

Seventh Edition

Forfar & Arneil's  
**TEXTBOOK**  
*of PEDIATRICS*

© 2008 Elsevier Ltd

© 2008 Elsevier Ltd

*Commissioning Editor:* Pauline Graham

*Development Editor:* Janice Urquhart

*Project Manager:* Nancy Arnott

*Design Direction:* Erik Bigland

*Illustrators:* Tim Loughhead, Richard Prime

Seventh Edition

Forfar & Arneil's

# TEXTBOOK *of PEDIATRICS*

© 2008 Elsevier Ltd

*Edited by*  
**Neil McIntosh** DSc(Med) FRCP(Edin) FRCP(Lond) FRCPCH

*Professor of Child Life and Health, University of Edinburgh;  
Honorary Consultant Paediatrician, Lothian University Hospitals NHS Trust, Edinburgh, UK*

**Peter J. Helms** MB BS PhD FRCP(Edin) FRCPCH

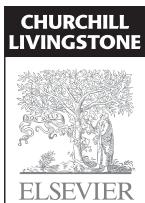
*Professor of Child Health, University of Aberdeen, Aberdeen, UK*

**Rosalind L. Smyth** MA MB BS MD FRCPCH F Med Sci

*Brough Professor of Paediatric Medicine, University of Liverpool, Liverpool, UK*

**Stuart Logan** MB ChB MSc(Epidemiology) MSc(politics) MRCP FRCPCH

*Professor of Paediatric Epidemiology; Director, Institute of Health Research, Peninsula Medical Service School,  
St Luke's Campus, Exeter, UK*



CHURCHILL  
LIVINGSTONE  
ELSEVIER

An imprint of Elsevier Limited

© 2008, Elsevier Limited. All rights reserved.

© 2003, Elsevier Limited.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or any information storage and retrieval system, without permission in writing from the publishers. Permissions may be sought directly from Elsevier's Rights Department: Phone: (+1) 215 239 3804 (US) or (+44) 1865 843830 (UK); fax: (+44) 1865 853333; e-mail: [healthpermissions@elsevier.com](mailto:healthpermissions@elsevier.com). You may also complete your request on-line via the Elsevier website at <http://www.elsevier.com/permissions>.

First edition 1973

Second edition 1978

Third edition 1984

Fourth edition 1992

Fifth edition 1998

Sixth edition 2003

Seventh edition 2008

ISBN 978-0-443-10396-4

IE ISBN 978-0-443-10397-1

**British Library Cataloguing in Publication Data**

A catalogue record for this book is available from the British Library

**Library of Congress Cataloging in Publication Data**

A catalog record for this book is available from the Library of Congress

**Note**

Knowledge and best practice in this field are constantly changing. As new research and experience broaden our knowledge, changes in practice, treatment and drug therapy may become necessary or appropriate. Readers are advised to check the most current information provided (i) on procedures featured or (ii) by the manufacturer of each product to be administered, to verify the recommended dose or formula, the method and duration of administration, and contraindications. It is the responsibility of the practitioner, relying on their own experience and knowledge of the patient, to make diagnoses, to determine dosages and the best treatment for each individual patient, and to take all appropriate safety precautions. To the fullest extent of the law, neither the Publisher nor the Authors assumes any liability for any injury and/or damage to persons or property arising out or related to any use of the material contained in this book.

*The Publisher*

**ELSEVIER** your source for books,  
journals and multimedia  
in the health sciences

[www.elsevierhealth.com](http://www.elsevierhealth.com)

Working together to grow  
libraries in developing countries

[www.elsevier.com](http://www.elsevier.com) | [www.bookaid.org](http://www.bookaid.org) | [www.sabre.org](http://www.sabre.org)

**ELSEVIER** BOOK AID  
International Sabre Foundation

The  
publisher's  
policy is to use  
paper manufactured  
from sustainable forests

Printed in China

# Preface

---

One of the most important developments in the 21<sup>st</sup> century has been the acknowledgment that clinical practice should be embedded where possible in a sound evidence base. The editors of this new edition of *Forfar & Arneil's Textbook of Pediatrics* continue to set contributors the challenging task of ensuring that the statements and recommendations made are based on the most robust clinical research available. The objective assessment of evidence and the formulation of secure recommendations from the evidence are gathering pace. In Child Health the evidence base, with the possible exception of disciplines such as oncology and neonatology, is not as comprehensive or as well defined as we would wish. This edition of Forfar & Arneil continues to flag up the most important evidence sources for the content of each chapter. The whole book has been revised and updated and the chapter authors and editors again incorporate where possible secure evidence of therapy, diagnosis, etiology and prognosis. This evidence is incorporated into the individual chapters and in the chapter reference list is starred for easy reference. We believe that the result is the most comprehensive evidence-based general textbook of pediatrics available. Our ability to access best evidence has been greatly enhanced by the rapid advances of information technology and electronic

publishing and consequently another important new feature for this edition is a website of the text in which references listed in PUBMED can be accessed via the internet. We would like to acknowledge the outstanding contributions of the many individual authors and our chapter editors, without whom this ambitious project would not have been possible. It has been a great privilege to work with them. We would also like to thank our own secretaries for their unstinting help (Elaine Forbes, Flora Buthlay, Collette Lorne and Stella Taylor) and of course our respective families for sharing the burden with us.

As with previous editions the book is produced by the Elsevier Organization. There have been many highly professional people involved. We hope that this new 7th edition with its expanded formal evidence base will be well received by you, the reader, and become as trusted a friend and guide as have previous editions.

Neil McIntosh  
Peter J. Helms  
Rosalind L. Smyth  
Stuart Logan

© 2008 Elsevier Ltd

© 2008 Elsevier Ltd

# Contents

List of Contributors.....	xv
Color plate section	

## Section 1

### FOUNDATIONS OF HEALTH AND PRACTICE

1 Evidence-based child health <i>Rosalind L. Smyth</i> .....	3
Introduction.....	3
The practice of evidence-based medicine .....	4
Systematic reviews.....	5
Evidence-based child health .....	6
How textbooks ensure that they are evidence based .....	6
Clinical evidence within the 7th edition of Forfar & Arneil .....	7
Summary .....	9
2 Epidemiology of childhood diseases <i>Stuart Logan</i> .....	11
Introduction.....	11
Mortality rates.....	11
Mortality in poor countries.....	12
Childhood mortality in the industrialized world.....	13
Morbidity in childhood.....	14
Population determinants of child health.....	16
3 Healthcare delivery in resource limited settings <i>Elizabeth Molyneux</i> .....	21
Background .....	21
The philosophy of care .....	21
Human resources.....	22
Health care financing .....	22
Drug supply – the pharmaceutical pipeline .....	22
National health programs.....	22
Health delivery and the referral chain .....	23
Vertical, parallel or horizontal services? .....	23
Information, surveillance and research.....	23
High-impact health interventions.....	23
Training .....	24
Dilemmas and constraints.....	24
Summary .....	25
4 Preventive pediatrics <i>Harry Campbell, Rachael Wood</i> .....	27
Determinants of child health .....	27
Contribution of health services to improving child health.....	27
Health promotion and disease prevention .....	28
Child health advocacy .....	28
A life course approach to disease prevention .....	29
Support for parenting.....	33
Child health screening and surveillance .....	33

5 Child protection <i>Alison M. Kemp, Sabine Maguire</i> .....	45
Background .....	45
Historical perspective.....	45
Prevalence .....	45
Child protection process .....	46
Physical abuse .....	46
Child sexual abuse .....	50
Emotional abuse .....	51
Neglect .....	52
Effects of domestic violence on children .....	52
Adult mental health, substance abuse and child protection.....	53
Protecting the child .....	53
6 Accidents, poisoning and SIDS <i>Ronan Lyons, John M. Goldsmid, Maurice A. Kibel, Alan E. Mills, Peter J. Fleming, Peter Blair</i> .....	55
Poisoning in childhood .....	55
Unintentional injuries .....	60
Injury prevention .....	63
Poisonous bites and stings .....	65
Sudden infant death syndrome (SIDS) .....	71
7 Developmental pediatrics <i>Alison Salt, Jenefer Sargent</i> .....	81
Introduction .....	81
Theories of child development .....	81
Factors that affect development .....	82
Normal development .....	84
Detecting and assessing developmental problems .....	85
Development: normal or abnormal? .....	85
Learning impairments .....	108
Interpretation of abnormal development using an evidence-based approach and developmental assessment findings .....	110
Services for children with neurodevelopmental disability .....	110
8 History, examination, basic investigations and procedures <i>Julie-Clare Becher, Ian Laing</i> .....	115
Introduction .....	115
Clinical history .....	118
Physical examination .....	120
Examination of individual systems .....	127
Invasive examinations .....	135

The newborn.....	136	Birth trauma <i>Neil McIntosh</i> .....	202
General principles of common investigations .....	144	Perinatal asphyxia <i>James Tooley</i> .....	204
Principles and practicalities of diagnostic imaging .....	151	Hypoxic-ischemic encephalopathy (HIE) <i>James Tooley</i> .....	205
General principles of common practical procedures .....	154	Resuscitation in the newborn <i>Malcolm Levene</i> .....	207
<b>9 Pediatric prescribing <i>George Rylance</i></b> .....	159	The small for gestational age infant <i>Neil McIntosh</i> .....	211
Introduction.....	159	The large for gestational age infant <i>Neil McIntosh</i> .....	213
Drug handling processes .....	159	Care of the preterm infant.....	213
Pharmacokinetics.....	160	Developmental care <i>Yvonne Freer</i> .....	213
Prescribing principles .....	160	Special care – fluid balance <i>Terence Stephenson</i> .....	215
Drug interactions .....	161	Special care – sodium and potassium <i>Helen Budge</i> .....	219
Drugs in breast milk .....	161	Special care – thermoregulation <i>A. J. Lyon</i> .....	221
Unlicensed medicines and use of licensed medicines for unlicensed applications .....	161	Special care – enteral nutrition <i>Alison Leaf</i> .....	225
What parents and children need to know about medicines.....	161	Intensive care of the newborn .....	229
<b>10 Ethics <i>Ben Stenson, Sheila McLean</i></b> .....	163	Organization of neonatal intensive care services <i>Ben Stenson</i> .....	229
Introduction.....	163	Practical parenteral nutrition <i>David Wilson</i> .....	231
Children's rights .....	163	Blood gases and respiratory support <i>Ben Stenson</i> .....	233
Children and capacity – communication and consent.....	163	Neurodevelopmental outcome <i>Janet Rennie</i> .....	239
Best interests of children .....	164	Neonatal death <i>Neil McIntosh</i> .....	242
Genetic testing .....	169	Problems of the newborn .....	245
Research.....	169	Pulmonary disorders and apnea <i>Henry L. Halliday</i> .....	245
Mental health care .....	171	Neonatal cardiovascular disease <i>Nicholas Archer</i> .....	261
A role for ethics committees? .....	171	Gastrointestinal problems and jaundice of the neonate <i>David Wilson</i> .....	269
Conclusion.....	171	Hematological problems of the newborn <i>Irene A. G. Roberts, Cristina Halsey</i> .....	283
Appendix .....	171	Neonatal neurology <i>Janet Rennie</i> .....	297
<b>Section 2</b> PERINATAL/NEONATAL MEDICINE		Renal disease in the neonate <i>Ian J. Ramage</i> .....	309
<b>11 Fetal medicine <i>Stephen C. Robson, Steven Sturgiss</i></b> .....	175	Eye problems in the newborn <i>Alistair R. Fielder</i> .....	314
Prenatal screening and diagnosis of congenital abnormalities.....	175	Infection and immunity in the newborn <i>Paul T. Heath</i> .....	319
Maternal serum screening .....	175	Neonatal neoplasia <i>Neil McIntosh</i> .....	332
Ultrasound .....	175	Neonatal metabolic disorders <i>Robert Hume</i> .....	333
Combined serum and ultrasound screening.....	176		
Management of prenatally detected structural anomalies .....	177		
Invasive procedures and fetal surgery.....	180		
Assessment of fetal size and well-being .....	181		
Multiple pregnancies .....	186		
Alloimmunization .....	187		
<b>12 The newborn <i>Neil McIntosh, Ben Stenson</i></b> .....	191		
Introduction.....	191		
Definitions – World Health Organization (WHO)			
<i>Neil McIntosh</i> .....	191		
The economics of newborn care <i>Stavros Petrou</i> .....	192		
The normal fetal–neonatal transition <i>Neil McIntosh</i> .....	195		
Routine care of the full-term infant .....	198		
Examination of the neonate <i>Sam Richmond</i> .....	198		
Labor ward routines <i>Ben Stenson</i> .....	199		
Postnatal ward routines <i>Ben Stenson</i> .....	200		
Feeding the full-term newborn			
<i>Nicholas D. Embleton</i> .....	200		
The high risk newborn.....	202		
<b>13 Infant feeding <i>Anthony F. Williams</i></b> .....	367		
Introduction.....	367		
Breast-feeding .....	367		
Breast milk substitutes.....	371		
Manufacture of infant formula .....	372		
Complementary feeding – weaning.....	373		
<b>Section 3</b>			
<b>THE SPECIALITIES</b>			
<b>14 Genetics <i>Michael A. Patton</i></b> .....	379		
Introduction.....	379		
Epidemiology .....	379		
Mitosis and meiosis .....	380		
Chromosomes .....	381		
Types of chromosome abnormality .....	383		
Nomenclature .....	384		
Chromosomal syndromes .....	385		
Sex chromosome abnormalities .....	391		
Single gene disorders: inheritance.....	393		
DNA and gene action .....	396		
Multifactorial inheritance.....	402		
Malformation syndromes .....	404		
Counseling and genetic services.....	405		

<b>15</b>	<b>Endocrine gland disorders and disorders of growth and puberty <i>Christopher J.H. Kelnar, Gary E. Butler</i></b> .....	409
	Mechanisms of hormone action.....	410
	History taking and examination.....	412
	Endocrine tests.....	413
	Fetal endocrinology.....	414
	Neonatal endocrinology.....	417
	Disorders of sexual differentiation.....	418
	Physical growth and development.....	422
	Growth regulation and disorders of growth.....	436
	Obesity and thinness.....	445
	Endocrinological aspects of puberty and adolescence.....	447
	Abnormal puberty.....	450
	Other disorders related to female and male reproduction.....	458
	The hypothalamo-pituitary unit.....	460
	The pineal gland.....	464
	The thymus.....	465
	The thyroid gland.....	465
	Parathyroid glands and calcium metabolism.....	473
	The adrenal glands.....	478
	Endocrine hypertension.....	487
	The endocrine consequences of curing childhood cancer.....	489
	The pancreas and carbohydrate metabolism.....	489
	Diabetes mellitus.....	491
	Hypoglycemia.....	503
<b>16</b>	<b>Nutrition <i>Barbara Golden, John Reilly</i></b> .....	513
	Nutrition, growth, development and disease.....	513
	Nutritional requirements.....	513
	Applications and limitations of dietary reference values.....	514
	Nutritional requirements during infancy and childhood.....	514
	Nutritional assessment.....	515
	Healthy diet: infancy, childhood and adolescence.....	518
	Principles of nutritional support.....	519
	Obesity.....	522
	Malnutrition.....	523
	Micronutrient deficiency and excess.....	526
<b>17</b>	<b>Fluid, electrolyte and acid-base disturbances <i>Gale A. Pearson</i></b> .....	531
	Introduction.....	531
	Differences among babies, children and adults.....	532
	Maintenance fluid and electrolyte requirements.....	532
	Ongoing losses.....	533
	Monitoring.....	533
	Total body water and sodium balance.....	534
	Compartmental distribution of water and electrolytes.....	534
	Acid-base.....	535
	Disturbance of acid-base.....	536
	Cautionary notes on laboratory tests of fluid and electrolytes.....	537
	Fluid and electrolyte disturbance.....	537
	Conclusion.....	540
	Appendix 1: Physical and physiological influences on the internal distribution of water and electrolytes .....	540
	Appendix 2: Acid-base chemistry and blood gas measurement .....	543
<b>18</b>	<b>Disorders of the urinary system <i>Moin A. Saleem, Jane Tizard, Jan Dudley, Carol Inward, Richard Coward, Mary McGraw</i></b> .....	545
	Renal physiology .....	546
	Assessment of renal function.....	548
	Renal tubular disorders .....	550
	Congenital abnormalities of the urinary tract.....	555
	Renal cystic disease .....	557
	Urinary tract infections .....	560
	Vesicoureteric reflux.....	565
	Enuresis (wetting) .....	568
	Hematuria .....	569
	Glomerulonephritis .....	572
	Proteinuria .....	578
	Nephrotic syndrome.....	580
	Renal hypertension .....	584
	Acute renal failure .....	587
	Chronic renal failure.....	592
<b>19</b>	<b>Disorders of the alimentary tract and liver <i>W. Michael Bisset, Susan V. Beath, Huw R. Jenkins, Alastair J. Baker</i></b> .....	601
	Introduction.....	602
	Gastrointestinal function.....	602
	Nature of gastrointestinal disease.....	603
	The mouth .....	603
	The esophagus.....	604
	The stomach and duodenum.....	608
	The small intestine .....	613
	Malabsorption .....	615
	Inborn errors of digestion and absorption.....	621
	Investigations of the small intestine .....	623
	Gastrointestinal tumors .....	624
	The pancreas.....	624
	Disorders of gastrointestinal motility .....	626
	Acute infective diarrhoea .....	626
	Protracted diarrhoea in early infancy .....	629
	Intestinal failure.....	630
	The colon .....	634
	Inflammatory bowel disease .....	634
	Chronic gastrointestinal symptoms .....	638
	Hepatic and biliary disease .....	642
	Charities and organizations .....	654
<b>20</b>	<b>Respiratory disorders <i>Edited by Peter Helms, John Henderson</i></b> .....	657
	Introduction <i>Peter Helms, John Henderson</i> .....	658
	Development of the respiratory system <i>Peter Helms</i> .....	662
	Respiratory physiology, pathophysiology and the measurement of respiratory function .....	664
	Specific clinical indications for airway endoscopy .....	680
	Special investigations – imaging <i>Keiran McHugh</i> .....	671
	Endoscopy of the airway <i>James Y. Paton, Jonathan Coutts</i> .....	678

Sleep disordered breathing	John Henderson, Stephen Stick and Peter Fleming.....	683
Asthma	Paul L P Brand, Johannes H. Wildhaber .....	689
Congenital abnormalities	Andrew Bush .....	697
Rare lung diseases	Andrew Bush.....	703
Cystic fibrosis	Alan Smyth.....	706
Respiratory infections	Heather Elphick.....	715
Respiratory defenses and infection in the compromised host	Tom Hilliard .....	723
Chronic lung disease of prematurity	Sailesh Kotecha .....	727

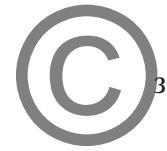
<b>21</b>	<b>Cardiovascular disease Edited by Denise J. Kitchiner.....</b>	<b>743</b>
	Clinical assessment of heart disease <i>Denise J. Kitchiner.....</i>	743
	Electrocardiography <i>Christopher Wren .....</i>	748
	Chest radiography <i>Denise J. Kitchiner.....</i>	750
	Echocardiography <i>Jonathan R. Skinner.....</i>	750
	Cardiac catheterization <i>Denise J. Kitchiner.....</i>	758
	Other cardiac investigations <i>Denise J. Kitchiner.....</i>	760
	The asymptomatic child with a murmur <i>Denise J. Kitchiner.....</i>	761
	Heart failure <i>Denise J. Kitchiner .....</i>	762
	Infective endocarditis <i>Denise J. Kitchiner .....</i>	763
	Congenital heart disease <i>Denise J. Kitchiner.....</i>	765
	Fetal diagnosis of heart disease <i>Denise J. Kitchiner .....</i>	766
	The neonate with a congenital heart disease <i>Jonathan R. Skinner.....</i>	767
	The infant and child with congenital heart disease <i>Denise J. Kitchiner.....</i>	780
	Cardiac arrhythmias <i>Christopher Wren .....</i>	792
	Acquired cardiovascular disorders <i>Denise J. Kitchiner.....</i>	799

<b>22</b>	<b>Neurology Edited by Colin Ferrie, Richard Newton and Tim Martland .....</b>	<b>811</b>
	The neurological consultation <i>Richard Newton .....</i>	811
	Investigation of suspected neurological disorders <i>John H. Livingston.....</i>	813
	Giving the news of disability <i>Richard Newton .....</i>	817
	Development of the human brain <i>Richard Newton .....</i>	818
	Neural tube defects <i>Richard Newton .....</i>	825
	Hydrocephalus <i>Richard Newton.....</i>	830
	The neurocutaneous diseases <i>Richard Newton .....</i>	837
	Seizures, epilepsy and other paroxysmal disorders <i>Colin Ferrie.....</i>	841
	Headache and migraine <i>Ishaq Abu-Arafeh.....</i>	872
	Disorders of movement <i>Michael Clarke .....</i>	878
	Cerebral palsy <i>Ian McKinlay.....</i>	888
	Degenerative brain disorders <i>Omar Ismayl.....</i>	898
	Neuromuscular disease <i>Mary Imelda Hughes .....</i>	904
	Decreased consciousness and coma <i>Timothy R. Martland .....</i>	920
	Infectious and inflammatory disorders of the CNS <i>Timothy R. Martland .....</i>	925
	Acute paraparesis or quadraparesis <i>Timothy R. Martland .....</i>	929
	Traumatic (accidental and non-accidental) brain and spinal cord injury and neurorehabilitation	

	Pamela Tomlin.....	930
	Childhood stroke syndromes <i>Vijaya Ganesan .....</i>	939
	Speech and language delay and disorders <i>Ian McKinlay.....</i>	942
<b>23</b>	<b>Disorders of the blood and bone marrow Paula Bolton-Maggs, Angela Thomas.....</b>	<b>959</b>
	Hematological assessment in childhood .....	959
	Anemia .....	959
	Deficiency anemias .....	960
	Aplastic anemias .....	964
	Hemolytic anemias .....	966
	Disorders of hemoglobin synthesis.....	969
	Secondary anemias .....	974
	Eosinophilia.....	975
	Disorders of hemostasis.....	975
	Leukemia.....	982
<b>24</b>	<b>Oncology Guy Makin, Stefan Meyer.....</b>	<b>991</b>
	Incidence and prevalence .....	991
	General principles of diagnosis.....	999
	Principles of therapy.....	999
	Central nervous system tumors .....	1005
	Glial tumors .....	1006
	Brainstem tumors .....	1008
	Ependymoma .....	1008
	Choroid plexus neoplasms .....	1009
	Embryonal tumors .....	1009
	Pineal tumors .....	1010
	Intracranial germ cell tumors .....	1010
	Craniopharyngioma .....	1011
	Lymphomas .....	1011
	Neuroblastoma .....	1015
	Nephroblastoma (Wilms tumor).....	1019
	Mesoblastic nephroma .....	1021
	Soft tissue sarcomas .....	1021
	Osteosarcoma .....	1023
	Ewing sarcoma .....	1025
	Germ cell tumors .....	1026
	Retinoblastoma .....	1028
	Liver tumors .....	1029
	Langerhans cell histiocytoses .....	1030
<b>25</b>	<b>Gynecological diseases Anne S. Garden.....</b>	<b>1039</b>
	Introduction.....	1039
	Physiology .....	1039
	Problems at birth .....	1039
	Problems in early childhood .....	1040
	Bloodstained vaginal discharge .....	1040
	Problems of puberty .....	1041
	Problems of adolescence .....	1043
	Teenage pregnancy .....	1046
<b>26</b>	<b>Inborn errors of metabolism: biochemical genetics Edited by Neil R.M. Buist, Robert D. Steiner.....</b>	<b>1049</b>
	Introduction <i>Neil R. M. Buist .....</i>	1050
	Disorders of amino acid metabolism <i>Markus Grompe .....</i>	1052
	Miscellaneous amino acid disorders .....	1067
	Fatty acid oxidation disorders <i>Cary O. Harding .....</i>	1067
	Disorders of carbohydrate metabolism <i>Cary O. Harding .....</i>	1071

Disorders of pyruvate metabolism and the Krebs cycle, and lactic acidemia <i>Neil R. M. Buist</i> .....	1079
Mitochondrial disease <i>Greg M. Enns, Neil R. M. Buist</i> .....	1081
Classification.....	1086
Genetic counseling.....	1087
Disorders of lipid, lipoprotein and bile acid metabolism <i>P. Barton Duell, Jean-Baptiste Roulet, Robert D. Steiner</i> .....	1089
Lysosomal storage diseases <i>Neil R. M. Buist, Robert D. Steiner</i> .....	1101
Peroxisomal disorders <i>Leesa M. Linck</i> .....	1113
Congenital disorders of glycosylation <i>K. Michael Gibson, Greg M. Enns</i> .....	1117
Disorders of neurotransmitter metabolism <i>K. Michael Gibson, Philip L. Pearl</i> .....	1119
Disorders of purine metabolism <i>K. Michael Gibson, Neil R. M. Buist</i> .....	1122
Disorders of pyrimidine metabolism <i>K. Michael Gibson, Neil R. M. Buist</i> .....	1123
Disorders of metal metabolism <i>David M. Koeller</i> .....	1124
Porphyrias <i>David M. Koeller</i> .....	1127
Disorders of bilirubin <i>David M. Koeller</i> .....	1128
Hereditary disorders of vitamin metabolism <i>Neil R. M. Buist</i> .....	1129
Miscellaneous inborn errors of metabolism <i>Neil R. M. Buist</i> .....	1130
<b>27 Immunodeficiency <i>Andrew J. Cant, E. Graham Davies, Catherine Cale, Andrew R. Gennery</i></b> .....	1139
Introduction.....	1140
The immune system.....	1140
Innate and adaptive immunity .....	1140
Innate immune mechanisms .....	1140
Adaptive immune mechanisms .....	1142
The development of the immune system .....	1146
Immunodeficiency disorders: general principles .....	1148
Diagnosis and investigation of immunodeficiency .....	1148
Disorders of cell-mediated immunity: combined immunodeficiencies .....	1154
MHC antigen deficiency .....	1157
Combined immunodeficiency forming part of other syndromes .....	1157
Disorders of immune regulation .....	1161
Defects of antibody production .....	1162
Disorders of phagocytic cells .....	1165
Complement disorders .....	1167
Secondary immunodeficiency.....	1169
Vaccination of the child with a potentially impaired immune response .....	1170
Hyposplenism .....	1171
Treatment of immunodeficiency .....	1171
Replacement immunoglobulin therapy .....	1172
Replacement therapy for combined deficiencies .....	1172
<b>28 Infections Edited by David Isaacs, Kim Mulholland</b> ...1177	
Mortality and morbidity in infectious disease <i>Angus Nicoll</i> .....	1178
Clinical problems .....	1188
The child with fever <i>Peter T. Rudd</i> .....	1188
The child with a rash <i>Peter T. Rudd</i> .....	1189
Fever and increased respiratory rate <i>Craig Mellis</i> .....	1192
Cough and fever <i>Craig Mellis</i> .....	1193
Rhinitis <i>Craig Mellis</i> .....	1193
Noisy breathing <i>Craig Mellis</i> .....	1194
Suspected meningitis <i>Nigel J. Klein</i> .....	1194
Septic shock <i>Nigel J. Klein</i> .....	1197
Congenital and neonatal infections <i>Cheryl J. Jones, David Isaacs</i> .....	1199
Hospital infection control <i>Alison M. Kesson</i> .....	1203
Bacterial infections .....	1204
The use of the bacteriology laboratory by the pediatrician <i>Alison M. Kesson</i> .....	1204
Principles of antimicrobial therapy <i>Alison M. Kesson</i> .....	1206
Botulism <i>David Isaacs</i> .....	1210
Brucellosis; undulant fever <i>Philip D. Welsby</i> .....	1211
Cholera <i>Stephen M. Graham</i> .....	1212
Diphtheria <i>Bridget A. Wills</i> .....	1213
<i>Escherichia coli</i> <i>C. Anthony Hart</i> .....	1216
<i>Haemophilus influenzae</i> <i>Paul T. Heath and E. Richard Moxon</i> .....	1218
Leprosy <i>Diana N. J. Lockwood</i> .....	1220
Leptospirosis <i>Philip D. Welsby</i> .....	1223
Lyme disease <i>Philip D. Welsby</i> .....	1224
Meningococcemia <i>Nigel J. Klein</i> .....	1226
<i>Mycobacterium tuberculosis</i> <i>J. Brian S. Coulter</i> .....	1227
Mycobacteria – environmental <i>J. Brian S. Coulter</i> .....	1239
Pertussis <i>Craig Mellis</i> .....	1241
<i>Pneumococcus</i> <i>Janice Main</i> .....	1243
<i>Pseudomonas</i> <i>John R. W. Govan</i> .....	1244
Relapsing fever <i>Amha Mekasha</i> .....	1245
Salmonellosis <i>Stephen M. Graham</i> .....	1246
<i>Shigella</i> (bacillary dysentery) <i>Karen L. Kotloff</i> .....	1249
<i>Staphylococcus</i> <i>Janice Main</i> .....	1251
<i>Streptococcus</i> and <i>Enterococcus</i> <i>Janice Main</i> .....	1252
Tetanus <i>Jeremy Farrar</i> .....	1254
Tularemia <i>Cheryl Jones</i> .....	1255
Yersiniosis and plague <i>David Lalloo</i> .....	1256
Infections due to viruses and allied organisms <i>David Isaacs, Cheryl Jones</i> .....	1258
Use of the virology laboratory by the clinician <i>Alison M. Kesson</i> .....	1258
HIV infection <i>Caroline Foster, Diana Gibb</i> .....	1259
Exanthemata <i>Cheryl Jones, David Isaacs</i> .....	1274
Herpesviruses <i>Cheryl Jones, David Isaacs</i> .....	1279
Viral and allied infections of the respiratory tract <i>Cheryl Jones, David Isaacs</i> .....	1286
Viral infections of the CNS <i>Cheryl Jones, David Isaacs</i> .....	1292
Viruses and the gastrointestinal tract <i>Cheryl Jones, David Isaacs</i> .....	1297
Ocular diseases caused by viruses and allied organisms <i>Cheryl Jones, David Isaacs</i> .....	1298
Viral infection of the liver <i>Cheryl Jones, David Isaacs</i> .....	1299
Miscellaneous viral infections <i>Cheryl Jones, David Isaacs</i> .....	1301
Rickettsial infections <i>Cheryl Jones, David Isaacs</i> .....	1303
Protozoal infections .....	1306

Amebic infections <i>J. Brian S. Coulter</i> .....	1306	Lacrimal system .....	1496
Cryptosporidiosis <i>C. Anthony Hart</i> .....	1308	Congenital abnormalities of eye development .....	1496
Giardiasis <i>C. Anthony Hart</i> .....	1310	Conjunctivitis.....	1496
Leishmaniasis <i>David Laloo</i> .....	1312	Corneal disease.....	1497
Malaria <i>Malcolm E. Molyneux</i> .....	1315	Uveitis.....	1497
Toxoplasmosis <i>Cheryl A. Jones</i> .....	1323	Cataract.....	1498
Trypanosomiasis <i>David Laloo</i> .....	1324	Lens subluxation.....	1498
Fungal infections <i>C. Anthony Hart</i> .....	1328	Glaucoma.....	1498
Helminth infection <i>John M. Goldsmid,</i> <i>Maurice A. Kibel, Alan E. Mills</i> .....	1337	Retinal diseases .....	1499
Flies, fleas, mites and lice <i>John M. Goldsmid,</i> <i>Maurice A. Kibel, Alan E. Mills</i> .....	1361	Diseases of the optic nerve.....	1501
Diseases transmitted by animals <i>John M. Goldsmid,</i> <i>Maurice A. Kibel, Alan E. Mills</i> .....	1365	The eye in relation to medical pediatrics and clinical genetics.....	1501
<b>29 Disorders of bones, joints and connective tissues</b>		Ocular trauma .....	1503
<i>Joyce Davidson, Andrew Gavin Cleary, Colin Bruce</i> ..	1385	Management of the visually impaired child and their family.....	1505
Assessment of the musculoskeletal system.....	1386		
Congenital and developmental problems.....	1387		
Inherited disorders of bones and joints.....	1397		
Infection in bones and joints .....	1401		
Juvenile idiopathic arthritis .....	1406		
Other arthropathies in childhood.....	1415		
Common orthopedic problems in childhood.....	1415		
Vasculitis .....	1423		
Other autoimmune rheumatic disorders.....	1427		
Chronic pain syndromes.....	1435		
Back problems in childhood and adolescence .....	1437		
Osteoporosis .....	1438		
Overuse and sport-related problems in children .....	1440		
<b>30 Disorders of the skin <i>Nigel P. Burrows</i></b> .....	1447		
Introduction.....	1447		
Nevi and other developmental defects .....	1448		
Hereditary diseases .....	1452		
Skin diseases of the neonate .....	1459		
Infections and infestations of the skin .....	1461		
Urticaria and erythemas .....	1468		
Vesicobullous disorders .....	1470		
Vasculitis .....	1470		
Eczema, dermatitis and psoriasis .....	1471		
Connective tissue diseases.....	1474		
Idiopathic photosensitivity eruptions .....	1475		
Disorders of hypopigmentation .....	1476		
Disorders of hair loss .....	1476		
The histiocytoses .....	1477		
<b>31 Disorders of the eye <i>Brian W. Fleck,</i> <i>Alan O. Mulvihill</i></b> .....	1481		
Normal visual development .....	1481		
Clinical assessment .....	1482		
Specialized methods of examination.....	1487		
Refractive errors and amblyopia.....	1488		
Strabismus .....	1490		
Pupil abnormalities.....	1491		
Nystagmus .....	1491		
The apparently blind infant .....	1492		
Acquired visual loss in children .....	1493		
Childhood visual loss with no abnormality on ophthalmic examination .....	1494		
Diseases of orbital and ocular tissues.....	1495		
Eyelid abnormalities .....	1495		
<b>32 Disorders of the ear, nose and throat</b>			
<i>Alastair I.G. Kerr</i> .....	1509		
The ear .....	1509		
Congenital abnormalities .....	1509		
Trauma and injuries.....	1509		
Infections of the ears .....	1510		
Referred otalgia.....	1510		
Deafness .....	1511		
The nose, sinuses and throat .....	1512		
The nose .....	1512		
Nasal septal deviation .....	1514		
Diseases of the paranasal sinuses .....	1514		
Nasal polyps .....	1514		
Choanal atresia .....	1514		
Diseases of the nasopharynx .....	1514		
Diseases of the pharynx .....	1515		
Disorders of phonation .....	1516		
<b>33 Allergic disorders <i>Peter D. Arkwright,</i> <i>Timothy J. David</i></b> .....	1519		
Definitions and explanation of terms .....	1519		
Immune mechanisms and timing of the allergic response .....	1519		
Hygiene hypothesis .....	1520		
Genetics of allergy and allergic disorders .....	1520		
Clinical spectrum of disease .....	1521		
Skin .....	1521		
Respiratory tract .....	1523		
Important allergens in children .....	1525		
Anaphylaxis .....	1532		
Diagnosis of allergy – taking a history .....	1532		
Diagnostic testing for allergy .....	1533		
Drug treatment of anaphylaxis and acute allergies .....	1535		
Hyposensitization .....	1536		
Novel treatment approaches .....	1537		
Prevention of atopic disease .....	1538		
<b>34 Psychiatric disorders in childhood <i>Peter Hoare</i></b> .....	1541		
Introduction .....	1541		
Normal and abnormal psychological development .....	1542		
Developmental theories .....	1542		
Developmental psychopathology .....	1545		
Personality development .....	1545		
General features of psychiatric disturbance .....	1546		
Assessment procedures .....	1547		
Psychological assessment .....	1548		



Disorders in preschool children .....	1548
Psychiatric aspects of child abuse .....	1549
Pervasive developmental disorders.....	1550
Emotional disorders.....	1552
Mood disorders.....	1554
Disorders of elimination.....	1555
Miscellaneous disorders.....	1556
Treatment methods .....	1558
Psychiatric disorders in adolescence .....	1560
Adolescent psychiatric syndromes.....	1561
Special topics .....	1565
Psychiatric aspects of learning disability in childhood.....	1567
<b>35 Adolescent medicine Russell Viner .....</b>	<b>1571</b>
What is adolescence?.....	1571
Why is a special medical approach needed for adolescents? .....	1571
Adolescent development.....	1572
Resilience and risk in adolescent health .....	1575
The management of ill-health in adolescence .....	1575
Health promotion for young people.....	1578
Conclusions .....	1578
<b>36 Emergency care Thomas F. Beattie, Gale A. Pearson.....</b>	<b>1581</b>
Pediatric injury and emergency care.....	1582
A pediatric emergency medical service (PEMS).....	1582
The home setting.....	1582
Data analysis and problem identification .....	1583
Devising a strategy .....	1583
Implementing a strategy.....	1583
Re-audit .....	1583
Community education .....	1583
Community care.....	1583
Prehospital care.....	1583
The emergency department services.....	1584
Approach to the management of the severely ill or injured child in the emergency department.....	1585
Stopping resuscitation .....	1587
Approach to the severely injured child .....	1587
Sciwora .....	1587
Breathing .....	1588
Circulation.....	1588
Disability .....	1588
Secondary survey.....	1588
Head injury.....	1588
Thoracoabdominal injuries.....	1589
Moderate chest injury.....	1589
Abdominal injury.....	1589
Seat belt injury.....	1589
Orthopedic injury .....	1589
Burn care .....	1591
Complications of burns .....	1591
Management of the unstable child with underlying pathology.....	1591
Conclusion.....	1593
Pediatric intensive care .....	1593
Introduction.....	1593
Postresuscitation stabilization and transfer .....	1594
Respiratory system.....	1595
Cardiovascular system.....	1597
Central nervous system .....	1598
Fluids and renal replacement therapy.....	1599
Host defence .....	1599
A combined organ system approach to critical illness.....	1600
<b>37 Surgical pediatrics Gordon A. MacKinlay .....</b>	<b>1603</b>
Neonatal surgery .....	1603
Surgery of the infant and child .....	1615
Surgical aspects of the genitourinary tract.....	1620
Congenital vascular malformations.....	1625
Cleft lip and palate .....	1626
Burns.....	1626
<b>38 Pain and palliative care Richard F. Howard, Finella Craig.....</b>	<b>1629</b>
Introduction.....	1629
Assessment .....	1629
Self-assessment.....	1630
Behavioral and multidimensional assessment .....	1630
Physiological responses .....	1631
Clinical management of pain .....	1631
Management of neonatal pain .....	1636
Management of pain in the ICU .....	1636
Chronic pain .....	1637
Palliative care .....	1637
Symptom management .....	1639
Anemia and bleeding .....	1641
Impaired appetite and poor feeding .....	1641
Psychosocial and spiritual support .....	1641
Conclusion.....	1641
<b>Section 4</b>	
<b>APPENDICES AND INDEX</b>	
Appendix Anne Green, Rachel Webster, I. A. Auchterlonie, Anita MacDonald .....	1645
Reference ranges for biochemical laboratory tests.....	1645
Introduction.....	1645
Laboratory Reference Values.....	1646
Nutrients and Formula Feeds.....	1646
Index.....	1683

© 2008 Elsevier Ltd

# Contributors

**Ishaq Abu-Arafeh, MBBS, MD, MRCP, FRCPCH**  
Consultant in Paediatrics and Paediatric Neurology, Stirling Royal Infirmary, Stirling; Honorary Consultant Paediatrician, Fraser of Allander Neurosciences Unit, Royal Hospital for Sick Children, Glasgow, UK

**N. Archer, MA FRCP FRCPCH DCH**  
Consultant Paediatric Cardiologist, Oxford Children's Hospital, Oxford; Honorary Clinical Senior Lecturer, University of Oxford, Oxford, UK

**Peter D. Arkwright, FRCPCH DPhil**  
Lecturer in Child Health, Department of Child Health, University of Manchester, Manchester, UK

**Ian A. Auchterlonie, MB ChB FRCPCH FRCP**  
Honorary Consultant Paediatrician (Retired), Royal Aberdeen Children's Hospital, Aberdeen, UK

**Alastair J. Baker, MB ChB FRCP FRCPCH**  
Consultant Paediatric Hepatologist, King's College Hospital, London, UK

**Susan V. Beath, BSc MB BS MRCP DTM&H FRCPCH**  
Consultant Paediatric Hepatologist, The Liver Unit, Birmingham Childrens Hospital, Birmingham, UK

**Thomas F. Beattie, MB MSc FRCSEd(A&E), FCEM, FRCPE, FFSEM, DCH**  
Consultant in Emergency Medicine, Royal Hospital for Sick Children, Edinburgh; Honorary Senior Lecturer in Paediatrics, University of Edinburgh, Edinburgh, UK

**Julie-Clare Becher, MB ChB MRCPCH MD**  
Consultant Neonatologist, Simpson Centre for Reproductive Health, Royal Infirmary of Edinburgh, Edinburgh, UK

**W. Michael Bisset, BSc MB ChB DCH MSc MD FRCPE FRCPCH**  
Consultant Paediatric Gastroenterologist, Department of Medical Paediatrics, Royal Aberdeen Children's Hospital, Aberdeen, UK

**Peter S. Blair, PhD**  
Medical Statistician, Senior Research Fellow, University of Bristol, Division of Child Health, Royal Hospital for Children, Bristol, UK

**Paula H.B. Bolton-Maggs, FRCPCH FRCP FRCPath**  
Consultant Haematologist, Manchester Comprehensive Care Haemophilia Centre, Department of Clinical Haematology, Manchester Royal Infirmary, Manchester, UK

**Paul L.P. Brand, MD**  
Consultant Paediatrician and Director of Postgraduate Education, Princess Amalia Children's Clinic, Isala klinieken, Zwolle, The Netherlands

**Colin E. Bruce, MB ChB FRCS FRCS(ORTH)**  
Consultant Paediatric Orthopaedic Surgeon, Alder Hey Children's Hospital, Liverpool, UK

**Helen Budge, BA BM BCh PhD MRCP FRCPCH**  
Associate Professor of Neonatology, University of Nottingham, Nottingham, UK

**Neil R.M. Buist, MB ChB FRCPE DCH**  
Professor Emeritus, Departments of Paediatrics and Medical Genetics, Oregon Health and Science University, Portland, Oregon, USA

**Nigel Peter Burrows, MD FRCP**  
Consultant Dermatologist and Associate Lecturer, Department of Dermatology, Addenbrooke's Hospital, Cambridge, UK

**Andrew Bush, MD FRCP FRCPCH**  
Professor of Paediatric Respiriology, Imperial College, London; Honorary Consultant Paediatric Chest Physician, Royal Brompton Hospital, London, UK

**Gary Butler, MB BS MD FRCPCH**  
Professor of Paediatrics, Institute of Health Sciences, University of Reading and Department of Paediatrics, Royal Berkshire Hospital, Reading, UK

**Catherine M. Cale, MB ChB PhD MRCP MRCPCH MRCPATH**  
Consultant in Paediatric Immunology and Immunopathology, Department of Immunology, Great Ormond Street Hospital, London, UK

**Harry Campbell, MD FRCPE FFPH FRSE**  
Professor of Genetic Epidemiology and Public Health Sciences, College of Medicine and Vet Medicine, University of Edinburgh, Edinburgh, UK

**Andrew J. Cant, BSc MD FRCP FRCPH**  
Consultant in Paediatric Immunology and Infectious Diseases, Newcastle General Hospital, Newcastle upon Tyne, UK

**Michael Clarke, BSc MRCP DCH FRCPCH**  
Consultant Paediatric Neurologist, Leeds Teaching Hospitals NHS Trust, Leeds, UK

**Andrew Gavin Cleary, MB ChB BSc MSc MRCPCH**  
Consultant Paediatric Rheumatologist, Royal Liverpool Children's Hospital, Liverpool, UK

**J. Brian S. Coulter, MD FRCP(I) FRCPCH**  
Honorary Clinical Lecturer in Tropical Child Health, Liverpool School of Tropical Medicine, Liverpool, UK

**Jonathan Coutts, MB ChB FRCPCH FRCP(Glas)**  
Consultant Neonatal and Respiratory Paediatrician, The Queen Mother's Hospital and Royal Hospital for Sick Children, Glasgow, UK

**Richard Coward, MB ChB MRCPCH PhD**  
MRC Clinician Scientist and Consultant Paediatric Nephrologist, Bristol Royal Hospital for Children, Bristol, UK

**Finella Craig, BSc MBBS MRCP**  
Consultant in Paediatric Palliative Care, Great Ormond Street Hospital for Children, London, UK

**Timothy J. David, MB ChB MD PhD FRCP FRCPCH DCH**  
Professor of Child Health and Paediatrics, Honorary Consultant Paediatrician, The University of Manchester, Manchester, UK

**Joyce E. Davidson, BSc MBChB MRCP (UK) FRCPCH**  
Consultant Paediatric Rheumatologist, Royal Hospital for Sick Children, Glasgow, and Royal Hospital for Sick Children, Edinburgh, UK

**E. Graham Davies, MB BChir MA FRCPCH**  
Consultant Paediatric Immunologist, Great Ormond Street Hospital, London, UK

**Jan Dudley, BM MRCP(UK) FRCPCH PhD**  
Consultant Paediatric Nephrologist, Bristol Royal Hospital for Children, Bristol, UK

**P. Barton Duell, MD**  
Associate Professor of Medicine, Division of Endocrinology, Diabetes, and Clinical Nutrition; director, Lipid-Atherosclerosis Laboratory and Metabolic Disorders Clinic, Oregon Health and Science University, Portland, Oregon

**Heather Elphick, MB ChB MRCP MRCPCH MD**  
Specialist Registrar in Respiratory Paediatrics, Sheffield Children's Hospital, Sheffield, UK

**Nicholas D. Embleton, BSc MD FRCPCH**  
Consultant in Neonatal Medicine and

Honorary Lecturer in Child Health, Newcastle Neonatal Service, Royal Victoria Infirmary, Newcastle upon Tyne, UK

**Gregory M. Enns, MB ChB**  
Associate Professor of Pediatrics, Director, Biochemical Genetics Program, Division of Medical Genetics, Stanford University, Stanford, California, USA

**Jeremy Farrar, FRCP DPhil OBE**  
Professor of Tropical Medicine Oxford University; Honorary Professor of International Health, London School of Hygiene and Tropical Medicine, London; Director, Oxford University Clinical Research Unit, The Hospital for Tropical Diseases, Ho Chi Minh City, Viet Nam

**Colin D. Ferrie, BSc MB ChB MD MRCP FRCPCH**  
Consultant Paediatric Neurologist, Department of Paediatric Neurology, Leeds General Infirmary, Leeds, UK

**Alistair R. Fielder, FRCP FRCS FRCOphth**  
Professor of Ophthalmology, Department of Optometry and Visual Science, City University, London, UK

**Brian W. Fleck, MD FRCOph**  
Consultant Ophthalmologist, Edinburgh Royal Infirmary and Edinburgh Royal Hospital for Sick Children, Edinburgh, UK

**Peter J. Fleming, PhD MB ChB FRCPCH FRCP FRCPC**  
Professor of Infant Health and Developmental Physiology, University of Bristol; Consultant Paediatrician, Royal Hospital for Children, Bristol, UK

**Caroline Foster, MB BS MRCP**  
Honorary Clinical Research Fellow, Imperial College London; SPR Paediatric HIV, St Mary's Hospital, London, UK

**Yvonne Freer, RGN RM RSCN BSc PhD**  
Research and Practice Development Facilitator, Neonatal Intensive Care, Simpson Centre for Reproductive Health, Royal Infirmary of Edinburgh, Edinburgh, UK

**Vijeya Ganesan, MRCPCH, MD**  
Senior Lecturer in Paediatric Neurology, Institute of Child Health, University College London, London, UK

**Anne S. Garden, FRCOG**  
Head of Department of Medicine and Director of the Centre for Medical Education, Lancaster University, Lancaster; Honorary Consultant in Paediatric and Adolescent Gynaecology, Royal Liverpool Children's Hospital, Liverpool; Honorary Consultant Gynaecologist, University Hospitals Morecambe Bay Trust, Morecambe, UK

**Andrew R. Gennery, MD MRCP MRCPCH DCH DipMedSci**  
Senior Lecturer and Honorary Consultant in Paediatric Immunology, BMT Institute of

Cellular Medicine, University of Newcastle upon Tyne, and Children's Bone Marrow Transplant Unit, Newcastle General Hospital, Newcastle upon Tyne, UK

**Diana Gibb, MD FRCPCH MSc**  
Professor of Paediatric Epidemiology, MRC Clinical Trials Unit, University College London, London, UK

**K. Michael Gibson, PhD, FACMG**  
Professor, Pediatrics, Pathology and Human Genetics, Division of Medical Genetics, Children's Hospital of Pittsburgh, University of Pittsburgh School of Medicine, Pittsburgh, PA, USA

**Barbara Golden, BSc MB BCh BAO MD FRCPI FRCPCH DCH RNutr**  
Associate Dean (Medicine), Clinical Senior Lecturer, Honorary Consultant International Child Health, Child Health Institute, School of Medicine, University of Aberdeen, Royal Aberdeen Children's Hospital, Aberdeen, UK

**John M. Goldsmid, BSc MSc PhD FRCPath FACTM FASM CBiol FIBiol FAIBiol HonFRCPA HonFACTM**  
Emeritus Professor, Discipline of Pathology, University of Tasmania, Hobart, Tasmania, Australia

**John R.W. Govan, BSc PhD DSc**  
Professor of Microbial Pathogenicity, Centre for Infectious Diseases, University of Edinburgh Medical School, Edinburgh, UK

**Stephen M. Graham, FRACP**  
Paediatric Research Fellow and Deputy Director Malawi-Liverpool-Wellcome Trust Clinical Research Programme, University of Malawi College of Medicine, Blantyre, Malawi; Senior Clinical Lecturer, Liverpool School of Tropical Medicine, Liverpool, UK

**Anne Green, BSc MSc PhD FRCPath FRCS FIBiol FRCPCH**  
Consultant Clinical Scientist, Birmingham Children's Hospital NHS Trust, Birmingham, UK

**Marcus Grompe, MD**  
Director, Oregon Stem Cell Center; Professor, Department of Molecular and Medical Genetics, Oregon and Health Science University, Portland, Oregon, USA

**Henry L. Halliday, FRCPE FRCP FRCPCH**  
Chair of Child Health and Welfare Research Group, Department of Child Health, Queen's University Belfast, Northern Ireland, UK

**Christina Halsey, BM BCh BA MRCP MRCPath**  
Leukaemia Research Fund Clinical Research Fellow, Faculty of Medicine, Glasgow University, Glasgow, UK

**Cary O. Harding, MD**  
Assistant Professor, Molecular and Medical Genetics; Director of the Biochemical Genetics Clinical Laboratory, Oregon Health

and Science University, Portland, Oregon, USA

**C. Anthony Hart, BScMB BS PhD FRCPCH FRCPath**  
Professor, Division of Medical Microbiology, School of Infection and Host Defence, University of Liverpool, Liverpool, UK

**Paul T. Heath, MB BS FRACP FRCPCH**  
Senior Lecturer and Honorary Consultant, Paediatric Infectious Diseases, Division of Child Health, St George's University of London, London, UK

**Peter J. Helms, MB BS PhD FRCP(Edin) FRCPCH**  
Professor of Child Health, University of Aberdeen, Aberdeen, UK

**John Henderson, MD FRCP FRCPCH FRCPed**  
Reader in Paediatric Respiratory Medicine, University of Bristol and Bristol Royal Hospital for Children, Bristol, UK

**Tom Hilliard, MD FRCPCH**  
Consultant Respiratory Paediatrician, Bristol Children's Hospital, Bristol, UK

**Peter Hoare, DM FRCPsych**  
Senior Lecturer, University of Edinburgh; Honorary Consultant Psychiatrist, Royal Hospital for Sick Children, Edinburgh, UK

**Richard F. Howard, BSc MBChB FRCA**  
Consultant in Anaesthesia and Pain Management, Great Ormond Street Hospital for Children, London, UK

**Imelda Hughes, FRCPCH**  
Consultant Paediatric Neurologist, Department of Paediatric Neurology, Royal Manchester Children's Hospital, Manchester, UK

**Robert Hume, BSc MB ChB PhD FRCPEdin FRCPCH**  
Professor of Developmental Medicine, Maternal and Child Health Sciences, University of Dundee, Dundee, UK

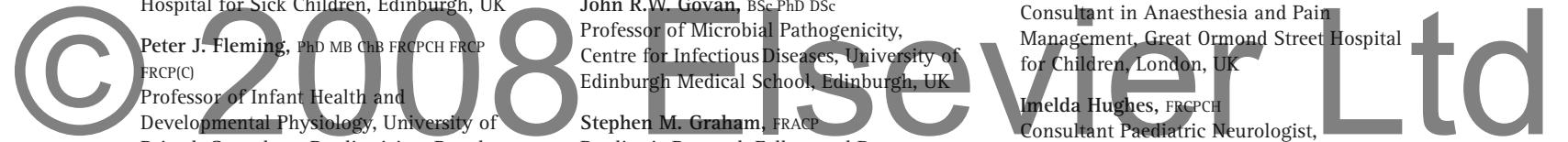
**Carol Inward, MBBCh MD FRCPCH**  
Consultant Paediatric Nephrologist, Bristol Royal Hospital for Children, Bristol, UK

**David Isaacs, MB BChir MD FRACP FRCPCH**  
Senior Staff Specialist at Children's Hospital at Westmead; Clinical Professor in Paediatric Infectious Diseases, University of Sydney, Sydney, Australia

**Omar Ismayil, MD MSc MRCPCH**  
Consultant Neurologist, Damascus University Children's Hospital, Mezza, Damascus, Syria

**Huw R. Jenkins, MA MD FRCP FRCPCH**  
Consultant Paediatric Gastroenterologist, Department of Child Health, University Hospital of Wales, Cardiff, Wales, UK

**Cheryl A. Jones, MB BS PhD FRACP**  
Associate Professor, and Sub Dean Postgraduate Studies, Discipline of Paediatrics and Child Health, University of Sydney; Sydney, New South Wales, Australia



**Christopher J.H. Kelnar, MA MD FRCP FRCPCH**  
Professor of Paediatric Endocrinology,  
Section of Child Life and Health, Division of  
Reproductive and Developmental Sciences,  
University of Edinburgh, Edinburgh, UK

**Alison M. Kemp, MB BCH DCH MRCP**  
FRCPCH FRCP(Edin)  
Reader in Child Heath, Department of Child  
Health, Cardiff University, Cardiff, Wales

**Alastair I.G. Kerr, MBChB FRCS(Edin & Glas)**  
Consultant Otolaryngologist, Ear, Nose and  
Throat Department, Royal Infirmary for Sick  
Children, Edinburgh, UK

**Alison M. Kesson, MB BS PhD FRACP FRCPA**  
Virologist, Microbiologist and Paediatric  
Infectious Disease Physician, The Children's  
Hospital, Westmead, Sydney New South  
Wales; Conjoint Associate Professor,  
Paediatrics and Child Health, University of  
Sydney, Sydney New South Wales, Australia

**Maurice A. Kibel, FRCP(Edin) DCH(Lond).**  
Emeritus Professor of Child Health, School  
of Child and Adolescent Health, University of  
Cape Town, South Africa

**Denise Kitchiner, MD FRCP FRCPCH**  
Consultant Paediatric Cardiologist,  
Royal Liverpool Children's NHS Trust,  
Liverpool, UK

**Nigel J. Klein, BSc MB BS MRCP PhD FRCPCH**  
Professor of Infection and Immunity,  
University College London; Head, Infectious  
Diseases and Microbiology Unit, Institute of  
Child Health; Head, Department of Infection,  
University College London; Consultant in  
Infectious Diseases and Microbiology,  
Great Ormond Street Hospital NHS Trust,  
London, UK

**David M. Koeller, MD**  
Associate Professor, Pediatrics and Molecular  
and Medical Genetics; Chief, Division  
of Metabolism, Department of Pediatrics,  
Doernbecher Children's Hospital, Oregon  
Health and Science University, Portland,  
Oregon, USA

**Sailesh Kotacha, MA FRCPCH PhD**  
Professor of Child Health, Department of  
Child Health, Wales College of Medicine,  
Cardiff University, Cardiff, Wales, UK

**Karen Kotloff, MD**  
Professor, Pediatrics and Medicine, Center  
for Vaccine Development, University of  
Maryland School of Medicine, Baltimore,  
Maryland, USA

**Ian A. Laing, MA MD FRCPE FRCPCH**  
Consultant Neonatologist, Simpson Centre  
for Reproductive Health, Royal Infirmary of  
Edinburgh, Edinburgh, UK

**David G. Laloo, MB BS MD FRCP**  
Reader In Tropical Medicine, Liverpool  
School of Tropical Medicine, Liverpool, UK

**Alison Leaf, BSc MB ChB MD MRCP FRCPCH**  
Consultant Neonatologist, Southmead  
Hospital, Bristol, UK

**Malcolm I. Levene, MD FRCPCH FMedSci**  
Professor of Paediatrics and Child Health,  
University of Leeds, Leeds General Infirmary,  
Leeds, UK

**Leesa M. Linck, MD MPH**  
Consultant Paediatrician,  
The Connty Clinic, Winthrop,  
Washington State, USA.

**John H. Livingston, MB ChB FRCP FRCPCH**  
Consultant Paediatric Neurologist,  
Department of Paediatric Neurology, Leeds  
General Infirmary, Leeds, UK

**Stuart Logan, MB ChB MSc(Epidemiology)**  
MSc(Econ) MRCP FRCPCH  
Professor of Paediatric Epidemiology;  
Director, Institute of Health and Social  
Care Research, Peninsula Medical School,  
St Luke's Campus, Exeter, UK

**Diana N.J. Lockwood, BSc MD FRCP**  
Consultant Physician and Leprologist,  
Hospital for Tropical Diseases, London, UK

**Andrew J. Lyon, MA MB FRCP FRCPCH**  
Consultant Neonatologist, Simpson Centre  
for Reproductive Health, Royal Infirmary of  
Edinburgh, Edinburgh, UK

**Ronan Lyons, MD FFPH FFPHM MPH DCH**  
Professor of Public Health, Centre for Health  
Information, Research and Evaluation,  
School of Medicine, Swansea University,  
Swansea, UK

**Anita Macdonald, PhD BSc SRD**  
Consultant Dietician in Inherited Metabolic  
Disorders, Birmingham Children's Hospital,  
Birmingham, UK, Head of Dietetics,  
Birmingham Children's Hospital NHS Trust,  
Birmingham, UK

**Mary McGraw, FRCP FRCPCH**  
Consultant Paediatric Nephrologist,  
Bristol Royal Hospital for Children,  
Bristol, UK

**Keiran McHugh, FRCR FRCPI DCH**  
Consultant Paediatric Radiologist, Great  
Ormond Street Hospital for Children,  
London, UK

**Neil McIntosh, DSc(Med)**  
Professor of Child Life and Health,  
Department of Child Life and Health,  
University of Edinburgh; Honorary  
Consultant Paediatrician, Lothian University  
Hospitals NHS Trust, Edinburgh, UK

**G.A. Mackinlay, MB BS LRCP FRCSEd**  
FRCSEng FRCPCH  
Senior Lecturer, Department of Clinical  
Surgery, University of Edinburgh; Consultant  
Paediatric Surgeon, Department of Paediatric  
Surgery, Royal Hospital for Sick Children,  
Edinburgh, UK

**Ian McKinley, OBE BSc MB ChB DCH FRCP FRCPCH**  
Senior Lecturer in Child Health, McKay-  
Gordon Centre, Royal Manchester Children's  
Hospital, Manchester, UK

**Sheila A.M. McLean, LLB MLitt PhD LLD FRSE**  
FRCP FMedSci FRCP(Edin) FRSA  
International Bar Association Professor of  
Law and Ethics in Medicine, University of  
Glasgow, Glasgow, UK

**Sabine Maguire, MB BCh BAO MRCPI FRCPI FRCPCH**  
Senior Lecturer in Child Health, Cardiff  
University, Department of Child Health,  
Cardiff, UK

**Janice Main, FRCP(Edin) FRCP(Lond)**  
Reader and Consultant Physician in  
Infectious diseases and General Medicine,  
Department of Medicine, Imperial College,  
St Mary's Hospital, London, UK

**Guy Makin, BA BM BCH PhD MRCP FRCPCH**  
Senior Lecturer in Paediatric Oncology,  
University of Manchester; Honorary  
Consultant Paediatric Oncologist,  
Royal Manchester Children's Hospital,  
Manchester, UK

**Timothy Martland, MB ChB MRCP MRCPCH**  
Consultant Paediatric Neurologist,  
Department of Paediatric Neurology,  
Royal Manchester Children's Hospital,  
Manchester, UK

**Amha Mekasha, MD MSc**  
Associate Professor of Paediatrics and Child  
Health, Department of Paediatrics and  
Child Health, Addis Ababa University,  
Adis Ababa, Ethiopia

**Craig Mellis, MB BS MPH MD FRACP**  
Head of School, Associate Dean, Central  
Clinic School, Faculty of Medicine, The  
University of Sydney, Sydney, Australia

**Stefan Meyer, MD PhD MRCPCH**  
CRUK Clinician Scientist and Consultant  
Paediatric Oncologist, University of  
Manchester, Royal Manchester Children's  
Hospital and Young Oncology Unit, Christie  
Hospital, Manchester, UK, Stefan Meyer MD  
PhD MRCPCH

**Alan E. Mills, MA MB DCP DPath FRCPA**  
FFPPathRCPI FACTM  
Consultant Pathologist, Dorevitch Pathology,  
Bendigo, Victoria, Australia

**Elizabeth Molyneux, OBE FRCP FRCPCH FEM**  
Professor and Head of Department of  
Paediatrics, College of Medicine, Blantyre,  
Malawi, C Africa.

**Malcolm E. Molyneux, MD FRCP FMedSci**  
Director, Malawi-Liverpool-Wellcome Trust  
Clinical Research Programme, College of  
Medicine, University of Malawi, Malawi;  
Professor of Tropical Medicine, School of  
Tropical Medicine, University of Liverpool,  
Liverpool, UK

**Kim Mulholland, MD FRACP**

Professor of Child Health, London School of Hygiene and Tropical Medicine, London, UK, Infectious Disease Epidemiology Unit, London School of Hygiene and Tropical Medicine, London, UK

**Alan O. Mulvihill, FRCSEd**

Consultant Ophthalmic Surgeon, Princess Alexandra Eye Pavilion and Royal Hospital for Sick Children, Edinburgh, UK

**Richard W. Newton, MD FRCPCH FRCR**

Consultant Paediatric Neurologist, Royal Manchester Children's Hospital, Manchester, UK

**Angus Nicoll, CBE FFPHE FRCP FRCPCH**

Director, Communicable Disease Surveillance Centre, Centre for Infection, Health Protection Agency, London, UK

**James Y. Paton, MD FRCPCH FRCPSG**

Reader in Paediatric Respiratory Medicine, Division of Developmental Medicine, University of Glasgow, Royal Hospital for Sick Children, Glasgow, UK

**Michael A. Patton, MA MSc MBChB FRCPCH**

Professor of Medical Genetics and Consultant Medical Geneticist, Department of Medical Genetics, St George's Hospital Medical School, London, UK

**Philip L. Pearl, MD**

Associate Professor of Paediatrics and Neurology, Department of Neurology, Children's National Medical Center, The George Washington University School of Medicine, Washington DC, USA

**Gale A. Pearson, MB BS MRCP FRCPCH**

Consultant in Paediatric Intensive Care, Birmingham Children's Hospital, Birmingham, UK

**Stavros Petrou, BSc MPhil PhD**

MRC Senior Non-Clinical Research Fellow, National Perinatal Epidemiology Unit, University of Oxford, Oxford, UK

**Ian J. Ramage, FRCPCH**

Consultant Paediatric Nephrologist, Royal Hospital for Sick Children, Glasgow, UK

**John J. Reilly, BSc PhD**

Professor of Paediatric Energy Metabolism, University Division of Developmental Medicine, Royal Hospital for Sick Children, Glasgow, UK

**J.M. Rennie, MD FRCP FRCPCH DCH**

Consultant and Senior Lecturer in Neonatal Medicine, Elizabeth Garrett Anderson and Obstetric Hospital, University College London Hospitals, London

**Sam Richmond, MB BS FRCP FRCPCH**

Consultant Neonatologist, Sunderland Royal Hospital, Sunderland, UK

**Irene A.G. Roberts, MD FRCP FRCPath FRCPCH DRCOG**

Professor of Paediatric Haematology and Consultant Paediatric Haematologist, Hammersmith Hospital and St Mary's Hospitals, Imperial College, London, UK

**Peter T. Rudd, MD FRCPCH**

Consultant Paediatrician, Royal United Hospital, Bath, UK

**S.C. Robson, MD MRCOG**

Professor of Fetal Medicine, School of Surgical and Reproductive Sciences, Newcastle University, Newcastle upon Tyne, UK

**Jean-Baptiste Roulet, PhD**

Associate Professor (Research), Division of Metabolism, Department of Paediatrics, Oregon Health and Science University, Portland, Oregon, USA; Adjunct Associate Professor of Pharmacology and Therapeutics, University of Calgary, Calgary, Alberta, Canada

**George Rylance, MB FRCPCH**

Consultant in Paediatrics, Department of Child Health, Royal Victoria Infirmary, Newcastle upon Tyne, UK

**Moin A. Saleem, MB BS FRCP PhD**

Reader and Honorary Consultant Paediatric Nephrologist, Bristol Children's Hospital, University of Bristol, Bristol, UK

**Alison Salt, MB BS MSc FRACP FRCPCH**

Consultant Developmental Paediatrician, Neurodisability Service, Great Ormond Street Hospital for Children NHS Trust and Institute of Child Health, London, UK

**Jenefer Sargent, MA MB BCh MSc MRCPCH**

Consultant Developmental Paediatrician, Neurodisability Service, Great Ormond Street Hospital for Children NHS Trust, London, UK

**Ayad Shafiq, FRCOphth MRCPPaeds DCH BM BCh**

Consultant Ophthalmologist, Royal Victoria Hospital, Newcastle upon Tyne, UK

**Jonathan R. Skinner, MB ChB FRCPCH FRACP MD**

Paediatric Cardiologist, Green Lane Paediatric and Cardiac Services, Starship Children's Hospital, Auckland, New Zealand

**Alan Smyth, MA MB BS MRCP MD FRCPCH**

Reader in Child Health, University of Nottingham; Honorary Consultant in Paediatric Respiratory Medicine, Nottingham University Hospitals NHS Trust, Nottingham, UK

**Rosalind L. Smyth, MA MB BS MD FRCPCH**

Brough Professor of Paediatric Medicine, University of Liverpool, Liverpool, UK

**Robert D. Steiner, MD**

Professor, Pediatrics and Molecular and Medical Genetics; Vice Chair for Research, Department of Pediatrics, Doernbecher

Children's Hospital; Deputy Director, Oregon Clinical and Translational Research Institute, Oregon Health and Science University, Portland, Oregon, USA

**Ben Stenson, MD FRCPCH FRCPE**

Consultant Neonatologist, Simpson Centre for Reproductive Health, Royal Infirmary of Edinburgh, Edinburgh, UK

**Terence Stephenson, DM FRCP FRCPCH**

Professor of Child Health; Dean, Faculty of Medicine and Health Sciences, Medical School, University of Nottingham, Queen's Medical Centre, Nottingham, UK

**Stephen Stick, PhD MB BChir MRCP FRACP**

Associate Professor, Department of Respiratory Medicine, Princess Margaret Hospital for Children, University of Western Australia, Australia

**Stephen Sturgiss, MD MRCOG**

Consultant in Obstetrics and Fetal Medicine, Royal Victoria Infirmary, Newcastle upon Tyne, UK

**David Sweet, MD FRCPCH**

Consultant Neonatologist, Royal Maternity Hospital, Belfast, Northern Ireland, UK

**Angela E. Thomas, MB BS PhD FRCPE FRCPath FRCPCH**

Consultant Paediatric Haematologist, Royal Hospital for Sick Children, Edinburgh, UK

**James Tooley, MB BS MRCPCH**

Consultant in Neonatal Medicine, Neonatal Intensive Care Unit, St Michael's Hospital, Bristol, UK

**E. Jane Tizard, MB BS, FRCP FRCPCH**

Consultant Paediatric Nephrologist, Bristol Royal Hospital for Children, Bristol, UK

**Russell Viner, MB BS FRCPCH FRACP FRCP PhD**

Consultant in Adolescent Medicine and Endocrinology, Department of Paediatrics, Middlesex Hospital, London, UK

**Rachel Webster, BSc PhD DipRCPath**

Clinical Scientist, Department of Clinical Biochemistry, Birmingham Children's Hospital, Birmingham, UK

**Philip D. Welsby, FRCP(Ed)**

Consultant in Infectious Diseases, Infectious Disease Unit, Western General Hospital, Edinburgh, UK

**Johannes Wildhaber, MD PhD**

Head, Division of Respiratory Medicine, University Children's Hospital, Zürich, Switzerland

**Anthony F. Williams, BSc DPhil MB BS**

FRCP FRCPCH Reader in Child Nutrition, St George's, University of London, London, UK



**Bridget A. Wills**, BmedSci BM BS MRCP DTM&H  
Clinical Senior Lecturer in Paediatrics,  
University of Oxford – Wellcome Trust  
Clinical Research Unit, Ho Chi Minh City,  
Vietnam

**David C. Wilson**, MD FRCP FRCPCH  
Senior Lecturer in Paediatric  
Gastroenterology and Nutrition, Child Life

and Health, Department of Reproductive  
and Developmental Sciences, University of  
Edinburgh, Edinburgh, UK

**Rachael Wood**, BSc MB ChB DCH MFH MFPH  
Clinical Academic Fellow, Department  
of Public Health Sciences and Centre for  
International Public Health Policy University  
of Edinburgh, Edinburgh, UK

**Christopher Wren**, MB ChB FRCP FRCPCH  
Consultant Paediatric Cardiologist, Freeman  
Hospital, Newcastle upon Tyne, UK

© 2008 Elsevier Ltd

© 2008 Elsevier Ltd