Index

a
ABO blood groups 1, 215–216
antibody screening test 60–61
autoantibodies 62–63
centralised transfusion service 250
column-agglutination systems 62
crossmatching techniques 63
grouping patterns 59
immunoglobulin test 61
liquid-phase systems 61–62
recipient’s D type 59
recipient’s identity, verification of 58–59
solid-phase systems 62
weak and partial D recipients 59–60
ABO-incompatible bone marrow problems 325, 326
ABO system
biosynthesis and molecular genetics 22
clinical significance 20, 22
H antigen 22–23
acquired haemostatic defects
anticoagulant, thrombolytic drugs 274–275
cardiopulmonary bypass 275
coaugulation inhibitors 275–276
disseminated intravascular coagulation 271–273
liver disease 273–274
oral anticoagulants 274–275
thrombolytic agents 275
thrombotic thrombocytopenic purpura 275
trauma 273
uraemia 274
vitamin K antagonists 274
vitamin K deficiency 275
active immunisation 490
acute anaemia 288, 290, 334
acute chest syndrome 334, 450
acute haemorrhage and critical care
ANH 291–292
antifibrinolytics 292–293
autologous transfusion techniques 291–292
coagulopathy 293–294
desmopressin 293
erthropoietin 292
fibrinogen replacement 295–296
fresh frozen plasma transfusion 295
iron therapy 292
massive blood transfusion 298
mechanical cell salvage 292
PAD 291
PCCs 296–298
red cell transfusion 287–289
rFVIIa 293
treatment adjuncts 289–291
acute HTR (AHTR) see also haemolytic transfusion reactions (HTRs)
aetiology and incidence 85–87
clinical presentations 87
complications 87
definition 81
intra-vascular haemolysis 82
management 89–90
prevention 90–91
suspected 87–90
symptoms and signs 87
acute normovolaemic haemodilution (ANH) 291–292
acute respiratory distress syndrome (ARDS) 109–110
acute transfusion reactions
algorithm 77–78
blood component types 71
categories 69
clinical presentation 71–75
considerations 69, 76
definition 69
fever 76
investigation and treatment of 76–77
management strategies 77, 78
medications 71
patient history 71
screening tests 77
signs/symptoms of 69–70
volume of blood components 76
adaptive humoral immunity 125
adaptive immune cells 11–13
adaptive immunity 125
adverse transfusion reactions
plasma and cryoprecipitate 169
platelet concentrates 168–169
red blood cells 169
affinity maturation 14
Age of Blood Evaluation (ABLE) study 122
Age of Red Blood Cells in Premature Infants (ARIPI) study 120
allergic transfusion reactions 97
antipyretics and/or antihistamines, premedication with 104
clinical presentation 101–102
differential diagnosis 102
frequency 102
IgA-deficient blood components 105
leucocyte reduction 104
management 103–104
pathogenesis 102–103
prevention 104–105
washed components/plasma-reduced components 104–105
allogeneic cells 468
allogeneic stem cell transplant 456–457
allogeneic vs. autologous HSCT 466
alloimmunisation
haemoglobinopathies 336
HLA 322–324
red cell alloimmunisation 17–18
red cell antigens 324–327
α-thalassaemia syndromes 330–331
altruism-based blood donation 203
altruistic model 204
American Association of Blood Banks (AABB) 177, 288, 437–438
American Board of Internal Medicine (ABIM) 405
American Society for Apheresis (ASFA) 449
American Society for Histocompatibility and Immunogenetics (ASHI) 439
America's Blood Centers (ABC) 190, 563
7-aminoactinomycin 458
anaemia
and acute haemorrhage 287–288
and major surgery 393, 395
management strategies 387–389
of prematurity 372
anaemia of chronic disease (ACD) 396
anaphylactic reactions 101–102
anaphylactoid reactions 101–102
Anaplasma phagocytophilum 163
ankylosing spondylitis and HLA 41
anti-A and anti-B high titres 216
anti-A antibodies 82
anti-A,B antibodies 82
anti-B antibodies 82
antibodies
and complement-mediated blood cell destruction 16–17
HLA 18
complement-dependent cytotoxicity test 36–37
DNA sequencing 35, 36
ELISA technique 37
flow cytometric techniques 37
formation of 35–36
Luminex technique 37
antibody-coated cells 15
antibody effector functions 15–16
antibody screening test 60–61
antibody variability 14–15
anti-D antibodies 15
antifibrinolytics 292–293
antigen–antibody interaction 218
antigen-presenting cells (APC) 11
function of B-cells 13
MHC class II molecules of 12
antiglobulin test 61
anti-Jkɑ antibodies 82–83
anti-Luɑ antibodies 83
antithetical red cell antigens 27
APC see antigen-presenting cells (APC)
apheresis components 222–223
arboviruses 161
Augustine glycoprotein 26
autoantibody formation/hyper haemolytic crises 336
autoimmune haemolytic anaemia (AIHA)
cold antibody 315
drug-induced 315–316
paroxysmal cold haemoglobinuria 315
red cell transfusions 312
warm antibody 314–315
autoimmune neutropenia 55
autologous cells 467
autologous stem cell transplant 455
autologous transfusion techniques 291–292

\textit{b}

\textit{Babesia} infection 155, 163–164
Babesiosis 163
back/plasma typing test 59
BacT/ALERT* 3D system 171–172
bacterial contamination
blood collection and production process 170
blood donors 170
contaminant species 169
incidence 168
platelet concentrates 168–169, 172
prevention strategies
BacT/ALERT* 3D system 171–172
bacterial detection methods 171
BacTx colorimetric assay 173
donor screening 170
first aliquot diversion 171
Pall Bacterial Detection System 172
Pan Genera Detection immunoassay 173
pathogen reduction technologies 173
single donor apheresis vs. pooled platelet concentrates 171
skin disinfection 170–171
\textit{S. aureus} 168
septic transfusion reactions 168, 170
sources 170
BacTx colorimetric assay 173
B-cell activation 13
B-cell receptor (BCR) 13, 14
\textit{BCL11A} 9
β-thalassaemia syndromes
intermedia 331–332
major 332–333
trait 331
biological response modifiers (BRMs) 99, 112
biostatistics
confidence intervals 542
data analysis 536
considerations 536, 538–539
nonparametric methods 539–541
parametric methods 539, 540
regression analysis 539, 541
diagnostic tests
accuracy characteristics, $2 \times 2$ table 533, 534
disseminated intravascular coagulation score 533, 535
post-test disease probability 533, 536
pretest disease probability 533
statistical terms 533, 535
equivalence trials 543
forest plots 544–546
incidence and prevalence 533
meta-analysis 544
noninferiority trials 543
P values 542
statistical significance, determination of 542
superiority trials 543
blood-borne infections 255–256
blood collection agencies 560
blood components
administration of 243
adverse transfusion reactions 168–169
apheresis collection of 222–223
clinical use of 5–7
collection, delivery of 242
component modifications 230–231
patient’s identity band 243–244
prescription of blood 240
processing 222
production and storage
cryoprecipitate 228–229
granulocyte 229
plasma 227–228
platelet 226–227
red blood cell 223–225
specifications for 223
blood donations 2, 3
ABO blood group 215–216
adequate donor base 562
anti-A high titre 216
anti-B high titre 216
and iron deficiency 562
metabolomics 561–562
microbiological testing 217–219
pathogen reduction technology 561
quality framework, operational issues 220
red cell genomic testing 561
red cell serological testing 215–217
RhD blood group 215–216
screening tests on 219
blood donors
adverse events, reactions 204–205
collection/donation process 212–213
EHN/ISBT 206
eligibility requirements 562–563
in Europe 204
infections risks from 206–208
iron deficiency in 208, 212
obligations to 213
paid, directed, payback/altruistic
203–204
recruitment and retention of 2
risks to 204–206
supply and usage 255–256
blood groups
antigens, biological significance of
26–27
definition 20
human see human blood group
blood product safety initiatives 560
Blood Safety and Quality Regulations (BSQR) 2005
223
blood supply
fiscal sustainability 563–564
safe and adequate of 2
blood transfusion
and HLA 39
infectious agents, transmission of 153
regulatory aspects
agencies involved 186–189
application and enforcement 185–186
donor involvement 191
feedback 186
guiding principles and law 184–185
haemovigilance 186
inspection/accreditation/licencing 185–186
ISO standards 185
market surveillance 186
national statutory bodies 186, 190
other agencies 190
patient involvement 190–191
precautionary principle 185
professional organisations 190
public bodies 191
regulatory compliance 191
supranational agencies 190
threat surveillance 186
blood-transmitted infections 259–260
blood utilisation metrics 419
Blundell, James 1, 2, 4, 9
B-lymphocytes 13
bone marrow 457
failure 317–318
transplantation, 8 see also haematopoietic stem cell transplantation (HSCT)
Bonferroni correction 542
B19 parvovirus 155, 162
B-type natriuretic peptide (BNP) 111
C
carbohydrate antigens, on glycolipids and glycoproteins 43
cardiac surgery
leucocyte-reduced allogeneic red cell transfusions 128
POC technologies 304
RECESS study 565
cardiopulmonary bypass (CPB) surgery 275, 318
Cas9 8–9
cascade model, coagulation  264–265
case–control studies  509–511
Case Mix Index (CMI)  424
CD34+ enrichment  459
CD34+ enumeration  458
cell–based model, coagulation  264–265
CELEX™ system  451
cell separators  442–443
cellular immunotherapy
gene–modified T–cells  492–494
HPC transplantation  490–491
nonspecific T–cell immunotherapy  491
passive  496–497
translational research  497
tumour–restricted natural killer cell
immunotherapy  494–496
tumour–specific/tumour–restricted T–cell
immunotherapy  491–492

cellular therapy  8, 9
American Association of Blood Banks  437–438
CD34 cell expansion  568–569
challenges  439
chimeric antigen receptors  567–568
College of American Pathologists  438
European Union directives and
legislation  430–431, 433
FACT and JACIE  436–437
haematopoietic stem cell transplant activity
430–431
histocompatibility accreditation  439
Human Tissue Act 2004  433
immunotherapy  568
manufacturing issues  569–570
NetCord–FACT  437
nongovernmental (voluntary) accreditation
435–436
Provenge®  568
stem cell tourism  569
structure of SCT programmes  430–432
T–cell receptors  567–568
United States Food and Drug Administration
433–435
World Marrow Donor Association  438–439
Central Blood Bank (CBB)  250
centralised transfusion service (CTS)  250
Chagas’ disease  164
chikungunya virus  161–162
chimeric antigen receptor modified T–cells  492
chimeric antigen receptors (CARs)  567–568
chimerism  144
chronic anaemias  313
chronic GvHD  471
chronic transfusion support  7
class I HLA genes  29, 30
class II HLA genes  31–32
clinical and laboratory practice issues  248
clinical audit  246–247
clinical decision support (CDS)  405
effectiveness  409–410
historical approaches  409
Clinical Randomisation of an Antifibrinolytic in
Significant Haemorrhage (CRASH–2)
study  511, 513
clustered regularly interspaced short palindromic
repeats (CRISPR) technology  8–9
coagulation
cascade model of  264–265
cell–based model of  264–265
coagulopathy
diagnosis  293–294
fibrinogen replacement  295–296
fresh frozen plasma transfusion  295
injury  281
PCCs  296–298
platelet transfusion  294–295
cohort studies  510–511
cold antibody AIHA  315
Colton glycoprotein  26
column–agglutination blood grouping
technology  62
common variable immunodeficiency (CVID)
358–360
comparative effectiveness research (CER)  526
complement activation, pathways for  15, 16
complement–dependent cytotoxicity (CDC) test
36–37
complement–mediated blood cell destruction
16–17
computerised physician order entry (CPOE)
systems  295–385
confidence intervals  524, 542
confounding by indication  424
Coombs’ test see antiglobulin test
cost analysis 551
cost-benefit analysis 553
cost-effectiveness analysis 553
cost minimisation analysis 553
cost-utility analysis 553
Coxiella burnetii bacterium 163
CRISPR-associated genes (cas) 8
CRISPR technology see clustered regularly interspaced short palindromic repeats (CRISPR) technology
crossmatching techniques 63–64
crossmatch-to-transfusion ratio 424
cryoprecipitate 66, 295
and plasma 169
production and storage 228–229
cryopreservation, of HPC freezing cellular products 462
product preservation 460–462
red cell removal 462
cytomegalovirus (CMV) 160–161, 319–321
cytotoxic T-cell therapy 473
d
DAT see direct antiglobulin test (DAT)
data analysis, biostatistics 536
considerations 536, 538–539
nonparametric methods 539–541
parametric methods 539, 540
regression analysis 539, 541
decellularised tissues 504–505
deferasirox 338
deferoxamine 337–338
delayed haemolysis 93
delayed HTR (DHT) see also haemolytic transfusion reactions (HTRs)
aetiology and incidence 91
definition 81
extravascular haemolysis 82
haemolysis 93
management 92
prevention 92–93
sickle cell disease 93–94
signs and symptoms 92
suspected 92
delayed-onset HIT 345–346
delayed serological transfusion reaction (DSTR) 91
descriptive statistics 536
desmopressin 293
diagnostic tests, biostatistics
accuracy characteristics, 2 × 2 table 533, 534
disseminated intravascular coagulation score 533, 535
post-test disease probability 533, 536
pretest disease probability 533
statistical terms 533, 535
Diego antigen 26
dimethyl sulfoxide (DMSO) 462, 463
direct antiglobulin test (DAT) 216–217
direct medical and nonmedical expenses 551, 552
disability-adjusted life-years (DALYs) 553
disease/case frequency measurements 533, 534
disseminated intravascular coagulation (DIC) 87, 318
causes of 272
ISTH 272
laboratory abnormalities 271
score 533, 535
DNA sequencing 34–36
DOMAINE donor management in Europe Project 204
Dombrock glycoprotein 27
donor lymphocyte infusions 457
Donor Management Manual 204
donor screening 170
drug-dependent antibodies (DDAbs) 46, 48
drug-dependent antigens 43
drug-induced AIHA 315–316
drug-induced immune neutropenia (DIIN) 55
Duffy system 25–26
dysfibrinogenaemia 273
e
EBM see evidence-based medicine (EBM)
EHN see European Haemovigilance Network (EHN)
EHN/ISBT Working Group 206
electronic health records (EHR) 405
electronic medical record (EMR) 416
electronic PBM (ePBM) performance measures 426
electronic red cell issue 63
emerging infections see also transfusion-transmitted infections (TTIs)

- awareness 177
- blood safety 177
- definition 176
- disease severity 180
- donor blood, infectivity test 181
- factors 176
- interventions 181–182
- outbreak 180
- pathogen reduction method 181–182
- precautionary principle 182
- risk assessment 177, 179, 180
- transfusion transmission, recognition of 180–181
- transmissible by blood transfusion 176–178
- XMRV recognition and management 180
- endogenous antigen-constituting self-antigens 12
- enzyme immunoassay (EIA) screening 255
- enzyme-linked immunosorbent assay (ELISA) technique 37
- enzyme method 61
- Epstein–Barr virus (EBV) 161, 473
- equivalence trials 543
- European Commission 186, 190
- European Haemovigilance Network (EHN) 204, 206
- The European Union Tissue and Cells Directives (EUTCD) 500
- evidence-based medicine (EBM) 530
  - comparative effectiveness research 526
  - critical appraisal process 521–522
  - description 520
  - limitations 529
  - narrative reviews 522
  - systematic reviews 522–526
- evidence base, for transfusion medicine
  - activated recombinant factor VII 528, 529
  - platelet transfusions 527–528
  - Transfusion Evidence Library 527
  - transfusion practices 528
- external quality assessment (EQA) schemes 248
- extracorporeal photochemotherapy (ECP) 451
- extravascular haemolysis 82

f

- Fagan nomogram 536, 537
- fatal haemolytic transfusion reactions 87, 88
- FDA Good Tissue Practice (GTP) Regulations 433
- febrile non haemolytic transfusion reactions (FNHTRs) 39
  - antibody mechanism 99
  - biological response modifiers 99
  - blood component factors 99
  - clinical presentation 97
  - definition 97
  - differential diagnosis 97–98
  - frequency 98–99
  - human neutrophil antigens 54–55
  - management strategy 100
  - pathogenesis 99
  - patient susceptibility factors 99
  - platelets 101
  - premedication 101
  - prevention 101
  - red cells 101
- fibrinogen replacement 295–296
- flow cytometric techniques 37
- Food and Drug Administration (FDA)
  - fatal haemolytic transfusion reactions 87, 88
  - TRALI 108
- Foundation for Accreditation of Cell Therapy (FACT) 436–437
- fresh frozen plasma (FFP) 112, 227, 448
  - transfusion 295
- front/cell typing test 59
- frozen plasma 566
  - components 227–228
- functional iron deficiency (FID) 396
- FUT1 and FUT2 23

G

- galactose (Gal) 22
- gastrointestinal 287
- gene-modified T-cells 492–494
- genotyping 4
- Glanzmann's thrombasthenia 303
- global blood safety report 254
- global context, blood transfusion
  - blood products 256–257
  - blood-transmitted infections 259–260
- Ebola pandemic in West Africa 261
financial requirements 260
future of 261–262
improvements 258–261
safety and supply 254–255
sub-Saharan Africa 257–258
supply and usage 255–258
testing blood products 255
transfusion practice 260–261
good manufacturing practice (GMP) 185, 446, 451, 497, 569
The Grading of Recommendations Assessment, Development and Evaluation (GRADE) tool 526
graft-versus-host disease (GVHD), 199 see also transfusion-associated graft-versus-host disease (TA-GVHD)
granulocyte antigens 43
granulocyte chemiluminescence tests 54
granulocyte colony-stimulating factor (G-CSF) 229, 318, 443
granulocyte immunofluorescence test by flow cytometry (GIFT-FC) 54
granulocyte production and storage 229
granulocyte transfusions 318–319

h
haematological disease complications 319–327
granulocyte transfusions 318–319
platelet transfusions 316–318
red cell transfusions 312–316
haematopoietic progenitor cell mobilisation 443–445
haematopoietic stem cell transplantation (HSCT) 317, 429
allogeneic cells 468
autologous cells 467
complications 470–472
cytotoxic T-cell therapy 473
donor care and selection 468
early post-engraftment 471–472
graft-versus-host disease 470–471
immediate post-HSCT 471
indications 467
infectious complications 471–472
late effects 472
outcome 472–473
post-bone marrow transplant chimerism 473
principles 466
reduced intensity conditioning transplants 470
regimen-related toxicity 470
registry data 472–473
regulatory aspects 473
rejection 470
relapse 471
sources of stem cells 467–469
stem cell collection 468–470
syngeneic cells 468
transplant activity 430–431
haemoglobin (Hb) Bart’s hydrops fetalis 331
haemoglobin-based oxygen carrier (HBOC) 567
haemoglobinopathies 331–333
α-thalassaemia syndromes 330–331
β-thalassaemia syndromes 331–333
iron chelation 337–338
SCD 333–336
transfusions in 336–337
haemolysis
acute haemolysis, from ABO-incompatible platelet transfusions 94
haemopoietic stem cell transplantation 93
haemolytic transfusion reactions (HTRs)
antibody specificities 85
definition 81–82
in sickle cell disease 93–94
pathophysiology
anti-A antibodies 82
anti-A,B antibodies 82
anti-B antibodies 82
antigen–antibody interactions 82
anti-Jka antibodies 82–83
anti-Lu antigens 83
complement activation 83–84
cytokines 84–85
Fc receptor interactions 84
haemophilia A 266–269
haemophilia B 269–270
haemopoietic progenitor cells (HPCs)
ABO incompatibility 459
allogeneic stem cell transplant 456–457
ambient temperature 460
7-aminoactinomycin 458
autologous stem cell transplant 455
bone marrow 457
haemopoietic progenitor cells (HPCs) (cont’d)
  CD34+ enrichment 459
  CD34+ enumeration 458
cryopreservation 460–462
donor lymphocyte infusions 457
  human 455, 456
laboratory processing procedures 460, 461
peripheral blood 457–458
quality assurance 463
sterility testing 459
storage requirements 460
T-cell depletion 460
terminology 455
thawing 462–463
transplant procedures 455–457
trypan blue 458
umbilical cord blood 458
in vitro HPC assays 458–459
haemopoietic stem cell transplantation 361
  haemolysis from 93
  and HLA 38–39
haemorrhage see also acute haemorrhage and
  critical care
  major 399–400
  protocols 298
  urgent transfusion during 7
haemorrhage-related mortality injury 280–281
haemostasis 8
  of abnormal 266–268
  clinical manifestations, treatment of 268
  normal 264–265
screening tests 266
haemovigilance programmes 248
haemovigilance, transfusion safety
  adverse event detection, reporting 194, 196
  breadth of 197
  data management 198
  future directions 200
  goal of 193
  incident reports 197
  intangible benefits 200
  learning from experience 199–200
  limitations of 196–197
  origin and structures 193–194
  reporting requirements structure 198
  terminology 194–195
  timeline of 193–194
haploidentical donors 468
haploidentical SCT 457
haplotypes 33
HbH disease 330
Health Canada 190
health economics
  economists view 549–550
  healthcare costs, within US 549
  in transfusion medicine, evaluation of
    cost analysis 551
    cost-benefit analysis 553
    cost-effectiveness analysis 553
    cost minimisation analysis 553
    cost-utility analysis 553
    design 550–553
    direct medical and nonmedical expenses
      551, 552
    incremental cost-effectiveness ratio 555
    intangible costs 551–552
    Markov models 556
    model analysis 553–556
    monetary outcomes 553
    net cost and net effectiveness calculation 554
    one-way sensitivity analysis 556
    probabilistic sensitivity analysis 556
    two-way sensitivity analysis 556
health research studies 520
Hemocue® 398
haemopoietic chimerism 144
HemosIL AcuStar HIT-IgG(PF4-H) 351
HemosIL HIT-Ab(PF4-H) 350–351
heparin-induced thrombocytopenia (HIT) 48
  clinicopathological syndrome
    Iceberg model 344–345
    pretest probability score 346–348
    thrombocytopenia 345
    thrombosis and other sequelae 346
    timing 345–346
epidemiology 343–344
laboratory testing
  PF4-dependent immunoassays 349–351
  platelet activation assays 347, 349
  washed platelet activation assays 347
pathogenesis 341–343
  treatment
    adjunctive therapies 353
    heparin exposure 353
management of isolated HIT 353
prevention of warfarin-induced venous limb gangrene 351–353
rapidly acting, non-heparin anticoagulants 351–352
hepatitis A virus 155, 157
hepatitis B virus 157–158
hepatitis C virus 158
hepatitis D virus 158
hepatitis E virus 158–159
hereditary haemochromatosis (HH) 29, 40
high-dose intravenous immunoglobulin (IVIgG) 353
high-resolution (HR) molecular typing 457
high-throughput HPA SNP typing techniques 46
histo-blood group system see ABO system
histocompatibility accreditation 439
HNA-1 52–53
HNA-2 53
HNA-3 53
HNA-4 and HNA-5 54
hospital blood transfusion
administration of 239–243
clinical audit 246–247
CTS 250–251
education, continuing professional development 249–250
governance of 235–236
guidelines, algorithms and protocols 245–246
HTCs 236
improve process to 236–238
influencing clinical practice 244–245
informed consent 238–239
litigation of 248–249
MSBOS 251–252
national schemes 248
patient misidentification errors in 243–244
SHOT 249
steps in 233–234
surveys 247–248
warning message 247
hospital transfusion committees (HTCs) 236–238
hospital transfusion process 233–234
human blood group
ABO system 20, 22–23
Duffy system 25–26
Kell system 25
Kidd system 26
MNS system 26
Rh system 23–24
systems 20, 21
human herpes virus 8 161
human immunodeficiency virus 155, 159–160
human leucocyte antigens (HLAs)
alloimmunisation 322–324
and blood transfusion 39
and haemopoietic stem cell transplantation 38–39
and solid organ transplantation 38
ankylosing spondylitis 41
antibodies 18
complement-dependent cytotoxicity test 36–37
ELISA technique 37
flow cytometric techniques 37
formation of 35–36
Luminex technique 37
class I genes 29, 30
class II genes 31–32
direct allorecognition pathways 38
DNA sequencing 35, 36
genetics 32–33
hereditary haemochromatosis 29, 40
HLA molecules, expression of 32
HLA molecules, function of 33
indirect allorecognition pathways 38
Klebsiella infection 41
neonatal alloimmune thrombocytopenia 41
nomenclature 34
PCR sequence-specific oligonucleotide probe 35
PCR sequence-specific priming 35
polymorphisms 33
recognised serologically defined antigens/alleles 34
subregions 29, 30
human neutrophil antigens (HNAs) 53
autoimmune neutropenia 55
detection 54
drug-induced immune neutropenia 55
febrile nonhaemolytic transfusion reactions 54–55
HNA-1 52–53
HNA-2 53
human neutrophil antigens (HNAs) (cont’d)
  HNA-3  53
  HNA-4 and HNA-5  54
neonatal alloimmune neutropenia  54
persistent post-bone marrow transplant neutropenia  55
transfusion-related acute lung injury  55
human platelet antigens (HPAs)  45
 alloantibodies
  clinical significance  48, 50–52
detection  48
autoantigens  46, 48
drug-dependent antigens  46, 48
GPIIb subunit  43
GPIIIa subunit  43
inheritance and nomenclature  44, 46
platelet isoantigens  46, 48
platelet membrane and glycoprotein
  representation  46, 47
typing for  46
  von Willebrand factor  43, 44
Human Tissue Act  500
Human Tissue Act 2004  433
human T-lymphotropic viruses 1 and 2  160
humoral immune response  13–15
Hurler’s syndrome  481
hyperhaemolytic transfusion reactions (HHTRs),
in sickle cell disease  93–94
hypotensive transfusion reaction  195

i
Iceberg model  344–345
IgA-deficient blood components  105
IgG-mediated process  15
immune blood disorders  313–314
  immune-mediated graft-versus-tumour (GvT)
    effect  466
immunohaematology  4–5
IMPACT Online  420
implicated donor  114
implicit association test (IAT)  61
incompatible transfusion, reasons for  85
incorrect blood component transfusion (IBCT)  86, 87
incremental cost-effectiveness ratio (ICER)  555
inflammatory aetiology  302
informing fresh-versus-old red cell management
  (INFORM) pilot trial  122, 526
inherited coagulation disorders
  abnormal haemostasis  266
  haemophilia A  266–269
  haemophilia B  269–270
  normal haemostasis  264–265
  other disorders  271
TEG  266–267
VWD  270–271
innate immune cells  11
innate immunity  125
intangible costs  551–552
INTERCEPT™ Blood System  173
International Classification of Disease (ICD-9)
  codes  424
International Haemovigilance Network (IHN)  193, 197
International Society for Thrombosis and
  Haemostasis (ISTH)  272
International Society of Blood Transfusion (ISBT)  194–195, 206, 216
International Standards Organization (ISO)
  standards  185
intravascular haemolysis  82
investigational medicinal products (IMPs)  497
in vitro HPC assays  458–459
iron therapy  292
irradiated red cell units  378

dose-related adverse effects  366–367
immediate infusion-related adverse
  effects  366
intravenous immunoglobulin  364–365
product selection and safe use  367
risks of viral transmission  367
secondary antibody deficiency  365–366
subcutaneous immunoglobulin  363, 367–369
use of IVIg  364

immunoglobulin therapy
irradiation, TA-GVHD
  adverse effects 138, 139
  guidelines and requirements 143–144
  universal 144
ISBT see International Society of Blood Transfusion (ISBT)

j
Joint Accreditation Committee of the ISCT and EBMT (JACIE) 436–437

k
Kell system 25
Kidd glycoprotein 26
Kidd system 26
killer immunoglobulin-like receptors (KIRs) 33, 494, 495

l
The Lancet (Blundell) 1
Landsteiner, Karl 1, 2
leucapheresis 455, 457
leucocytapheresis 446–447
leucocyte inactivation methods 137, 138
leucocyte/platelet-derived biological response modifiers 99
leucocyte-reduced allogeneic red cell transfusions 128
leucocyte reduction 226
light transmission aggregometry (LTA) 303
limbal stem cells 505
liquid nitrogen, cryopreservation in 8
liquid-phase systems 61–62
liver disease 273–274
low ionic strength solution (LISS) 61
low-resolution (LR) typing 456
Luminex technique 37
lung histology 113

m
MAIPA assay see monoclonal antibody
  immobilisation of platelet antigens (MAIPA) assay
major ABO-incompatible transplants 93
major haemorrhage 399–400
major histocompatibility complex (MHC) class molecules 11–12
malaria 163–164
malignant disease 480–481
Markov models 556
massive blood loss
  burden of 279–280
  coagulopathy after injury 281
  conventional blood products 282–283
  damage control resuscitation 283–284
  definition of 279
  haemorrhage-related mortality injury 280–281
  other situations 284
  in small children 284
massive blood transfusion 298, 318
maximum allowable storage duration, for red cells 118
maximum surgical blood ordering schedule (MSBOS) 251–252, 386, 424
mechanical cell salvage 292
Medicines and Healthcare products Regulatory Agency (MHRA) in the UK 186
membrane attack complex (MAC) 15
membrane-bound molecules 17
mesenchymal stem cells (MSCs) 567
metabolic disorders 481
metabolomics 561–562
8-methoxypsoralen (8-MOP) 451
microbiological test, blood donations
  infectious disease testing 218–219
  repeat reactive sample 217–218
  samples 217
  screening tests on 219
  testing process, donor management 217
microchimerism (MC) 144
mild non-systemic allergic transfusion reactions 103
minimal clinically important difference (MCID) 516
minimally important difference (MID) 516
minor ABO-incompatible transplants 93
Mirasol® system 173
MNC-apheresis 457
MNS system 26
moderate non-systemic allergic transfusion reactions 103
Mollison, Patrick 1, 2
monoclonal antibodies 218
monoclonal antibody immobilisation of granulocyte antigens (MAIGA) assay 54
monoclonal antibody immobilisation of platelet antigens (MAIPA) assay 48, 49, 149
mononuclear cell-impregnated biodegradable scaffolds 567
mononuclear phagocytic system 17
Mozobil 445
multiorgan failure syndrome (MOFS) 335
myasthenia gravis 447, 449
myeloablative treatment 313
myelosuppressive treatment 313

n
N-acetylgalactosamine (GalNAc) 22
narrative vs. systematic reviews 522
NAT see nucleic acid testing (NAT)
National Health Service Blood and Transplant (NHSBT) 215, 216, 395, 550, 560–562
national transfusion service in Nigeria 259
natural killer (NK) cells 33
negative selection process 12
neonatal alloimmune thrombocytopenia (NAIT)
antenatal management 51–52
clinical features 50
counselling 52
definition and pathophysiology 50
differential diagnosis 50
history 48
and HLA 41
incidence 50
laboratory investigations 50–51
neonatal management 51
neonatal transfusion medicine 7
NetCord-FACT 437
next-generation advances, in blood donations 561–562
non-ABO AHTRs, prevention of 91
nongovernmental (voluntary) accreditation 435–436
noninferiority trials 543
noninvasive HPA genotyping assays 46
nonspecific T-cell immunotherapy 491
non-systemic allergic transfusion reactions 101, 103
nucleic acid amplification method 502
nucleic acid testing (NAT) 158, 159, 161, 163, 217–219, 255

o
obstetric transfusion medicine 7
Omenn syndrome 484
one-way sensitivity analysis 556
oral anticoagulants 274–275

p
PAD see preoperative autologous donation (PAD)
paediatric transfusion medicine 7
Pall Bacterial Detection System 172
Pan American Health Organization (PAHO) 190
Pan Genera Detection immunoassay 173
paraproteinaemia 449
parasitic diseases 163–164
paroxysmal cold haemoglobinuria 315
paroxysmal nocturnal haemoglobinuria (PNH) 316
partial thromboplastic time 281, 283
passenger lymphocyte syndrome 93
passive cellular immunotherapy, of infectious disease 496–497
passive immunisation 490
pathogen reduction technology 173, 561
patient assessment and treatment planning 443
patient blood management (PBM) 236
alternative blood transfusion methods and systems 387
anaemia management strategies 387–389
blood management education, awareness and auditing for clinicians 388, 390
blood utilisation metrics 419
clinical outcome data 421–424
cost of blood 388, 391
crossmatch-to-transfusion ratio 424
data extraction, analysis and presentation 421–423
data variables 416–417
electronic medical record 416
iatrogenic blood loss limitation 388
initiatives 560
preoperative anaemia screening and management 425–426
risk adjustment 424–425
sources of data 419–421
waste reduction 385–387
patient-centred care 238
patient’s identity band 243–244
Paul Ehrlich Institute (PEI) in Germany 186
PBM see patient blood management (PBM)
PCCs see prothrombin complex concentrates (PCCs)
perioperative patient blood management see also patient blood management (PBM)
anæmia and major surgery 393, 395
intraoperative management 398–399
major haemorrhage 399–400
pathways to surgery 401
post-operative patient blood management 399, 401
preoperative optimisation 395–398
three-pillar, nine-field matrix 393–394
peripheral blood 457–458
HPC collection 446–447
progenitor cell transplants 325, 326
peripheral blood cells, antigen expression on 43, 44
peripheral blood progenitor cells (PBPC) 429
peripheral blood stem cell (PBSC) 468, 470
persistent post-bone marrow transplant neutropenia 55
PF4-dependent immunoassays
enzyme-linked immunosorbent assays 349
fluid-phase immunoassays 349
instrumentation-based immunoassays 350–351
particle-based solid-phase immunoassays 349–350
phagocytes 11, 15, 32, 84
photopheresis see extracorporeal photochemotherapy (ECP)
physiological anaemia of infancy 372
PIDs see primary immunodeficiency disorders (PIDs)
PLADO trial 6
plasma and cryoprecipitates
adverse transfusion reactions 169
Burkholderia cepacia 169
Pseudomonas aeruginosa 169
plasma coagulation factors 282
plasma component selection 65–66
plasma exchange 447–450
plasma production and storage 227–228
Plasmodium falciparum 163, 164
platelet concentrates 172
adverse transfusion reactions 168–169
propionibacteria 169
Staphylococcus epidermidis 169
Platelet Dose (PLADO) trial 513
platelet immunofluorescence test (PIFT) 48
platelet-rich plasma 226
platelets
additive solutions 227
component selection 65–66
production and storage 226–227
storage lesion 227
platelet therapy 566
platelet transfusions 294
bone marrow failure 317–318
cardiopulmonary bypass surgery 318
causes of 323
DIC 318
HLA alloimmunisation 322–324
immune thrombocytopenias 318
massive blood transfusion 318
physiology and pathophysiology 378–379
platelet products to transfuse 380
practices 379–380
Plerixafor 445
point-of-care (POC) testing
conventional coagulation testing 302–303
options of 303–307
platelet function 303–304
rotational thromboelastometry 306–307
ROTEM 306–307
TEG 304–306
in transfusion algorithms 307–309
viscoelastic testing 304
polymerase chain reaction sequence-specific oligonucleotide probe (PCR-SSOP) 35
polymerase chain reaction sequence-specific priming (PCR-SSP) 35, 46
post-bone marrow transplant chimerism 473
post-operative patient blood management 399, 401
posttransfusion purpura (PTP)
clinical features 148
definition 147
differential diagnosis 148
high-dose intravenous immunoglobulin 150
HPA-1a antibodies 148
posttransfusion purpura (PTP) (cont’d)
  human leucocyte antigen antibodies 148
  incidence 147
  laboratory investigations 148–149
  MAIPA assay 149
  pathophysiology 149
  platelet transfusions 150–151
  recurrence 151
  time course 149
  treatment 149
posttransplant transfusions 325
Pragmatic Randomized Optimal Plasma and Platelet Ratios (PROPPR) trial 283
predominant B-cell deficiency disorders
  common variable immunodeficiency 358–360
  severe combined immunodeficiency 361–362
  X-linked agammaglobulinaemia 360–361
preoperative anaemia screening and management 425–426
preoperative autologous donation (PAD) 291, 386
pretransfusion compatibility testing 241
goal of 58
  plasma component selection 65–66
  platelets component selection 65–66
  red blood cell selection 64–66
priapism 335
primary immunodeficiency disorders (PIDs) 357–358
investigation of suspected immunodeficiency 362–363
management 363
predominant B-cell deficiency disorders
  common variable immunodeficiency 358–360
  severe combined immunodeficiency 361–362
  X-linked agammaglobulinaemia 360–361
primary immunodeficiency syndromes 481, 484
probabilistic sensitivity analysis 556
process issues 248
progressive organ failure 335
ProMED Mail 177
prostatic acid phosphatase (PAP) 568
protein antigens 43
prothrombinase 264
prothrombin complex concentrates (PCCs) 296–298
protozoan parasites 155
PTP see posttransfusion purpura (PTP)
pulmonary infiltrates 108
P values 542, 543
q
quality-adjusted life-years (QALYs) 553
r
randomised controlled trials (RCTs) 288, 509
  ABLE study 122
  ARIP study 120, 121
  autologous transfusions 127
  cluster design 514
  Cochrane Collaboration’s database 527
  crossover design 514
  design challenges 521
  design considerations 511, 512
  efficacy and effectiveness trial 511–513
  external validity 511
  factorial design 514
  history 508
  INFORM trial 122
  leucocyte-reduced red cell transfusions 127
  Multiple Organ Dysfunction Score 122
  outcomes 515–517
  parallel group design 513–514
  planning suggestions 517
  RECESS 122
  of red cell storage duration 120–121
  restrictive red cell transfusion thresholds 127, 128
  statistical efficiency 511
  study population, choice of 514–515
  TRANSFUSE trial 122
  rapidly acting, non-heparin anticoagulants 351–352
  rapid-onset HIT 345
  RBC transfusion 5, 6
  RCTs see randomised controlled trials (RCTs)
  recombinant activated Factor VII (rFVIIa) 293
  recombinant erythropoietin (RhEpo) 313
  recombinant human erythropoietin 292, 397
  red blood cell (RBC)
    serological testing
      ABO, RhD blood group 215–216
      supplementary test 216–217
    storage duration and immunomodulation 130
Index

red blood cells (RBCs)

adverse transfusion reactions 169
alloimmunisation 17–18
antibodies 15–16
antigens 5, 324–327
blood components 282
components 223–224
exchange 450–451
genomics 4
genomic testing 561
massive blood loss 279
production and storage 223–225
storage
maximum allowable storage duration 118
randomised controlled trials 120–122
in vitro changes 118–119
Yersinia enterocolitica 169
red blood cells (RBCs) selection see also ABO blood groups
ABO-compatible red cells 64
recommendations 65
uncrossmatched red cell usage 64–65
unexpected antibodies 64, 68
red blood cell (RBC) transfusions 16, 112
AIHA 312
anaemia and acute haemorrhage 287–288
chronic anaemias 313
immune blood disorders 313–314
indications for 288–289
irradiated red cell units 378
myelosuppressive/myeloablative treatment 313
physiology and pathophysiology 372–373
PNH 316
practices 373–376
prevention of transfusion-transmitted
cytomegalovirus 377–378
red cell products to transfuse 376–377
RhEpo 313
Red Cell Storage Duration Study (RECESS) 122, 565
reduced intensity conditioning (RIC) regimens 486
reduced intensity conditioning (RIC) transplants 456, 470
regenerative medicine and tissue processing
decellularised tissues 504–505
limbal stem cells 505
tracheal transplants 505
restrictive transfusion practice
accreditation agencies 405
clinical decision support 405
effectiveness 409–410
historical approaches 409
clinical practice guidelines 408–409
educational interventions 409
future directions 413
key clinical trials 406–407
Stanford experience 410–413
RhD blood group 215–216
Rhesus D-incompatible transplants 327
Rh system
anti-D 24
C/c and E/e antigens 24
D antigen 24
fetal Rh phenotype prediction 24
genes and proteins 23
risk-based decision making (RBDM) 563
rotational thromboelastometry (ROTEM) 306–307
ROTEM® 398
SaBTO (Advisory Committee on the Safety of Blood, Tissues and Organs) 320
safe transfusion practice 243, 245
secondary stroke prevention 335
septic transfusion reactions 170
Serious Hazards of Transfusion (SHOT) confidential reporting scheme 86
Serious Hazards of Transfusion (SHOT) haemovigilance scheme 81
severe combined immune deficiency (SCID) syndrome 361–362, 484
severe non-systemic allergic transfusion reactions 103
short tandem repeat DNA sequences see clustered regularly interspaced short palindromic repeats (CRISPR) technology
sickle cell anaemia 7
sickle cell disease (SCD)
acute complications of 334–335
indications for regular transfusion in 335
preoperative blood transfusion 336
transfusions not indicated 335
types of 333
sickle cell haemolytic transfusion reaction 93–94
(sCHTR) syndrome
silent cerebral infarct (SIT) 335
single donor apheresis vs. pooled platelet concentrates 171
skin disinfection 170–171
solid organ transplantation
and HLA 38
recipients 143
solid-phase blood grouping technology 62
solvent–detergent (SD) method 113
somatic hypermutations (SHM) 14
Stanford Health Care (SHC) 410

Staphylococcus aureus contamination 168
stem cell collection and therapeutic apheresis
cell separators 442–443
complications 451–452
extracorporeal photochemotherapy 451
haemopoietic progenitor cell mobilisation 443–445
patient assessment and treatment planning 443
peripheral blood HPC collection 446–447
plasma exchange 447–450
red cell exchange 450–451
sterility testing, HPC 459
storage requirements, HPC 460
Strengthening the Reporting of Observational Studies in Epidemiology (STROBE)
framework 522
stroke 334, 335
Stroke Prevention in Sickle Cell Anaemia (STOP) trial 511
stromal-derived factor 1 (SDF-1) 444, 445, 457
subcutaneous immunoglobulin 363, 367–369
superiority trials 543
suspected AHTR
laboratory investigation 89, 90
medical staff, actions for 89
nursing staff, actions for 87, 89
suspected DHTTR 92
suspected TTI, investigation of 154
syngeneic cells 468
systematic reviews 530
confidence intervals 524
critical appraisal process 524–526
evaluation 526
hypothetical forest plot 524, 525
meta-analysis 524
vs. narrative reviews 522
rules 522–524
validity assessment 524–525
systemic allergic transfusion reactions 101

T
TA-GVHD see transfusion-associated graft-versus-host disease (TA-GVHD)
Taqman assays 46
T-cell apheresis 457
T-cell-dependent antibody formation 13
T-cell depletion 460
T-cell receptors (TCRs) 11–12, 567–568
T-cell receptors (TCRs) gene transfer 492–494
TCR see T-cell receptors (TCRs)
TEG see thromboelastography (TEG)
thawing, of cryopreserved HPCs 462–463
T helper (Th) Cells 12–13
THERAKOS™ system 451
Therapeutic Goods Administration (TGA) in Australia 186
thrombocytopenia 345
Thromboelastogram (TEG™) 266–267
thromboelastography (TEG) 304–306
thromboembolectomy 353
thrombolytic agents 275
thrombolytic therapy 353
thrombosis 346
thrombotic thrombocytopenic purpura (TTP) 227, 275, 448
tick-borne Rickettsia-like bacteria 163
tissue allografts 504
tissue banking
adverse events and reactions 504
allografts, indications for 504
clinical applications 504
consent 500–501
donor selection and testing 501–502
regulation 500
supply and traceability 503–504
tissue processing 503
tissue procurement 502–503
T-lymphocytes 11–12
TOPPS trial 6–7
tracheal transplants 505
TRALI see transfusion-related acute lung injury (TRALI)
tranexamic acid (TXA) 259, 271, 284, 292, 293, 298, 299, 398, 567
transcranial Doppler (TCD) scans 335
transfusion algorithms 307–308
transfusion-associated circulatory overload (TACO) 98, 110–112, 197, 199, 239, 246
transfusion-associated dyspnoea (TAD) 112, 293
transfusion-associated graft-versus-host disease (TA-GVHD) 39, 142, 321
in allogeneic and autologous HSC transplant recipients 141
in aplastic anaemic patients 141
blood component factors
  age of blood 138, 140
  cellular blood components 140
  leucocyte dose 140
bone marrow 137
in Campath recipients 141
in chronic lymphocytic leukaemia patients 141
clinical features 136–137
in congenital immunodeficiency patients 140–141
definition 136
development 136
diagnosis 137
in fætuses and neonates 141
in fludarabine recipients 141
γ-irradiation 137
haemovigilance 144
in HIV/AIDS patients 143
in immunocompetent patients 143
ionising radiation, source and dose of 137–138
irradiation
  adverse effects 138, 139
  guidelines and requirements 143–144
  universal 144
in leukaemia and lymphoma patients 141, 142
leucocyte inactivation methods 137, 138
liver biopsy 137
pathogenesis 136
pathogen inactivation technologies 137
in patients receiving chemotherapy and immunotherapy 141, 143
polymerase chain reaction-based HLA typing 137
skin biopsy changes 137
in solid organ transplantation recipients 143
treatment 137
transfusion-associated septic events 168, 170
transfusion immunomodulation
  allogeneic transfusions 130, 131
  animal models 126
  description 125
  effects 130, 131
  experimental studies 130–132
  history 125–126
  leucocyte-reduced allogeneic red cell transfusions 128
  mitigation after red cell transfusion 126–128
in observational and cohort studies 128–130
and red cell storage duration 130
transfusion medicine
  alternatives 566–567
  case–control studies 509–511
  clinical practice 565–566
  cohort studies 510–511
  complications 564–565
  hospital service and patient care perspectives 564–567
  immunohaematology 564
  neonatal and paediatric transfusions 565
  observational studies 509–511
  origins of 1
  randomised controlled clinical trials see randomised controlled trials (RCTs)
  range of disciplines 1, 2
  risks of 3–4
transfusion-related acute lung injury (TRALI) 3, 39, 199
  blood component types 113–114
  chest x-rays of 110
  clinical manifestations 109–110
  definition of 108
  diagnosis 109–112
  human neutrophil antigens 55
  lung histology 113
  mitigation strategies 114
  pathogenesis 112–113
  patient management 114–115
  and risk factors 108–109
Index

Transfusion Requirements after Cardiac Surgery (TRACS) 406
Transfusion Requirements in Critical Care (TRICC) trial 6, 406, 418, 513
transfusion resources 1, 2
transfusion-transmitted infections (TTIs) 196, 258
Anaplasma phagocytophilum 163
arboviruses 161
Babesia infection 155, 163
bacteria 163
B19 parvovirus 155, 162
chikungunya virus 161–162
control methods 156–157
Coxiella burnetii bacterium 163
cytomegalovirus 160–161
donor prevalence rates 156
Epstein–Barr virus 161
hepatitis A virus 155, 157
hepatitis B virus 157–158
hepatitis C virus 158
hepatitis D virus 158
hepatitis E virus 158–159
human herpes virus 8 161
human immunodeficiency virus 155, 159–160
human T-lymphotropic viruses 1 and 2 160
parasitic diseases 163–164
P. falciparum 163, 164
protozoan parasites 155
risks of 3
suspected TTI, investigation of 154
T. cruzi infection 155, 164
tick-borne Rickettsia-like bacteria 163
Treponema pallidum 163
variant Creutzfeldt–Jakob disease prion 156, 164
West Nile virus 161
trauma resuscitation strategies 280
Treponema pallidum 163
trypan blue (TB) 458
Trypanosoma cruzi infection 155, 164
tumour-associated antigens (TAAs) 491, 492
tumour-restricted natural killer cell immunotherapy 494–496
tumour-specific antigens (TSAs) 491, 492
tumour-specific/tumour-restricted T-cell immunotherapy 491–492
twentieth-century transfusion 1
two-way sensitivity analysis 556
typical-onset HIT 345
U
UK Blood Transfusion Services 223
umbilical cord blood 458, 468
advantages and disadvantages 484, 485
banking 478–479
donor recruitment, selection and consent 478, 479
future developments 484, 486
limitation 481, 484
reduced intensity conditioning regimens 486
testing 478, 480
transplantation 477
with HSC in adult patients 481, 483
with HSC in paediatric patients 481, 482
malignant disease 480–481
metabolic disorders 481
primary immunodeficiency syndromes 481, 484
Unified Theory of Acceptance and Use of Technology (UTAUT) model 410
United States Code of Federal Regulations (CFR) 222
United States Food and Drug Administration (FDA) 186, 190, 433–435
University of Pittsburgh Medical Center (UPMC) 247
uraemia 274
urgent transfusion 7
utilisation and wastage schemes 248
V
variant Creutzfeldt–Jakob disease (vCJD) 156, 164, 230, 248
vasovagal reactions 206
V genes 15
viscoelastic testing 304
vitamin K antagonists 274
vitamin K deficiency 275
von Willebrand disease (VWD) 266, 270–271
von Willebrand factor (vWF) 43, 227, 264, 266, 293
warfarin-induced venous limb gangrene 351–353
warm antibody AIHA 314–315
washed platelet activation assays 347
West Nile virus (WNV) 161, 176, 177, 179–181, 196, 219
whole blood-derived plasma 222
World Health Organization (WHO) 2, 184, 190, 254–255, 257–261
World Marrow Donor Association (WMDA) 438–439
wrong blood incidents 86, 90–91
wrong blood in tube (WBIT) 58, 249

X

X-linked agammaglobulinaemia (XLA) 360–361
XMRV recognition and management 180