</td>
<td>6110</td>
<td>6135</td>
<td>6161</td>
<td>6186</td>
<td>6211</td>
<td>6236</td>
</tr>
<tr>
<td>174 cm</td>
<td>6009</td>
<td>6035</td>
<td>6061</td>
<td>6087</td>
<td>6113</td>
<td>6139</td>
<td>6165</td>
<td>6190</td>
<td>6215</td>
<td>6241</td>
<td>6266</td>
</tr>
<tr>
<td>175 cm</td>
<td>6037</td>
<td>6063</td>
<td>6090</td>
<td>6116</td>
<td>6142</td>
<td>6168</td>
<td>6194</td>
<td>6219</td>
<td>6245</td>
<td>6270</td>
<td>6295</td>
</tr>
<tr>
<td>176 cm</td>
<td>6065</td>
<td>6092</td>
<td>6118</td>
<td>6145</td>
<td>6171</td>
<td>6197</td>
<td>6223</td>
<td>6248</td>
<td>6274</td>
<td>6300</td>
<td>6325</td>
</tr>
<tr>
<td>177 cm</td>
<td>6094</td>
<td>6120</td>
<td>6147</td>
<td>6173</td>
<td>6200</td>
<td>6226</td>
<td>6252</td>
<td>6278</td>
<td>6303</td>
<td>6329</td>
<td>6354</td>
</tr>
<tr>
<td>178 cm</td>
<td>6122</td>
<td>6149</td>
<td>6175</td>
<td>6202</td>
<td>6228</td>
<td>6255</td>
<td>6281</td>
<td>6307</td>
<td>6332</td>
<td>6358</td>
<td>6384</td>
</tr>
<tr>
<td>179 cm</td>
<td>6150</td>
<td>6177</td>
<td>6204</td>
<td>6231</td>
<td>6257</td>
<td>6283</td>
<td>6310</td>
<td>6336</td>
<td>6362</td>
<td>6387</td>
<td>6413</td>
</tr>
<tr>
<td>180 cm</td>
<td>6179</td>
<td>6206</td>
<td>6232</td>
<td>6259</td>
<td>6286</td>
<td>6312</td>
<td>6338</td>
<td>6365</td>
<td>6391</td>
<td>6417</td>
<td>6442</td>
</tr>
<tr>
<td>181 cm</td>
<td>6207</td>
<td>6234</td>
<td>6261</td>
<td>6288</td>
<td>6314</td>
<td>6341</td>
<td>6367</td>
<td>6394</td>
<td>6420</td>
<td>6446</td>
<td>6472</td>
</tr>
<tr>
<td>182 cm</td>
<td>6235</td>
<td>6262</td>
<td>6289</td>
<td>6316</td>
<td>6343</td>
<td>6370</td>
<td>6396</td>
<td>6422</td>
<td>6449</td>
<td>6475</td>
<td>6501</td>
</tr>
<tr>
<td>183 cm</td>
<td>6263</td>
<td>6290</td>
<td>6317</td>
<td>6345</td>
<td>6371</td>
<td>6398</td>
<td>6425</td>
<td>6451</td>
<td>6478</td>
<td>6504</td>
<td>6530</td>
</tr>
<tr>
<td>184 cm</td>
<td>6291</td>
<td>6318</td>
<td>6346</td>
<td>6373</td>
<td>6400</td>
<td>6427</td>
<td>6454</td>
<td>6480</td>
<td>6507</td>
<td>6533</td>
<td>6559</td>
</tr>
<tr>
<td>185 cm</td>
<td>6319</td>
<td>6347</td>
<td>6374</td>
<td>6401</td>
<td>6428</td>
<td>6455</td>
<td>6482</td>
<td>6509</td>
<td>6535</td>
<td>6562</td>
<td>6588</td>
</tr>
<tr>
<td>186 cm</td>
<td>6347</td>
<td>6375</td>
<td>6402</td>
<td>6430</td>
<td>6457</td>
<td>6484</td>
<td>6511</td>
<td>6538</td>
<td>6564</td>
<td>6591</td>
<td>6617</td>
</tr>
<tr>
<td>187 cm</td>
<td>6375</td>
<td>6403</td>
<td>6430</td>
<td>6458</td>
<td>6485</td>
<td>6512</td>
<td>6539</td>
<td>6566</td>
<td>6593</td>
<td>6620</td>
<td>6646</td>
</tr>
<tr>
<td>188 cm</td>
<td>6403</td>
<td>6431</td>
<td>6458</td>
<td>6486</td>
<td>6513</td>
<td>6541</td>
<td>6568</td>
<td>6595</td>
<td>6622</td>
<td>6649</td>
<td>6675</td>
</tr>
<tr>
<td>189 cm</td>
<td>6431</td>
<td>6459</td>
<td>6487</td>
<td>6514</td>
<td>6542</td>
<td>6569</td>
<td>6596</td>
<td>6624</td>
<td>6650</td>
<td>6677</td>
<td>6704</td>
</tr>
<tr>
<td>190 cm</td>
<td>6459</td>
<td>6487</td>
<td>6515</td>
<td>6542</td>
<td>6570</td>
<td>6597</td>
<td>6625</td>
<td>6652</td>
<td>6679</td>
<td>6706</td>
<td>6733</td>
</tr>
<tr>
<td>191 cm</td>
<td>6486</td>
<td>6515</td>
<td>6543</td>
<td>6570</td>
<td>6598</td>
<td>6626</td>
<td>6653</td>
<td>6681</td>
<td>6708</td>
<td>6735</td>
<td>6762</td>
</tr>
<tr>
<td>192 cm</td>
<td>6514</td>
<td>6542</td>
<td>6570</td>
<td>6598</td>
<td>6626</td>
<td>6654</td>
<td>6682</td>
<td>6709</td>
<td>6736</td>
<td>6763</td>
<td>6791</td>
</tr>
<tr>
<td>193 cm</td>
<td>6542</td>
<td>6570</td>
<td>6598</td>
<td>6626</td>
<td>6654</td>
<td>6682</td>
<td>6710</td>
<td>6737</td>
<td>6765</td>
<td>6792</td>
<td>6819</td>
</tr>
<tr>
<td>194 cm</td>
<td>6569</td>
<td>6598</td>
<td>6626</td>
<td>6654</td>
<td>6683</td>
<td>6710</td>
<td>6738</td>
<td>6766</td>
<td>6793</td>
<td>6821</td>
<td>6848</td>
</tr>
<tr>
<td>195 cm</td>
<td>6597</td>
<td>6626</td>
<td>6654</td>
<td>6682</td>
<td>6711</td>
<td>6739</td>
<td>6766</td>
<td>6794</td>
<td>6822</td>
<td>6849</td>
<td>6877</td>
</tr>
<tr>
<td>196 cm</td>
<td>6625</td>
<td>6653</td>
<td>6682</td>
<td>6710</td>
<td>6739</td>
<td>6767</td>
<td>6795</td>
<td>6823</td>
<td>6850</td>
<td>6878</td>
<td>6905</td>
</tr>
<tr>
<td>197 cm</td>
<td>6652</td>
<td>6681</td>
<td>6710</td>
<td>6738</td>
<td>6767</td>
<td>6795</td>
<td>6823</td>
<td>6851</td>
<td>6879</td>
<td>6906</td>
<td>6934</td>
</tr>
<tr>
<td>kg</td>
<td>110</td>
<td>111</td>
<td>112</td>
<td>113</td>
<td>114</td>
<td>115</td>
<td>116</td>
<td>117</td>
<td>118</td>
<td>119</td>
<td>120</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>198 cm</td>
<td>6680</td>
<td>6709</td>
<td>6737</td>
<td>6766</td>
<td>6794</td>
<td>6823</td>
<td>6851</td>
<td>6879</td>
<td>6907</td>
<td>6935</td>
<td>6962</td>
</tr>
<tr>
<td>199 cm</td>
<td>6707</td>
<td>6736</td>
<td>6765</td>
<td>6794</td>
<td>6822</td>
<td>6851</td>
<td>6879</td>
<td>6907</td>
<td>6935</td>
<td>6963</td>
<td>6991</td>
</tr>
<tr>
<td>200 cm</td>
<td>6735</td>
<td>6764</td>
<td>6793</td>
<td>6821</td>
<td>6850</td>
<td>6879</td>
<td>6907</td>
<td>6935</td>
<td>6963</td>
<td>6991</td>
<td>7019</td>
</tr>
</tbody>
</table>
APPENDIX 3. DATA PROCESSING SYSTEMS
1. **Planning of a system**

There are a variety of computer systems and software programs available and each has different functions. Prior to purchase, the user should:

- establish a list of requirements that will meet the needs of the user, including the duration of record keeping (in general 15 years in EU member states) and the duration of data keeping for traceability (30 years are required under EU Directive 2002/98/EC);
- evaluate the different computer systems and choose the one that meets the established requirements;
- audit the developer/manufacturer to ensure that they are able to provide a product that meets regulatory requirements;
- establish responsibility between the user and the developer/supplier/manufacturer to define roles and responsibilities with regard to testing, user instructions, maintenance, system improvements and access to source codes.

These steps ensure that the user has all the necessary information about the purchased system and has an established relationship with the developer. This course of action also minimises the need for ‘work-around’ by the user, which can be a source of error.

2. **Defining the system**

The computer system of a blood establishment or hospital blood bank includes: hardware, software, peripheral devices and documentation (e.g. manuals and SOPs). To define the system, in co-operation with the vendor or developer, the user should generate a written description of the system, the functions that it is designed to perform and all human interactions. The documentation should be current, effectively updated, accurate and as detailed as necessary to ensure proper operation of the system. The documentation should include:
Appendix 3. Data processing systems

- a detailed specification (inventory) of the hardware, software and peripheral devices, including their environmental requirements and limitations;
- diagrams or flow charts of the system’s operations that describe all component interfaces, a network diagram (if applicable) and all database structures, e.g. file sizes, input and output formats, etc.;
- SOPs that describe how the system is used. The user should develop the SOPs based on the instructions for use provided by the software developer and the internal procedures of the blood establishment or hospital blood bank. In particular, SOPs should address all manual and automated interactions with the system including:
  - routine back-up, maintenance and diagnostic procedures, including assignment of responsibilities;
  - ‘work-arounds’ for system limitations;
  - procedures for handling errors, including assignment of responsibilities;
  - procedures for handling disasters and contingency planning, including assignment of responsibilities;
  - procedures for handling disasters and contingency planning, including assignment of responsibilities;
  - procedures for supervised changes to incorrect data;
  - procedures for validation of a change;
  - a training system including training manuals, documentation and procedures for training.

3. Implementation and validation

Provisions of the Good Practice Guidelines for blood establishments and hospital blood banks must be taken into account.

Validation documents and the results of tests performed and approved by the supplier/vendor/developer of the system should be presented to the user. The user can then perform tests according to a pre-defined and documented test plan. Types of risk to consider include
inadequate design of the system, errors that may occur in use (user error or system defects), and loss/compromise of data. Testing should involve the entire system, and in the manner it is expected to perform in the blood facility. Testing may be performed by a third party but, in that case, must also include personnel from the blood facility. The following types of basic testing should be conducted.

**Functional testing of components**

The system components are presented with all types of expected interaction, including normal value, boundary, invalid and special case inputs. The system must produce the correct outputs, including error messages by control programs. It is useful to perform this testing in parallel with a reference or standard system.

Each test case should include the input, expected output, acceptance criteria and whether the test passed or failed. For traceability purposes and to facilitate quality assurance review and follow-up, it is recommended that any supporting documentation, such as print-screens, be included to verify the specific test case.

**Data migration**

The process for data migration should be defined, documented and appropriately tested. This should ensure full maintenance of traceability, including archiving of data where necessary.

**Environmental testing**

All qualification steps and results should be documented and approved before routine use of the system.

In the actual operating environment, functional tests are performed to demonstrate that:

- the software systems work properly with the hardware;
- all applications of the software perform properly with the operating system software;
• proper information passes correctly through system interfaces, including appropriate data transfer to or from other laboratory and automated (e.g. apheresis machine) systems, if applicable;
• accessories, such as barcode scanners, perform as expected with the blood establishment’s barcode symbols;
• printed reports are appropriately and correctly formatted;
• personnel are trained and use the system correctly;
• the system performs properly at peak production times and with the maximum number of concurrent users;
• back-ups restore data in a correct way;
• if the system includes wireless radio frequency (RF) technology, it should be evaluated for electromagnetic compatibility (EMC) and electro-magnetic interference (EMI) in the setting in which it is used.

Change control
In case of changes in the software, the validation status must be re-established. If a re-validation analysis is needed, it should be based on risk assessment and conducted not only for validation of the individual change, but also to determine the extent and impact of that change on the entire computerised system.

Maintenance of the system
The database should be checked periodically and systematically to identify and remove unwanted data such as duplicate records, and to ensure that data entries are accurate and stored correctly. Manual entry of critical data requires independent verification by a second authorised person.

Security of the database should be maintained by:
• an adequate change history of the system, including for software and hardware (when necessary);
periodically altering electronic passwords (without re-use) and by removing unnecessary or out-dated access;

creating records of all data changes, i.e. an audit trail, including a retained record of the previous data and the reason for the change;

the appropriate use of programs to detect and remove computer viruses;

the control of administrative security access to ensure that only authorised personnel can make changes to the software, to the system configuration and to the data;

regular testing to verify the proper integrity and accuracy of backed up data.

Data should be archived periodically using a long-term stable medium and placed 'off-site' at a location other than that of the hardware to ensure safety. Such archives should be challenged at least annually to verify data retrieval.

Procedures should be defined for:

investigation and correction of discrepancies in the database;

corrective actions to be taken when validation testing yields unexpected results;

handling, reporting, documenting and, if needed, correcting real-time problems, errors and alarms;

manual operations (contingency planning) in the event of any system outage (even partial).

**Quality assurance**

The quality assurance programme should exercise oversight of the electronic data processing systems that affect product quality. At a minimum, such oversight should include:
• ensuring the on-going accuracy and completeness of all documentation on equipment, software maintenance and operator training;

• performing periodic audits to verify proper accomplishment of all performance tests, routine maintenance, change procedures, data integrity checks, error investigations and operator competency evaluations.
APPENDIX 4.
STATISTICAL PROCESS CONTROL
1. **Introduction**
Statistical Process Control (SPC) is a tool that enables an organisation to detect changes in the processes and procedures it carries out by monitoring data collected over a period of time in a standardised fashion. SPC became mandatory in 2005 for blood establishments in the EU (Directive 2004/33/EC). Methods and standards for the application of SPC to quality assurance of blood components need to be continuously studied and further developed. The technique can be applied to all activities in a blood facility, including administrative/clerical, scientific and technical processes. It is important that the processes to which SPC are to be applied are prioritised due to the amount of work involved. Currently, SPC is proving most beneficial in monitoring the performance of infectious markers and leucocyte-depletion testing. SPC is one of the few methods that can show how an improvement to a process has achieved the desired result, and enables decision-making to be placed on a much more rational and scientific basis.

2. **Implementation of SPC**
As for all other aspects of quality, implementation of SPC demands understanding and commitment on the part of the management of the blood facility. It must be included in the quality system of the facility, and a training programme should be introduced for senior management as well as operational staff. Plans must be made for data collection, including of control charts, and all matters dealing with changes detected in processes, especially sudden situations. Regular reviews of processes against SPC data should take place, with the specific objective of continuous improvement.

3. **Strategy for statistical sampling**
As much as possible, the number and frequency of components sampled for quality control and the number of test failures per sample that trigger an appropriate response (e.g. investigation or re-validation of materials and procedures) should be based on the considerations detailed below.
Tolerance of failure
A ‘target failure rate’ should be established as the failure rate that should not be exceeded. This ensures that monitoring of aspects of quality is continuous and that a failure rate exceeding target values triggers appropriate corrective action.

Confidence level
A confidence level should be set for the detection of an actual failure rate that lies above the ‘target failure rate’.

A valid method of statistical analysis should be used to determine whether actual failure rate lies above the ‘target failure rate’.

4. Frequency of control sampling
A number of challenges arise in framing statistically based quality control testing programs for labile blood components. Due to the complexity of the transfusion system, blood facilities should consult statistical experts when designing process control systems. Issues include the: very large variation in volumes of blood components at different blood establishments; need to minimise losses in blood components through testing at small centres; very low expected rate of non-conformance for some processes, and the number of discrete conditions that arise in the manufacture of otherwise similar components. These may include:

- number of sites, operators and work shifts;
- different collection and processing systems and equipment;
- use of multiple reagent lots;
- alternative preparation times and temperatures;
- donor-related variables may affect the final quality of the blood component, even in a fully controlled process (e.g. for HbS donor blood with poor leucofiltration properties);
• the fact that blood components may be used for more than one clinical indication and require different levels of control (e.g. leucocyte-depleted RBCs for neonates vs for general transfusion).

Additionally, in many cases, the medical basis for currently accepted quality standards has not been rigorously established, making it difficult to determine the level of deviation from the expected level of conformance that can be tolerated. Nevertheless, to implement SPC, blood establishments need to establish the ‘target failure rate’ that should not be exceeded for each control test.

It is also desirable that the criterion for non-conformance should have at least a power of 80 per cent to detect the target failure rate, while giving a false-positive result in fewer than 5 per cent of determinations.

Consideration must also be given to the strategy for representative sampling of units for control testing. Because similar components are prepared under a variety of conditions, it is important that the sample set should include representative units prepared in all possible ways. Sampling may need to be stratified accordingly (i.e. to include a minimum number of samples from each condition).

The sample numbers specified for statistically valid process controls are minimum samples. In circumstances in which there are multiple processing conditions, and in blood establishments with large volumes of blood components, quality-control testing should be increased above the statistically determined minimum. This should be done in a controlled manner through the application of more rigorous statistical parameters, such as an increase in the expected proportion of samples that conform to a defined standard.

Additional considerations that may apply to the design of a quality control strategy include:

• the public-health importance of the standard being controlled (i.e. the period of time during which a process deviation could be tolerated before detection and correction);

• the overall blood component volume;
Appendix 4. Statistical Process Control

- the capacity for sampling and quality-control testing of the facility, including whether the quality-control testing is ablative (i.e. destructive of the processed blood component);
- the target failure rate of a process that is in control;
- a pre-defined strategy for managing non-process failures, e.g. a failed leucocyte-depletion procedure where further evaluation determined that the donor was HbS positive.

Three methods of statistical process control are provided below as examples.¹

**Example 1. Use of control charts**

By plotting historical and prospective data on specially constructed charts, signs of process change can often be detected at an early stage, enabling remedial action to be taken. Steps for the construction of SPC charts are the same for all applications:

- collection of historical data;
- calculation of ‘location and variation statistics’ (see below);
- calculation of statistical control limits for the location and variation statistics;
- construction of the chart;
- plotting of prospective data.

Two types of data are conventionally collected:

- variable data, appropriate to anything that is measured directly such as cell count, pH, time taken for a process, etc.;
- attribute data, appropriate to anything that is counted on a ‘yes or no’ basis.

The type of SPC chart used depends on the type of data collected.

Control charts for variable data

Major applications in a blood establishment are likely to be Individual/Moving Range charts and Average/Range charts.

Individual/Moving Range charts are used where a process is monitored by a single measurement on the sample, of the parameter in question e.g. residual leucocyte count on a platelet preparation. The steps for constructing an SPC chart are as follows:

- Historical data are collected by measuring a random sample each day, and the moving range established by taking the difference between each sample and its predecessor.
- The location statistic is the average of the individual counts, whereas the variation statistic is the average moving range.
- The natural variation in a process is defined as the process average, plus or minus 3 standard deviations. Hence, the Upper Control Limit (UCL) and the Lower Control Limit (LCL) for the location and variation statistics are determined as the appropriate average, plus and minus 3 standard deviations.
- SPC charts conventionally have two distinct parts: one for the location statistic, which appears above the other for the variation statistic. For each part, the average is drawn as a solid line between two dotted lines that signify the UCL and LCL.

Prospective data are plotted on SPC charts in a similar way.

Average/Range charts are used in a situation where an early statistical response to a small process change is required, and where multiple control samples (up to 10) are subjected to the process. A typical example might be repeated use of a control sample during the daily use of a cytometer. In this situation, the average daily count on the control sample is calculated, the location statistic being the average of the averages. Each day shows a range in the control counts; the variation statistic is the average of these ranges. The Average/Range chart is then constructed in a similar manner to the Individual/Moving Range chart, except that the LCL for the Range part of the chart is, by definition, zero.
Control charts for attribute data

Attribute data, in general, fall into one of two categories: those counting the number of units sampled which are defective, and those counting the incidence of non-conformance to a requirement (each non-conformance in this case being classified as a defect). For example, a completed form is classified as ‘defective’ even if it contains only one non-conformance (though it may, in fact, contain multiple defects).

Attribute charts for the proportion of defective units (sometimes known as p-charts) are based on the calculation of the proportion of units found to be defective, i.e. having one or more defects per unit sampled, in sets of units sampled at intervals. The location statistic for the attribute is calculated by dividing the total number of defective units by the total number of units sampled, unless the sets of samples are always the same size, in which case the average of the proportion of defective units in each set may be taken. Since the data stem from yes/no criteria, attribute charts do not have a variation statistic.

UCL and LCL are determined as described above. In this system, it is possible to arrive at a negative value for the LCL, in which case it defaults to zero.

It should be noted that the calculation of standard deviation in a yes/no system such as this depends on the sample size. Hence, an increase or decrease in the set of units sampled necessitates re-establishing the UCL and LCL. An increase in sampling size generally results in convergence of UCL and LCL, making the system more sensitive to changes in the process.

Construction of the chart is carried out as described above.

Attribute charts for defects (sometimes known as u-charts) are generally useful when the object under investigation often has more than one non-conformance with requirements. They are well-suited to the control of clerical procedures. Collection of historical data involves counting the number of defects in each unit of a set of samples, repeated at intervals.
The location statistic is the average number of defects per unit, calculated by dividing the total number of defects in the total number of historical samples. As before, there is no variation statistic for attribute data.

Once again, UCL and LCL are calculated on the basis of the location statistic, plus and minus 3 standard deviations. Standard deviation in this system again depends on sample size, and any prospective increase requires re-establishment of the UCL and LCL.

The likely result is a convergence on the average, facilitating the detection of smaller changes in the process.

Construction of the u-chart follows the convention set for all SPC charts.

**Interpretation of control charts**

In general, if prospective data are plotted on the control chart and they follow the pattern established using historical data, the process may be assumed to be ‘in control’. Changes in the pattern area reliable and sensitive means of detecting that a change has taken place in the process, warranting investigations into the cause. Rules have been established to give guidance to users as to when a change has occurred:

- **Rule 1:** Any point outside one of the control limits;
- **Rule 2:** Seven consecutive points all above or all below the average line;
- **Rule 3:** Seven consecutive points all increasing or all decreasing (a particular indicator of drift in the process average or range).

In addition, any unusual pattern or trend within the control lines may be an indicator of change.

Should information from the charts indicate that unplanned change is taking place within the process, action should be taken to identify any specific or common cause of the change. Application of SPC is the most reliable way of confirming that measures taken to improve the efficiency of a process are giving the desired results, by showing
reduction in variation around the mean (for measured data) or a trend toward zero defects (for counted data).

**Example 2. Method of scan statistics**

The method of scan statistics provides a suitable model for determining the frequency of control testing. In this method, the number of non-conforming test results in a fixed sample size is determined. However, the sample set is regarded as a ‘window’ of observations that ‘moves’ progressively as test results are accumulated. For example, if the ‘window size’ is set at 60 observations, the first test set includes observations 1 through to 60; the second test set includes observations 2 through to 61; the third test set includes observations 3 through to 62. Progression of the ‘window’ can also be done a few samples at a time, such as by addition of daily test results as a group.

To apply this method, the blood facility must identify a reasonably large ‘universe’ of ultimate test samples, typically representing a year or more of testing, or a period after which routine re-validation might be expected to occur because of process modifications (e.g. equipment replacement, software upgrades). The size of the moving window can then be determined based on the expected rate of failed tests for a conforming process (as defined in the Quality Control tables of each component described in Chapter 5), the size of the test universe, and the target failure rate to be detected as indicating a non-conforming process. The table below shows the minimum failure rate that can be detected at 80 per cent or greater power in any single window of control tests for test criteria with false-positive rates below 5 per cent.

Requiring that the number of control tests in the ‘window’ should take place in the desired time interval yields the frequency of control testing.

The following example illustrates how the method of scan statistics can be used.

---

A blood facility seeks to monitor the failure rate of Leucocyte-Depleted. The expected failure rate (rate of non-conforming tests for a conforming process) is taken to be 0.1 per cent. The facility sets an action trigger at 5 per cent as a means to detect a defective lot of filters. The quality-control standard is established to ensure, with at least 80 per cent confidence, that a true failure rate of 5 per cent would be detected, but at a false-positive rate below 5 per cent for a declaration of non-conformance.

For a blood facility with 400 quality-control tests per year (approximately 34 per month), a non-conforming process can be declared if, in any ‘moving window’ of 60 consecutive such tests, two or more non-conforming test results are found (i.e. the trigger is greater than one non-conforming test in any window of 60 tests). This model has a power of 80.8 per cent to detect a true rate of non-conformance of 5 per cent in any window of 60 tests, and near certainty to detect this rate over 1 year. Based on scan statistics, the false-positive rate of such declarations is only 2.0 per cent.

If the number of quality control tests is 1200 per year (100 per month), a non-conforming process can be declared if in any ‘moving window’ of 120 sequential quality control tests, three or more non-conforming test results are found. The false-positive rate of such declarations is only 0.7 per cent. The power is 80.7 per cent to detect a non-conformance rate of 4.6 per cent (the power is 85.6 per cent to detect a 5 per cent failure rate) for any window of 120 tests, and near certainty over 1 year.
# Table 1. Sample size (‘window’) and maximum number of failed tests allowed for a conforming process based on scan statistics

<table>
<thead>
<tr>
<th>Allowed failure rate for a conforming process</th>
<th>Number of tests in ‘universe’ (e.g. the number of tests per year)</th>
<th>Sample size (i.e. the fixed number of tests in a moving ‘window’)</th>
<th>Maximum allowed number of failed tests in window</th>
<th>False positive rate of test criterion</th>
<th>Minimum failure rate of a non-conforming process detectable at &gt; 80% power in any single ‘window’</th>
<th>Power to detect non-conforming process in any window of quality control tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>400</td>
<td>30</td>
<td>16</td>
<td>2.5%</td>
<td>63%</td>
<td>81.9%</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>26</td>
<td>2.9%</td>
<td>50%</td>
<td>81.7%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1200</td>
<td>30</td>
<td>17</td>
<td>2.0%</td>
<td>66%</td>
<td>81.3%</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>27</td>
<td>3.8%</td>
<td>52%</td>
<td>83.0%</td>
<td></td>
</tr>
<tr>
<td>10%</td>
<td>400</td>
<td>30</td>
<td>9</td>
<td>3.5%</td>
<td>40%</td>
<td>82.4%</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>14</td>
<td>2.7%</td>
<td>30%</td>
<td>83.8%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1200</td>
<td>30</td>
<td>10</td>
<td>2.8%</td>
<td>43%</td>
<td>81.1%</td>
</tr>
<tr>
<td>5%</td>
<td>400</td>
<td>30</td>
<td>6</td>
<td>3.7%</td>
<td>29%</td>
<td>81.0%</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>9</td>
<td>2.3%</td>
<td>21%</td>
<td>83.7%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1200</td>
<td>30</td>
<td>7</td>
<td>2.2%</td>
<td>33%</td>
<td>82.3%</td>
</tr>
<tr>
<td>1%</td>
<td>400</td>
<td>30</td>
<td>3</td>
<td>1.0%</td>
<td>18%</td>
<td>81.4%</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>4</td>
<td>0.9%</td>
<td>11%</td>
<td>80.3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1200</td>
<td>60</td>
<td>4</td>
<td>2.7%</td>
<td>11%</td>
<td>80.3%</td>
</tr>
</tbody>
</table>
Guide to the preparation, use and quality assurance of blood components

<table>
<thead>
<tr>
<th>Allowed failure rate for a conforming process</th>
<th>Number of tests in ‘universe’ (e.g. the number of tests per year)</th>
<th>Sample size (i.e. the fixed number of tests in a moving ‘window’)</th>
<th>Maximum allowed number of failed tests in window</th>
<th>False positive rate of test criterion</th>
<th>Minimum failure rate of a non-conforming process detectable at &gt; 80% power in any single ‘window’</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1%</td>
<td>400</td>
<td>30</td>
<td>1</td>
<td>1.1%</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>81.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>120</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.2%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>81.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>120</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.6%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80.7%</td>
</tr>
</tbody>
</table>

Example 3. Statistical process control for dichotomous outcomes: an approach based upon hypergeometric/binomial distributions

A hypergeometric distribution is based upon random sampling (without replacement) of a factor that has a dichotomous outcome. This distribution is applicable for the assessment of quality control measures related to blood components for which the outcome is pass/fail. A binomial distribution is very similar to a hypergeometric distribution, but it is based upon sampling with replacement. At sampling levels of n ≥ 59 to meet the 95 per cent criterion, these two distributions are essentially identical.

For statistical quality control using the hypergeometric/binomial approach, a cycle is defined as the blood-component volume that is being subject to quality assessment within a defined time period. The appropriate size for a quality-control cycle is determined based upon
the desired frequency of control sampling as described above and the selected proportion of conforming samples.\(^3\)

Statistical quality control based upon a hypergeometric distribution is applicable for cycle sizes between \(n = 30\) and \(n = 4\,500\).\(^4\) Successful control requires that predetermined random sample sizes be assessed with an outcome of 0, 1 or 2 failures, depending on the cycle size.

For cycle sizes above \(n = 4\,500\), the hypergeometric distribution approaches the binomial distribution and the traditional binomial approach can be applied, i.e. assessing \(n = 60\) random samples per cycle with an outcome of zero failures; \(n = 93\) with one failure or \(n = 124\) with 2 failures.

\(^3\) For example, 95\% conformance (and the resulting high level of quality-control testing) would be appropriate for a safety-related blood component standard such as residual leucocytes in a Leucocyte-Depleted component. However, 75\% conformance may be acceptable for a standard such as components content, where standardisation is desirable, but is not directly related to recipient safety.

\(^4\) For a cycle size of 30, greater than 95 per cent conformance is reflected by, at most, one non-conforming unit because \(29/30 = 96.7\%\) per cent and \(28/30 = 93.3\%\) per cent. To define this conformance statistically, it is necessary to be able to conclude with 95 per cent confidence that greater than 95 per cent of the units are conforming (i.e. \(\leq n = 1\) non-conforming unit for a cycle size of \(n = 30\)). Using a null hypothesis that there are at least two non-conforming units among the 30 units, the alternative hypothesis is that there are fewer than two non-conforming units among the 30 units. Under this null hypothesis, the probability that the first 22 units are all good is 6.4 per cent, which is calculated as:

\[
\frac{28}{30} \times \frac{27}{29} \times \frac{26}{28} \times \cdots \times \frac{9}{11} \times \frac{8}{10} \times \frac{7}{9} = \frac{8 \times 7}{30 \times 29} = 0.064
\]

So the null hypothesis cannot be rejected at the 5% significance level, which corresponds to ‘with 95 per cent confidence’.

Under the null hypothesis stated above, the probability that the first 23 units are all good is 4.8 per cent:

\[
\frac{28}{30} \times \frac{27}{29} \times \frac{26}{28} \times \cdots \times \frac{9}{11} \times \frac{8}{10} \times \frac{7}{9} \times \frac{6}{8} = \frac{7 \times 6}{30 \times 29} = 0.048
\]

So the null hypothesis can be rejected at the 5% significance level which corresponds to ‘with 95 per cent confidence’. Thus, 23 samples without a non-conformance are needed to conclude with 95 per cent confidence that greater than 95 per cent of the units are conforming.
The table below provides random sample sizes across a range of cycle sizes. With a larger cycle size, 1 or 2 occurrences of non-conformance are allowed in conjunction with a larger pre-specified sample size.

For example, if the cycle size is 65 (95%/95%), there are three options that need to be pre-determined: a sample size of 34 without any failure, a sample size of 49 with 1 failure, or a sample size of 59 with 2 failures. If (i) a sample size of 34 and observation of one failure, or (ii) a sample size of 49 and observation of two failures is chosen, 100 per cent quality control can still be done to make the final determination, whether or not greater than 95 per cent of the components meet the standard.

After the cycle size reaches 7 000 for 95%/95% and 13 000 for 95%/75%, the results based on the hypergeometric distribution are same as those based on a binomial distribution.
Table 2. Sizes of random samples needed at various quality control cycle sizes to assess 95%, 90% or 75% conformance to a standard with 95% confidence

<table>
<thead>
<tr>
<th>Lot size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No failure</td>
<td>1 failure allowed</td>
<td>2 failures allowed</td>
<td>No failure</td>
<td>1 failure allowed</td>
<td>2 failures allowed</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>23</td>
<td>30</td>
<td>N/A</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>31</td>
<td>1</td>
<td>24</td>
<td>31</td>
<td>N/A</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>32</td>
<td>1</td>
<td>25</td>
<td>32</td>
<td>N/A</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>33</td>
<td>1</td>
<td>26</td>
<td>33</td>
<td>N/A</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>34</td>
<td>1</td>
<td>26</td>
<td>34</td>
<td>N/A</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>35</td>
<td>1</td>
<td>27</td>
<td>35</td>
<td>N/A</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td>36</td>
<td>1</td>
<td>28</td>
<td>36</td>
<td>N/A</td>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>37</td>
<td>1</td>
<td>29</td>
<td>37</td>
<td>N/A</td>
<td>3</td>
<td>19</td>
</tr>
</tbody>
</table>
### Guide to the preparation, use and quality assurance of blood components

**95%/95%**

95% confidence that > 95% of the components meet the standard

<table>
<thead>
<tr>
<th>Lot size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No failure</td>
<td></td>
<td>No failure</td>
<td></td>
<td>No failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 failure allowed</td>
<td></td>
<td>1 failure allowed</td>
<td></td>
<td>1 failure allowed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 failures allowed</td>
<td></td>
<td>2 failures allowed</td>
<td></td>
<td>2 failures allowed</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>3</td>
<td>3</td>
<td>20</td>
<td>28</td>
<td>34</td>
<td>9</td>
</tr>
<tr>
<td>39</td>
<td>3</td>
<td>3</td>
<td>20</td>
<td>29</td>
<td>35</td>
<td>9</td>
</tr>
<tr>
<td>40</td>
<td>3</td>
<td>3</td>
<td>21</td>
<td>30</td>
<td>36</td>
<td>9</td>
</tr>
<tr>
<td>45</td>
<td>4</td>
<td>4</td>
<td>20</td>
<td>29</td>
<td>36</td>
<td>11</td>
</tr>
<tr>
<td>50</td>
<td>4</td>
<td>4</td>
<td>22</td>
<td>33</td>
<td>40</td>
<td>12</td>
</tr>
<tr>
<td>55</td>
<td>5</td>
<td>5</td>
<td>21</td>
<td>32</td>
<td>40</td>
<td>13</td>
</tr>
<tr>
<td>60</td>
<td>5</td>
<td>5</td>
<td>23</td>
<td>34</td>
<td>43</td>
<td>14</td>
</tr>
<tr>
<td>65</td>
<td>6</td>
<td>6</td>
<td>22</td>
<td>33</td>
<td>42</td>
<td>16</td>
</tr>
<tr>
<td>70</td>
<td>6</td>
<td>6</td>
<td>24</td>
<td>36</td>
<td>46</td>
<td>17</td>
</tr>
<tr>
<td>75</td>
<td>7</td>
<td>7</td>
<td>23</td>
<td>35</td>
<td>44</td>
<td>18</td>
</tr>
</tbody>
</table>

**95%/90%**

95% confidence that > 90% of the components meet the standard

**95%/75%**

95% confidence that > 75% of the components meet the standard
Appendix 4. Statistical Process Control

<table>
<thead>
<tr>
<th>Lot size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No failure</td>
<td>1 failure allowed</td>
<td>2 failures allowed</td>
<td>No failure</td>
<td>1 failure allowed</td>
<td>2 failures allowed</td>
</tr>
<tr>
<td>80</td>
<td>3</td>
<td>42</td>
<td>60</td>
<td>72</td>
<td>7</td>
<td>47</td>
</tr>
<tr>
<td>85</td>
<td>4</td>
<td>38</td>
<td>56</td>
<td>69</td>
<td>8</td>
<td>46</td>
</tr>
<tr>
<td>90</td>
<td>4</td>
<td>40</td>
<td>59</td>
<td>73</td>
<td>8</td>
<td>49</td>
</tr>
<tr>
<td>95</td>
<td>4</td>
<td>42</td>
<td>62</td>
<td>77</td>
<td>9</td>
<td>47</td>
</tr>
<tr>
<td>100</td>
<td>4</td>
<td>45</td>
<td>65</td>
<td>81</td>
<td>9</td>
<td>50</td>
</tr>
<tr>
<td>120</td>
<td>5</td>
<td>47</td>
<td>69</td>
<td>87</td>
<td>11</td>
<td>52</td>
</tr>
<tr>
<td>140</td>
<td>6</td>
<td>48</td>
<td>72</td>
<td>92</td>
<td>13</td>
<td>53</td>
</tr>
<tr>
<td>160</td>
<td>7</td>
<td>49</td>
<td>75</td>
<td>95</td>
<td>15</td>
<td>54</td>
</tr>
<tr>
<td>180</td>
<td>8</td>
<td>50</td>
<td>77</td>
<td>98</td>
<td>17</td>
<td>55</td>
</tr>
<tr>
<td>200</td>
<td>9</td>
<td>51</td>
<td>78</td>
<td>101</td>
<td>19</td>
<td>55</td>
</tr>
</tbody>
</table>
Guide to the preparation, use and quality assurance of blood components

<table>
<thead>
<tr>
<th>Lot size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No failure 1 failure allowed 2 failures allowed</td>
<td>No failure 1 failure allowed 2 failures allowed</td>
<td>No failure 1 failure allowed 2 failures allowed</td>
<td>No failure 1 failure allowed 2 failures allowed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>220</td>
<td>10 52 79</td>
<td>103 21 42</td>
<td>56 54</td>
<td>11 17 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>240</td>
<td>11 52 80</td>
<td>104 23 43</td>
<td>56 59</td>
<td>11 17 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>260</td>
<td>12 53 81</td>
<td>106 25 43</td>
<td>57 64</td>
<td>11 17 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>280</td>
<td>13 53 82</td>
<td>107 27 43</td>
<td>57 69</td>
<td>11 17 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>14 54 83</td>
<td>108 29 43</td>
<td>57 74</td>
<td>11 17 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>320</td>
<td>15 54 83</td>
<td>109 31 44</td>
<td>57 79</td>
<td>11 17 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>340</td>
<td>16 54 84</td>
<td>110 33 44</td>
<td>58 84</td>
<td>11 17 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>360</td>
<td>17 54 85</td>
<td>111 35 44</td>
<td>58 89</td>
<td>11 17 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>380</td>
<td>18 55 85</td>
<td>111 37 44</td>
<td>58 94</td>
<td>11 17 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>19 55 85</td>
<td>112 39 44</td>
<td>58 99</td>
<td>11 17 23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lot size</td>
<td>Failures allowed in lot</td>
<td>Sample size</td>
<td>Failures allowed in lot</td>
<td>Sample size</td>
<td>Failures allowed in lot</td>
<td>Sample size</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------</td>
<td>-------------</td>
<td>------------------------</td>
<td>-------------</td>
<td>------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>No failure</td>
<td>1 failure allowed</td>
<td>2 failures allowed</td>
<td>No failure</td>
<td>1 failure allowed</td>
<td>2 failures allowed</td>
</tr>
<tr>
<td>450</td>
<td>22</td>
<td>54</td>
<td>84</td>
<td>111</td>
<td>44</td>
<td>59</td>
</tr>
<tr>
<td>500</td>
<td>24</td>
<td>56</td>
<td>87</td>
<td>114</td>
<td>49</td>
<td>59</td>
</tr>
<tr>
<td>550</td>
<td>27</td>
<td>55</td>
<td>86</td>
<td>113</td>
<td>54</td>
<td>59</td>
</tr>
<tr>
<td>600</td>
<td>29</td>
<td>56</td>
<td>88</td>
<td>116</td>
<td>59</td>
<td>60</td>
</tr>
<tr>
<td>650</td>
<td>32</td>
<td>56</td>
<td>87</td>
<td>115</td>
<td>64</td>
<td>59</td>
</tr>
<tr>
<td>700</td>
<td>34</td>
<td>57</td>
<td>89</td>
<td>117</td>
<td>69</td>
<td>60</td>
</tr>
<tr>
<td>750</td>
<td>37</td>
<td>56</td>
<td>88</td>
<td>116</td>
<td>74</td>
<td>60</td>
</tr>
<tr>
<td>800</td>
<td>39</td>
<td>57</td>
<td>89</td>
<td>118</td>
<td>79</td>
<td>60</td>
</tr>
<tr>
<td>850</td>
<td>42</td>
<td>56</td>
<td>89</td>
<td>117</td>
<td>84</td>
<td>60</td>
</tr>
<tr>
<td>900</td>
<td>44</td>
<td>57</td>
<td>90</td>
<td>119</td>
<td>89</td>
<td>60</td>
</tr>
<tr>
<td>Lot size</td>
<td>Failures allowed in lot</td>
<td>Sample size</td>
<td>Failures allowed in lot</td>
<td>Sample size</td>
<td>Failures allowed in lot</td>
<td>Sample size</td>
</tr>
<tr>
<td>----------</td>
<td>-------------------------</td>
<td>-------------</td>
<td>-------------------------</td>
<td>-------------</td>
<td>-------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>No failure</td>
<td>1 failure allowed</td>
<td>2 failures allowed</td>
<td>No failure</td>
<td>1 failure allowed</td>
<td>2 failures allowed</td>
</tr>
<tr>
<td>950</td>
<td>47</td>
<td>57</td>
<td>89</td>
<td>118</td>
<td>94</td>
<td>29</td>
</tr>
<tr>
<td>1000</td>
<td>49</td>
<td>57</td>
<td>90</td>
<td>119</td>
<td>99</td>
<td>29</td>
</tr>
<tr>
<td>1500</td>
<td>74</td>
<td>58</td>
<td>91</td>
<td>121</td>
<td>149</td>
<td>29</td>
</tr>
<tr>
<td>2000</td>
<td>99</td>
<td>58</td>
<td>92</td>
<td>122</td>
<td>199</td>
<td>29</td>
</tr>
<tr>
<td>2500</td>
<td>124</td>
<td>58</td>
<td>92</td>
<td>122</td>
<td>249</td>
<td>29</td>
</tr>
<tr>
<td>3000</td>
<td>149</td>
<td>58</td>
<td>92</td>
<td>123</td>
<td>299</td>
<td>29</td>
</tr>
<tr>
<td>3500</td>
<td>174</td>
<td>58</td>
<td>93</td>
<td>123</td>
<td>349</td>
<td>29</td>
</tr>
<tr>
<td>4000</td>
<td>199</td>
<td>58</td>
<td>93</td>
<td>123</td>
<td>399</td>
<td>29</td>
</tr>
<tr>
<td>4500</td>
<td>224</td>
<td>59</td>
<td>93</td>
<td>123</td>
<td>449</td>
<td>29</td>
</tr>
<tr>
<td>5000</td>
<td>249</td>
<td>59</td>
<td>93</td>
<td>123</td>
<td>499</td>
<td>29</td>
</tr>
</tbody>
</table>
## Appendix 4: Statistical Process Control

511

<table>
<thead>
<tr>
<th>Lot size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
<th>Failures allowed in lot</th>
<th>Sample size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No failure</td>
<td>1 failure allowed</td>
<td>2 failures allowed</td>
<td>No failure</td>
<td>1 failure allowed</td>
<td>2 failures allowed</td>
<td>No failure</td>
<td>1 failure allowed</td>
</tr>
<tr>
<td>6000</td>
<td>299</td>
<td>59</td>
<td>93</td>
<td>123</td>
<td>599</td>
<td>29</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>7000</td>
<td>349</td>
<td>59</td>
<td>93</td>
<td>124</td>
<td>699</td>
<td>29</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>8000</td>
<td>399</td>
<td>59</td>
<td>93</td>
<td>124</td>
<td>799</td>
<td>29</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>9000</td>
<td>449</td>
<td>59</td>
<td>93</td>
<td>124</td>
<td>899</td>
<td>29</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>10000</td>
<td>499</td>
<td>59</td>
<td>93</td>
<td>124</td>
<td>999</td>
<td>29</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>11000</td>
<td>549</td>
<td>59</td>
<td>93</td>
<td>124</td>
<td>1099</td>
<td>29</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>12000</td>
<td>599</td>
<td>59</td>
<td>93</td>
<td>124</td>
<td>1199</td>
<td>29</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>13000</td>
<td>649</td>
<td>59</td>
<td>93</td>
<td>124</td>
<td>1299</td>
<td>29</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>14000</td>
<td>699</td>
<td>59</td>
<td>93</td>
<td>124</td>
<td>1399</td>
<td>29</td>
<td>46</td>
<td>61</td>
</tr>
<tr>
<td>15000</td>
<td>749</td>
<td>59</td>
<td>93</td>
<td>124</td>
<td>1499</td>
<td>29</td>
<td>46</td>
<td>61</td>
</tr>
</tbody>
</table>
DEFINITIONS
<table>
<thead>
<tr>
<th><strong>Additive solution</strong></th>
<th>Solution specifically formulated to maintain beneficial properties of cellular components during storage.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adverse event</strong></td>
<td>Any untoward occurrence associated with the collecting, testing, processing, storage and distribution of blood and blood components that might lead to an adverse reaction in blood recipients or blood donors.</td>
</tr>
<tr>
<td><strong>Adverse reaction</strong></td>
<td>Unintended response in a donor or patient associated with the collection or transfusion of blood or blood components.</td>
</tr>
<tr>
<td><strong>Allogeneic donation</strong></td>
<td>Blood and blood components collected from an individual and intended for transfusion to another individual, for use in medical devices or as starting material/raw material for manufacturing into medicinal products.</td>
</tr>
<tr>
<td><strong>Antibody quantitation</strong></td>
<td>Technique routinely used to measure the level of antibody, i.e. anti-RhD (or anti-c) antibody in maternal sera.</td>
</tr>
<tr>
<td><strong>Antiglobulin testing technique</strong></td>
<td>The direct antiglobulin test (direct Coombs’ test) and the indirect antiglobulin test. It detects antibody or complement bound to red cells in vivo.</td>
</tr>
<tr>
<td><strong>Anti-IgA antibodies</strong></td>
<td>IgG or occasionally IgM anti-IgA produced by an IgA-deficient patient. Severe anaphylactoid transfusion reactions can occur in such patients.</td>
</tr>
<tr>
<td><strong>Apheresis</strong></td>
<td>Method of obtaining one or more blood components by machine processing of whole blood, in which the residual components of the blood are returned to the donor during or at the end of the process.</td>
</tr>
<tr>
<td><strong>Audit programme</strong></td>
<td>A systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.</td>
</tr>
<tr>
<td><strong>Autologous collection</strong></td>
<td>Autologous collection means blood and blood components collected from an individual and intended solely for subsequent autologous transfusion or other human application to that same individual.</td>
</tr>
<tr>
<td><strong>Autologous donors</strong></td>
<td>Individuals who give blood for their own use if the need for blood can be anticipated and a collection plan developed.</td>
</tr>
<tr>
<td><strong>Definitions</strong></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td><strong>Autologous transfusion</strong></td>
<td>Transfusion in which the donor and the recipient are the same person and in which pre-deposited blood and blood components are used.</td>
</tr>
<tr>
<td><strong>Automated system</strong></td>
<td>A broad range of systems including, but not limited to, automated processing equipment, automated laboratory equipment, process control, processing execution, laboratory information management, processing resource planning and document management systems. The automated system consists of the hardware, software and network components, together with the controlled functions and associated documentation.</td>
</tr>
<tr>
<td><strong>Blood component</strong></td>
<td>Therapeutic components of blood (red cells, white cells, platelets, plasma) that can be prepared by centrifugation, filtration and freezing using conventional methodologies in blood banks.</td>
</tr>
<tr>
<td><strong>Blood component release</strong></td>
<td>Procedure which enables a blood component to be released from a quarantine status by the use of systems and procedures to ensure that the finished product meets its release specifications.</td>
</tr>
<tr>
<td><strong>Blood establishment</strong></td>
<td>Any structure or body that is responsible for any aspect of the collection and testing of human blood or blood components, whatever their intended purpose, and their processing, storage and distribution if intended for transfusion. This does not include hospital blood banks.</td>
</tr>
<tr>
<td><strong>Blood product</strong></td>
<td>Any therapeutic product derived from human blood or plasma.</td>
</tr>
<tr>
<td><strong>Buffy coat</strong></td>
<td>Blood component prepared by centrifugation of a unit of whole blood, which contains a considerable proportion of the leucocytes and platelets.</td>
</tr>
<tr>
<td><strong>Buoyant density centrifugation</strong></td>
<td>Technique for separation based on density differences between cells.</td>
</tr>
<tr>
<td><strong>Calibration</strong></td>
<td>Set of operations that establish, under specified conditions, the relationship between values indicated by a measuring instrument/system or values represented by a material measure and the corresponding known values of a reference standard.</td>
</tr>
<tr>
<td><strong>Cell free plasma</strong></td>
<td>Plasma obtained by cross-flow filtration, when blood flows along a membrane with a pore size allowing free passage of plasma proteins, but not of blood cells.</td>
</tr>
<tr>
<td><strong>Cell separator</strong></td>
<td>An instrument for apheresis.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Change control</td>
<td>A formal system by which qualified representatives of appropriate disciplines review proposed or actual changes that might affect the validated status of facilities, systems, equipment or processes. The intent is to determine the need for action that would ensure and document that the system is maintained in a validated state.</td>
</tr>
<tr>
<td>Computerised system</td>
<td>A system comprising the input of data, electronic processing and the output of information to be used either for reporting, automatic control or documentation.</td>
</tr>
<tr>
<td>Counter-current centrifugation (elutriation)</td>
<td>Technique where cells subjected simultaneously to a liquid flow and a centrifugal force in opposite directions tend to be separated according to their size.</td>
</tr>
<tr>
<td>CPD-Adenine (CPDA)</td>
<td>Citrate-Phosphate-Dextrose with Adenine is a preservative-anticoagulant solution used for whole blood collection.</td>
</tr>
<tr>
<td>Cryopreservation</td>
<td>Prolongation of the storage life of blood components by freezing.</td>
</tr>
<tr>
<td>Cytapheresis</td>
<td>An apheresis procedure intended for the collection of a cellular component of blood, such as red cells, leucocytes or platelets.</td>
</tr>
<tr>
<td>Depth and surface filtration</td>
<td>Technique of filtration using a filter bed of fibres: owing to the specific properties of platelets and granulocytes, as well as the low flexibility of lymphocytes, these cells are more easily trapped in such filters than are red cells.</td>
</tr>
<tr>
<td>Distribution</td>
<td>Act of delivery of blood and blood components to other blood establishments, hospital blood banks, and manufacturers of blood- and plasma-derived products. It does not include issuing blood or blood components for transfusion.</td>
</tr>
<tr>
<td>Donor</td>
<td>A person in normal health with a good medical history who voluntarily gives blood or blood components for therapeutic use.</td>
</tr>
<tr>
<td>Donor deferral</td>
<td>Suspension of the eligibility of an individual to donate blood or blood components; such suspension being either permanent or temporary.</td>
</tr>
<tr>
<td>Febrile transfusion reactions</td>
<td>A febrile response associated with the administration of blood or blood components.</td>
</tr>
<tr>
<td>First-time donor</td>
<td>Someone who has never donated either blood or a blood component.</td>
</tr>
<tr>
<td><strong>Definitions</strong></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td><strong>Full blood count</strong></td>
<td>Analysis of haematological parameters including Hb and RBC indices as well as counts of RBCs, white cells and platelets.</td>
</tr>
<tr>
<td><strong>Glycerol</strong></td>
<td>Propanetriol, used as a cell-cryoprotective agent for the storage of red cells in the frozen state.</td>
</tr>
<tr>
<td><strong>Good practice</strong></td>
<td>All elements in established practice that collectively lead to final blood or blood components that consistently meet pre-defined specifications and compliance with defined regulations.</td>
</tr>
<tr>
<td><strong>Haematocrit</strong></td>
<td>Result obtained by the measurement of the volume of red cells in blood, after centrifugation, expressed as a percentage or as a ratio in the SI system.</td>
</tr>
<tr>
<td><strong>Haematopoietic progenitor cells</strong></td>
<td>HPC are primitive pluripotent cells capable of self-renewal as well as differentiation and maturation into all haematopoietic lineages. They are found in bone marrow (bone marrow cells (BMC)), in the mononuclear cells of circulating blood (peripheral blood stem cells (PBSC)) and in umbilical cord blood (umbilical stem cells (USC)).</td>
</tr>
<tr>
<td><strong>Haemovigilance</strong></td>
<td>Organised surveillance procedures related to serious adverse or unexpected events or reactions in donors or recipients, and the epidemiological follow-up of donors.</td>
</tr>
<tr>
<td><strong>Hospital blood bank</strong></td>
<td>Hospital unit which stores and distributes and may perform compatibility tests on blood and blood components exclusively for use within the hospital facilities, including hospital-based transfusion activities.</td>
</tr>
<tr>
<td><strong>Inspection</strong></td>
<td>Formal and objective control according to adopted standards to assess compliance with a given directive and other relevant legislation and to identify problems.</td>
</tr>
<tr>
<td><strong>Leucocyte depletion</strong></td>
<td>The removal of leucocytes from blood.</td>
</tr>
<tr>
<td><strong>Mobile site</strong></td>
<td>A temporary or movable place used for the collection of blood and blood components which is in a location outside of, but under the control of the blood establishment.</td>
</tr>
<tr>
<td><strong>Pathogen reduction technologies (PRT)</strong></td>
<td>Procedures that irreversibly impede proliferation of pathogens, either by removal or inactivation with physical and/or chemical methods.</td>
</tr>
<tr>
<td><strong>Pathogen reduced (PR)</strong></td>
<td>A term applied to a blood component that has been prepared following the use of PRT.</td>
</tr>
</tbody>
</table>
Peripheral blood stem cells (PBSC) | Primitive pluripotent cells capable of self-renewal as well as differentiation and maturation into all haematopoietic line ages, and found in the mononuclear cells of circulating blood (see haematopoietic progenitor cells).

Plasma | The liquid portion of the blood in which the cells are suspended. Plasma may be separated from the cellular portion of whole blood for therapeutic use as fresh frozen plasma or further processed to cryo-precipitate and cryoprecipitate-depleted plasma for transfusion. It may be used for the manufacture of medicinal products derived from human blood and human plasma or used in the preparation of pooled platelets, or pooled leucocyte-depleted platelets. It may also be used for re-suspension of red cell preparations for exchange transfusion or peri-natal transfusion.

Platelet standard adult dose | A dose of platelets derived from 4-6 whole blood donations or obtained by apheresis, with a minimum platelet content of 200 × 10^9 platelets.

Regular donor | Someone who routinely donates their blood or plasma (i.e. within the last 2 years), in accordance with minimum time intervals, in the same donation centre.

Replacement donor | Donor recruited by a patient to enable them to undergo elective surgery.

Repeat donor | Someone who has donated before, but not within the last two years in the same donation centre.

RhD Immunoglobulin | Immunoglobulin specific for RhD antigen is given routinely to RhD-negative mothers bearing RhD-positive infants to protect them from red cell exposure during pregnancy and delivery, and so prevent allo-immunisation.

Risk assessment | Method to assess and characterise the critical parameters in the functionality of equipment, systems or processes.

Serious adverse event | Any untoward occurrence associated with the collecting, testing, processing, storage and distribution of blood and blood components that might lead to death or life-threatening, disabling or incapacitating conditions for donors or recipients or which results in, or prolongs, hospitalisation or morbidity.
### Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Serious adverse reaction</strong></td>
<td>Unintended response in donor or in recipient associated with the collection or transfusion of blood or blood components that is fatal, life-threatening, disabling, incapacitating, or which results in, or prolongs hospitalisation or morbidity.</td>
</tr>
<tr>
<td><strong>Specification</strong></td>
<td>Description of the criteria that must be fulfilled in order to achieve the required quality standard.</td>
</tr>
<tr>
<td><strong>Standard</strong></td>
<td>The requirements that serve as the basis for comparison.</td>
</tr>
<tr>
<td><strong>Standard operating procedures (SOPs)</strong></td>
<td>Detailed written procedures that give direction for performing certain operations.</td>
</tr>
<tr>
<td><strong>Statistical process control</strong></td>
<td>Method of quality control of a product or a process that relies on a system of analysis of an adequate sample size, without the need to measure every product of the process.</td>
</tr>
<tr>
<td><strong>Trace-back</strong></td>
<td>The process of investigating a report of a suspected transfusion-associated adverse reaction in a recipient to identify a potentially implicated donor.</td>
</tr>
<tr>
<td><strong>Validation</strong></td>
<td>Refers to establishment of documented and objective evidence that the pre-defined requirements for a specific procedure or process can be fulfilled consistently.</td>
</tr>
<tr>
<td><strong>Validation plan</strong></td>
<td>Description of validation activities, responsibilities and procedures. It describes specifically how a certain validation is to be done.</td>
</tr>
<tr>
<td><strong>Washed</strong></td>
<td>A process of removing plasma or storage medium from cellular components by centrifugation, decanting of the supernatant liquid from the cells and addition of an isotonic suspension fluid, which in turn is generally removed and replaced following further centrifugation of the suspension. The centrifugation, decanting, replacing process may be repeated several times.</td>
</tr>
<tr>
<td><strong>Washed red cells</strong></td>
<td>A component derived from whole blood by centrifugation and removal of plasma, with subsequent washing of the red cells in an isotonic solution.</td>
</tr>
<tr>
<td><strong>Whole blood</strong></td>
<td>Blood collected from a single donor and processed either for transfusion or further manufacturing.</td>
</tr>
<tr>
<td><strong>Written procedures</strong></td>
<td>Controlled documents that describe how specified operations are to be carried out.</td>
</tr>
</tbody>
</table>
**Xenotransplantation**

Any procedure that involves transplantation or infusion into a human recipient of live animal cells, tissues or organs, or human body fluids, cells, tissues or organs that have ex vivo contact with live animal cells, tissues or organs.
ABBREVIATIONS
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag</td>
<td>Antigen</td>
</tr>
<tr>
<td>AIDS</td>
<td>Acquired Immune Deficiency Syndrome</td>
</tr>
<tr>
<td>ALT</td>
<td>Alanine Amino Transferase</td>
</tr>
<tr>
<td>AML</td>
<td>Acute Myeloid Leukaemia</td>
</tr>
<tr>
<td>AS</td>
<td>Additive Solution</td>
</tr>
<tr>
<td>AS-BCR</td>
<td>Additive Solution-Buffy Coat Removed</td>
</tr>
<tr>
<td>BCR</td>
<td>Buffy Coat Removed</td>
</tr>
<tr>
<td>BPAT</td>
<td>Batch Pre-Acceptance Testing</td>
</tr>
<tr>
<td>BSE</td>
<td>Bovine Spongiform Encephalopathy</td>
</tr>
<tr>
<td>BTS</td>
<td>Blood Transfusion Services</td>
</tr>
<tr>
<td>CAPA</td>
<td>Corrective and Preventative Action</td>
</tr>
<tr>
<td>CD-P-TS</td>
<td>European Committee on Blood Transfusion</td>
</tr>
<tr>
<td>CETS</td>
<td>Council of Europe Treaty Series (formerly ETS: European Treaty Series)</td>
</tr>
<tr>
<td>CJD</td>
<td>Creutzfeldt–Jakob disease</td>
</tr>
<tr>
<td>CMV</td>
<td>Cytomegalovirus</td>
</tr>
<tr>
<td>DMSO</td>
<td>Dimethylsulfoxide</td>
</tr>
<tr>
<td>DQ</td>
<td>Design Qualification</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>EDQM</td>
<td>European Directorate for the Quality of Medicines &amp; HealthCare</td>
</tr>
<tr>
<td>ELISA</td>
<td>Enzyme-linked immuno-sorbent assay</td>
</tr>
<tr>
<td>EMA</td>
<td>European Medicines Agency</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>FFP</td>
<td>Fresh Frozen Plasma</td>
</tr>
<tr>
<td>FTA</td>
<td>Fluorescent Treponemal Antibody</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Definition</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
</tr>
<tr>
<td>GCSF</td>
<td>Granulocyte Colony Stimulating Factor</td>
</tr>
<tr>
<td>GMP</td>
<td>Good Manufacturing Practice</td>
</tr>
<tr>
<td>GPG</td>
<td>Good Practice Guidelines</td>
</tr>
<tr>
<td>GTS</td>
<td>Ad hoc working group on the guide to the preparation, use and quality assurance of blood components</td>
</tr>
<tr>
<td>GVHD</td>
<td>Graft-Versus-Host disease</td>
</tr>
<tr>
<td>ECV</td>
<td>Extracorporeal volume</td>
</tr>
<tr>
<td>Hb</td>
<td>Haemoglobin</td>
</tr>
<tr>
<td>HBc</td>
<td>Hepatitis B core antigen</td>
</tr>
<tr>
<td>HBsAg</td>
<td>Hepatitis B surface antigen</td>
</tr>
<tr>
<td>HCV</td>
<td>Hepatitis C virus</td>
</tr>
<tr>
<td>Hct</td>
<td>Haematocrit</td>
</tr>
<tr>
<td>HES</td>
<td>Hydroxyethyl starch</td>
</tr>
<tr>
<td>HIV</td>
<td>Human Immunodeficiency virus</td>
</tr>
<tr>
<td>HLA</td>
<td>Human Leucocyte Antigen</td>
</tr>
<tr>
<td>HPA</td>
<td>Human Platelet Antigen</td>
</tr>
<tr>
<td>HTLV</td>
<td>Human T-cell lymphotropic virus</td>
</tr>
<tr>
<td>IQ</td>
<td>Installation Qualification</td>
</tr>
<tr>
<td>ISBT</td>
<td>International Society for Blood Transfusion</td>
</tr>
<tr>
<td>IU</td>
<td>International Unit</td>
</tr>
<tr>
<td>JACIE</td>
<td>Joint Accreditation Committee-ISCT (Europe) &amp; EBMT</td>
</tr>
<tr>
<td>LD</td>
<td>Leucocyte-Depleted</td>
</tr>
<tr>
<td>LISS</td>
<td>Low Ionic Strength (Salt) Solution</td>
</tr>
<tr>
<td>MDS</td>
<td>Myelodysplasia</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
</tr>
<tr>
<td>NAT</td>
<td>Nucleic Acid Amplification Techniques</td>
</tr>
<tr>
<td>OQ</td>
<td>Operational Qualification</td>
</tr>
<tr>
<td>PAT</td>
<td>Pre-deposit Autologous Donation</td>
</tr>
<tr>
<td>Ph. Eur.</td>
<td>European Pharmacopoeia</td>
</tr>
<tr>
<td>PQ</td>
<td>Performance Qualification</td>
</tr>
<tr>
<td>PR</td>
<td>Pathogen Reduced</td>
</tr>
<tr>
<td>PRP</td>
<td>Platelet-rich Plasma</td>
</tr>
<tr>
<td>PRT</td>
<td>Pathogen Reduction Technology</td>
</tr>
<tr>
<td>QA</td>
<td>Quality Assurance</td>
</tr>
<tr>
<td>QC</td>
<td>Quality Control</td>
</tr>
<tr>
<td>RBC</td>
<td>Red Blood Cells</td>
</tr>
<tr>
<td>SAGM</td>
<td>Saline Adenine Glucose Mannitol solution</td>
</tr>
<tr>
<td>SOPs</td>
<td>Standard Operating Procedures</td>
</tr>
<tr>
<td>SPC</td>
<td>Statistical Process Control</td>
</tr>
<tr>
<td>T. cruzi</td>
<td>Trypanosoma cruzi</td>
</tr>
<tr>
<td>TA</td>
<td>Transfusion-Associated</td>
</tr>
<tr>
<td>TACO</td>
<td>Transfusion-Associated Circulatory Overload</td>
</tr>
<tr>
<td>TPHA</td>
<td>Treponema pallidum Haemagglutination Assay</td>
</tr>
<tr>
<td>TRALI</td>
<td>Transfusion-Related Acute Lung Injury</td>
</tr>
<tr>
<td>TTI</td>
<td>Transfusion-Transmitted Infection</td>
</tr>
<tr>
<td>TTP</td>
<td>Thrombotic Thrombocytopenic Purpura</td>
</tr>
<tr>
<td>vCJD</td>
<td>Variant Creutzfeld–Jakob disease</td>
</tr>
<tr>
<td>VMP</td>
<td>Validation Master Plan</td>
</tr>
</tbody>
</table>
### Recommendations and resolutions of the Council of Europe in the field of blood transfusion

<table>
<thead>
<tr>
<th>Resolution (78) 29</th>
<th>on harmonisation of legislations of member states relating to removal, grafting and transplantation of human substances</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation No. R (79) 5</td>
<td>concerning international exchange and transportation of human substances</td>
</tr>
<tr>
<td>Recommendation No. R (80) 5</td>
<td>on blood products for the treatment of haemophiliacs</td>
</tr>
<tr>
<td>Recommendation No. R (81) 5</td>
<td>concerning ante-natal administration of anti-D immunoglobulin</td>
</tr>
<tr>
<td>Recommendation No. R (81) 14</td>
<td>on preventing the transmission of infectious diseases in the international transfer of blood, its components and derivatives</td>
</tr>
<tr>
<td>Recommendation No. R (83) 8</td>
<td>on preventing the possible transmission of acquired immune deficiency syndrome (AIDS) from affected blood donors to patients receiving blood or blood products</td>
</tr>
<tr>
<td>Resolution 812 (1983)</td>
<td>of the Parliamentary Assembly on acquired immune deficiency syndrome (AIDS)</td>
</tr>
<tr>
<td>Recommendation No. R (84) 6</td>
<td>on the prevention of the transmission of malaria by blood transfusion</td>
</tr>
<tr>
<td>Recommendation No. R (85) 5</td>
<td>on a model curriculum for the training of specialists in blood transfusion</td>
</tr>
<tr>
<td>Recommendation No. R (85) 12</td>
<td>on the screening of blood donors for the presence of AIDS markers</td>
</tr>
<tr>
<td>Recommendation No. R (86) 6</td>
<td>on guidelines for the preparation, quality control and use of fresh frozen plasma (FFP)</td>
</tr>
<tr>
<td>Recommendation No. R (87) 25</td>
<td>concerning a common European public health policy to fight the acquired immunodeficiency syndrome (AIDS)</td>
</tr>
<tr>
<td>Recommendation No. R (88) 4</td>
<td>on the responsibilities of health authorities in the field of blood transfusion</td>
</tr>
<tr>
<td>Recommendation No. R (90) 3</td>
<td>concerning medical research on human beings</td>
</tr>
<tr>
<td>Recommendation No. R (90) 9</td>
<td>on plasma products and European self-sufficiency</td>
</tr>
<tr>
<td>Recommendation No. R (93) 4</td>
<td>concerning clinical trials involving the use of components and fractionated products derived from human blood or plasma</td>
</tr>
<tr>
<td>Recommendation No. R (95) 14</td>
<td>on the protection of health of donors and recipients in the area of blood transfusion</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Recommendation No. R (96) 11</td>
<td>on documentation and record-keeping to guarantee the traceability of blood and blood products, especially in hospital</td>
</tr>
<tr>
<td>Recommendation No. R (98) 2</td>
<td>on provision of haematopoietic progenitor cells</td>
</tr>
<tr>
<td>Recommendation No. R (98) 10</td>
<td>on the use of human red blood cells for the preparation of oxygen-carrying substances</td>
</tr>
<tr>
<td>Recommendation Rec (2001) 4</td>
<td>on the prevention of the possible transmission of variant Creutzfeldt–Jakob disease (vCJD) by blood transfusion</td>
</tr>
<tr>
<td>Recommendation Rec (2002) 11</td>
<td>on the hospital’s and clinician’s role in the optimal use of blood and blood products</td>
</tr>
<tr>
<td>Recommendation Rec (2003) 11</td>
<td>on the introduction of pathogen inactivation procedures for blood components</td>
</tr>
<tr>
<td>Recommendation Rec (2004) 8</td>
<td>on autologous cord blood banks</td>
</tr>
<tr>
<td>Recommendation Rec 2004) 18</td>
<td>on teaching transfusion medicine to nurses</td>
</tr>
<tr>
<td>Resolution Res (2008) 5</td>
<td>on donor responsibility and limitation of donation of blood and blood components</td>
</tr>
<tr>
<td>Resolution CM/Res (2013) 3</td>
<td>on sexual behaviours of blood donors that have an impact on transfusion safety</td>
</tr>
</tbody>
</table>

N.B. The figure in parentheses indicates the year of adoption.
## Council of Europe publications in the field of blood transfusion

<table>
<thead>
<tr>
<th>Year</th>
<th>Title</th>
<th>Study Director(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>Indications for the use of albumin, plasma protein solutions and plasma substitutes. Study Director: J. O’Riordan with M. Aebischer, J. Darnborough and I. Thoren</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>Assessment of the risks of transmitting infectious diseases by international transfer of blood, its components and derivatives. Study Director: W. Weise with T. Nielsen, P. Skinhot, J. P. Saleun</td>
<td></td>
</tr>
<tr>
<td>1983</td>
<td>Essential aspects of tissue typing. B. Bradley and S. Gore</td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>Study on the current position of training programmes for future specialists in blood transfusion in Council of Europe member states and in Finland. Study Director: E. Freiesleben with A. André, A. Franco, B. Baysal, J. Cash</td>
<td></td>
</tr>
<tr>
<td>1986</td>
<td>Quality control in blood transfusion services. Study Director: E. Freiesleben, R. Butler, C. Hogman, W. Wagstaff</td>
<td></td>
</tr>
<tr>
<td>1988</td>
<td>First European Symposium on quality in blood transfusion Résumé of lectures (publication of the Health Division of the Council of Europe)</td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>European Course on Blood transfusion (Athens, March 1988) Compendium of lecturers (publication of the Health Division of the Council of Europe)</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>Blood transfusion: 2nd European Course (Madrid 1990) Compendium of lecturers (publication of the Health Division of the Council of Europe)</td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td>Impact of the Aids epidemic on health care services and planning in Europe (publication of the Health Division of the Council of Europe)</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Reference</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>1993</td>
<td>Blood transfusion in Europe: a ‘white paper’. Safe and sufficient blood in Europe by Piet J. Hagen</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Survey of blood transfusion services of central and eastern European countries and their co-operation with western transfusion services. Report by H. T. Heiniger</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The collection and use of human blood and plasma in Europe. Prof. Dr W.G. van Aken</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>Guide on the preparation, use and quality assurance in blood components (appendix to Recommendation No. R (95) 15)</td>
<td></td>
</tr>
<tr>
<td>1997</td>
<td>Collection and use of blood and plasma in Europe (member States of the Council of Europe not members of the European Union). Study 1995, report by Dr Rejman</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Activities of blood banks in relation to bone marrow transplantations. Study Director: I.M. Francklin; Group members S. Koskimies, R. Kroczek, M. Reti, L. de Waal, R. Arrieta, F. Carbonell-Uberos</td>
<td></td>
</tr>
<tr>
<td>1998</td>
<td>Blood transfusion: half a century of contribution by the Council of Europe. Report by Prof. Dr B. Genetet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Autologous blood donation and transfusion in Europe – 1997 data. Report by Prof. Politis</td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>Pathogen inactivation of labile blood products. Study Director: Prof. A. Morell</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>Autologous blood donation and transfusion in Europe – 2000 data. Report by Prof. Politis</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>Collection, testing and use of blood and blood products in Europe – 2001 data. Report by Drs C.L. van der Poel, M.P. Janssen and M.E. Behr-Gross</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>Collection, testing and use of blood and blood products in Europe – 2002 data. Report by Drs C.L. van der Poel, M.P. Janssen and M.E. Behr-Gross</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Collection, testing and use of blood and blood products in Europe – 2003 data. Report by Drs C.L. van der Poel, M.P. Janssen and M.E. Behr-Gross</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>Collection, testing and use of blood and blood products in Europe – 2004 data. Report by Drs C.L. van der Poel, M.P. Janssen and M.E. Behr-Gross</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collection, testing and use of blood and blood products in Europe — 2006 data. Report by Drs C.L. van der Poel, M.P. Janssen and M.E. Behr-Gross</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collection, testing and use of blood and blood products in Europe — 2007 data. Report by Drs C.L. van der Poel, M.P. Janssen and M.E. Behr-Gross</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collection, testing and use of blood and blood products in Europe — 2008 data. Report by Drs C.L. van der Poel, M.P. Janssen and M.E. Behr-Gross</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collection, testing and use of blood and blood products in Europe — 2009 data. Report by Drs C.L. van der Poel, M.P. Janssen and M.E. Behr-Gross</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collection, testing and use of blood and blood products in Europe — 2010 data. Report by Drs C.L. van der Poel, M.P. Janssen and M.E. Behr-Gross</td>
<td></td>
</tr>
</tbody>
</table>
The use of blood components represents the only therapy available for many seriously ill patients who suffer from acute or chronic diseases.

To provide all those working in the field of transfusion medicine – from blood services to hospital departments to regulators – with a compendium of measures designed to ensure the safety, quality and efficacy of blood components, the Council of Europe has developed a guide as a technical annex to its Recommendation No. R (95) 15 on the preparation, use and quality assurance of blood components. The Guide contains recommendations for blood establishments on blood collection, blood components, technical procedures, transfusion practices and quality systems. It represents the basis for a large number of national regulations, as well as for the blood directives of the European Commission.

This is the 18th Edition of the Guide, compiled by leading European experts under the aegis of the European Committee (Partial Agreement) on Blood Transfusion (CD-P-TS).

For matters dealing with the use of organs and tissues and cells, see the Council of Europe Guide to the quality and safety of organs for transplantation and Guide to the quality and safety of tissues and cells for human application, respectively.

www.edqm.eu