ERS | handbook

Paediatric Respiratory Medicine

2nd Edition

Editors

Ernst Eber

Fabio Midulla

ERS|handbook

Paediatric Respiratory Medicine

2nd Edition

Editors

Ernst Eber

Fabio Midulla

PUBLISHED BY THE EUROPEAN RESPIRATORY SOCIETY

CHIEF EDITORS

Ernst Eber (Graz, Austria)

Fabio Midulla (Rome, Italy)

ERS STAFF

Caroline Ashford-Bentley, Alice Bartlett, Sarah Cleveland, Claire Marchant,
Catherine Pumphrey, Elin Reeves, Ben Watson

© 2021 European Respiratory Society

Design by Claire Marchant, ERS

Typeset by Nova Techset Private Limited, India

Indexed by Merrall-Ross International, UK

Printed by Page Bros Group Ltd, Norwich, UK

All material is copyright to the European Respiratory Society.

It may not be reproduced in any way including electronically without the express permission of the society.

CONTACT, PERMISSIONS AND SALES REQUESTS:

European Respiratory Society, 442 Glossop Road, Sheffield, S10 2PX, UK

Tel: +44 114 2672860 Fax: +44 114 2665064 e-mail: books@ersnet.org

Print ISBN: 978-1-84984-130-6

Online ISBN: 978-1-84984-131-3

ePub ISBN: 978-1-84984-132-0

Purchased by ,
From: European Respiratory Society Publications (reader.ersjournals.com)

Table of contents

Contributors	xi
Preface	xxiii
List of abbreviations	xxiv
 1 – Structure and function of the respiratory system	
Anatomy and development of the respiratory system	1
Pinelopi Anagnostopoulou and Johannes C. Schittny	
Applied respiratory physiology	14
Monika Gappa and Nicole Beydon	
Immunology and defence mechanisms	24
Johanna Theodorou and Bianca Schaub	
 2 – Respiratory symptoms and signs	
History and physical examination	36
Sotirios Fouzas, Konstantinos Douros and Michael B. Anthracopoulos	
Evaluation and management of acute and chronic cough	45
Julie M. Marchant, Anne B. Chang and Ahmad Kantar	
Evaluation and management of wheezing, stridor, snoring and hoarseness	53
Konstantinos Douros, Sotirios Fouzas and Kostas N. Priftis	
Evaluation and management of dyspnoea, respiratory distress and respiratory insufficiency	62
Nilay Bas Ikizoglu, Sedat Oktem and Refika Ersu	
Questionnaires in clinical assessment	73
John A. King and Louise J. Fleming	

3 – Pulmonary function and diagnostic testing

Static and dynamic lung volumes 80

Elisabeth Kieninger, Yasmin Salem Mahmoud and Oliver Fuchs

Respiratory mechanics 89

Marc-Alexander Oestreich, Christoph Corin Willers and Oliver Fuchs

Respiratory muscle function 97

Brigitte Fauroux, Alessandro Amaddeo and Sonia Khirani

Reversibility and bronchial provocation testing 104

Nicole Beydon and Monika Gappa

Cardiopulmonary exercise testing 113

Helge Hebestreit and Thomas Radtke

Blood gas assessment and oximetry 121

Paola Papoff, Corrado Moretti and Raffaella Nenna

Single- and multiple-breath washout techniques 129

Bettina Sarah Frauchiger, Sophie Yammine and Florian Singer

Pulmonary function testing in infants and preschool children 135

Enrico Lombardi, Claudia Calogero and Graham L. Hall

Forced oscillation techniques 141

Shannon J. Simpson, Sherlynn Ang and Graham L. Hall

Exhaled nitric oxide, induced sputum and exhaled breath analysis 146

Mariëlle Pijnenburg, Valentina Ferraro and Silvia Carraro

Assessing respiratory risks of air travel, altitude and diving 154

Mary J. Sharp, Carly E. Seeber and Graham L. Hall

4 – Airway endoscopy

Flexible airway endoscopy 158

Ernst Eber, Jacques de Blic and Fabio Midulla

Bronchoalveolar lavage: techniques and indications 169

Fabio Midulla, Raffaella Nenna and Ernst Eber

Bronchial brushing and bronchial and transbronchial biopsies 176

Petr Pohunek, Václav Koucký and Pierre Goussard

Purchased by ,
From: European Respiratory Society Publications (reader.ersjournals.com)

Rigid and interventional airway endoscopy	183
Ernst Eber, Thomas Nicolai and Fabio Midulla	
Sedation for airway endoscopy	190
Jacques de Blic	
5 - Imaging	
Conventional chest radiography	196
Matthias C. Schaal and Meinrad Beer	
Lung/chest ultrasonography	203
Michael Riccabona	
Chest computed tomography	212
Harm A.W.M. Tiddens, Pierluigi Ciet and Marcel van Straten	
Chest magnetic resonance imaging	222
Pierluigi Ciet, Harm A.W.M. Tiddens and Piotr Wielopolski	
Lung isotope imaging methods	234
Georg Berding	
Chest interventional radiology	238
Eftymia Alexopoulou, Argyro Mazioti and Dimitrios Filippiadis	
6 - Respiratory infections	
Upper respiratory tract infections	244
Rossa Brugha, Chinedu Nwokoro and Jonathan Grigg	
Acute lower respiratory tract infections	253
Vanessa E. Craven and Mark L. Everard	
Acute viral bronchiolitis	267
Fabio Midulla, Greta Di Mattia and Laura Petrarca	
Pleural infection, necrotising pneumonia and lung abscess	274
Fernando Maria de Benedictis, Roberto Guidi and Giovanni Cobellis	
Mycobacterial infection and disease	284
James Paton	
Protracted bacterial bronchitis and non-CF bronchiectasis	312
Adeline Y.L. Lim, Ahmad Kantar and Anne B. Chang	

Lung involvement in the immunocompromised host	324
Rossa Brugha and Paul Aurora	

Microbiology and infectivity	331
Elpis Hatziaorou, Emmanuel Roilides and John Tsanakis	

Immunisation against respiratory pathogens	339
Horst von Bernuth, Volker Strenger and Philippe Stock	

7 - Asthma and wheezing disorders

Epidemiology and phenotypes of asthma and wheezing disorders	348
Franca Rusconi, Cristina Ardura-Garcia and Claudia E. Kuehni	

Genetic and environmental factors in asthma and wheezing disorders	355
Erika von Mutius	

Preschool wheezing	361
Giorgio Piacentini and Laura Tenero	

Asthma	369
Mariëlle Pijnenburg, Antonella Frassanito and Alexander Moeller	

Difficult and severe asthma	382
Andrew Bush and Louise Selby	

8 - Allergic disorders

Anaphylaxis	390
Antonella Muraro and Stefania Arasi	

Allergic rhinitis	396
Michele Miraglia del Giudice, Annalisa Allegorico, Fabio Decimo and Anna Maria Zicari	

Allergic bronchopulmonary aspergillosis	406
Andrew Bush and Dominic Hughes	

Diagnosis and basic management of associated allergic conditions	414
Maurizio Mennini, Stefania Arasi, Vincenzo Fierro, Maria Cristina Artesani and Alessandro Giovanni Fiocchi	

In vivo and in vitro allergy diagnostics	422
Full text available on the European Respiratory Society Publications (reader.ersjournals.com)	

Prevention measures in allergic disorders	427
Susanne Halken	
9 – Cystic fibrosis	
Epidemiology, genetics, pathophysiology and prognosis of CF	435
Caroline Poulter, Iolo Doull and Jayesh Mahendra Bhatt	
Screening and diagnosis of CF	446
Jürg Barben and Kevin W. Southern	
CF lung disease	452
Nicolas Regamey and Giulia Cangiano	
Extrapulmonary manifestations of CF	461
Vanessa Stadlbauer	
Microbiology, cross-infection and hygiene in CF	473
Michael Hogardt and Silke Besier	
10 – Congenital malformations	
Airway malformations	484
Ernst Eber and Andreas Pfleger	
Lung malformations	495
Ashok Daya Ram, Katherine Burke, Jennifer Calvert and Sailesh Kotecha	
Vascular malformations	504
Oliviero Sacco and Laura Petrarca	
11 – Bronchopulmonary dysplasia	
Epidemiology, aetiology, prevention, diagnosis, management and complications of BPD	515
Alice Hadchouel, Pierre-Henri Jarreau and Christophe Delacourt	
Long-term respiratory outcomes of BPD	521
Laura Moschino, Charles C. Roehr and Eugenio Baraldi	
12 – Effects of systemic and extrapulmonary conditions on the respiratory system	
Effects of systemic and extrapulmonary conditions on the respiratory system	532
Andrew Bush and Rishi Pabary	

13 – Aerodigestive disorders

GOR-associated lung disease and chronic pulmonary aspiration syndrome 550

Charmaine Chai, Anna Rybak and Osvaldo Borrelli

Laryngeal cleft, tracheo-oesophageal fistula and oesophageal atresia 557

Colin Butler, Richard Hewitt, Paolo de Coppi and Colin Wallis

Foreign body aspiration 563

Iolo Doull

14 – Rare diseases

Primary ciliary dyskinesia 569

Bruna Rubbo, Myrofora Goutaki and Jane S. Lucas

Bronchiolitis obliterans 579

Marco Poeta, Francesca Santamaria and Salvatore Cazzato

Interstitial lung diseases 588

Nadia Nathan, Laura Berdah and Annick Clement

Surfactant dysfunction syndromes and pulmonary alveolar proteinosis 602

Elias Seidl, Christina Rapp, Matthias Kappler and Matthias Griesse

Pulmonary vascular disorders 610

Andrew Bush and Elizabeth Scotney

Pulmonary haemorrhage 620

Matthias Griesse

Pleural effusion, chylothorax, haemothorax and mediastinitis 626

Juan Antón-Pacheco, Carmen Luna-Paredes and
Alvaro Gimeno Díaz de Atauri

Pneumothorax and pneumomediastinum 637

Nicolaus Schwerk, Julia Carlens and Hartmut Grasemann

Drug- and radiation-induced lung disease 646

Nicolaus Schwerk, Julia Carlens and Matthias Griesse

Neuromuscular disorders 657

Anita K. Simonds, Claudio Cherchi and Renato Cutrera

From: European Respiratory Society Publications (reader.ersjournals.com)

Chest wall disorders	661
Daniel Trachsel, Thierry de Trey and Daniel Studer	
Plastic bronchitis	669
Bruce K. Rubin and Maxim Itkin	
Haemangiomas, lymphangiomas and papillomatosis	675
Thomas Nicolai	
Lung and mediastinal tumours	683
Amalia Schiavetti and Giulia Varrasso	
Sickle cell disease	689
Tobias Ankermann	
15 - Sleep medicine and breathing control disorders	
Physiology and pathophysiology of sleep	694
Frederic Proulx, Valeria Caldarelli and Refika Ersu	
Polysomnography	705
Ela Erdem Eralp, Sedat Oktem and Refika Ersu	
OSAS and upper airway resistance syndrome	718
Maria Pia Villa, Melania Evangelisti and Athanasios G. Kaditis	
Central sleep apnoeas and hypoventilation syndromes	725
Ha Trang and Iulia Ioan	
Breathing pattern disorders	732
Samatha Sonnappa and Charlotte Wells	
16 - Long-term management in chronic respiratory disorders	
Rehabilitation programmes and nutritional management	739
Andreas Jung	
Respiratory physiotherapy	747
Marlies Wagner	
Sports medicine	753
Giancarlo Tancredi, Giovanna De Castro and Ambra Nicolai	
Lung transplantation and management after transplantation	760
Paul D. Robinson and Paul Aurora	

17 - Inhalation therapy

Inhalation therapy 771

Wytse B. van den Bosch and Hettie M. Janssens

18 - Technology-dependent children

Home oxygen therapy, noninvasive and invasive ventilation, and home ventilatory support 782

Brigitte Fauroux, Sonia Khirani and Alessandro Amaddeo

Tracheostomy 789

Colin Wallis and Joanne Cooke

19 - Epidemiology and environment

Epidemiology of lower respiratory tract infections 797

Hepsi Xavier and Steve Turner

Impact of indoor and outdoor pollution on respiratory health 806

Norrice Liu and Jonathan Grigg

Prevention and cessation of smoking 815

Giuliana Ferrante, Giovanna Cilluffo and Stefania La Grutta

Index 820

Contributors

Chief editors

Ernst Eber
Division of Paediatric Pulmonology and
Allergology, Dept of Paediatrics and
Adolescent Medicine, Medical University
of Graz, Graz, Austria
ernst.eber@medunigraz.at

Fabio Midulla
Paediatric Emergency Service, Dept of
Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
midulla@uniroma1.it

Authors

Efthymia Alexopoulou
2nd Dept of Radiology, University
Hospital “Attikon”, National and
Kapodistrian University of Athens,
Athens, Greece
ealex64@hotmail.com

Annalisa Allegorico
Università degli studi della Campania
“Luigi Vanvitelli”, Naples, Italy
aallegorico@gmail.com

Alessandro Amaddeo
Paediatric Noninvasive Ventilation
and Sleep Unit, Necker University
Hospital, AP-HP, and Paris University EA
VIFASOM, Paris, France
alessandro.amaddeo@aphp.fr

Pinelopi Anagnostopoulou
Medical School and Respiratory Hub,
University of Cyprus, Nicosia, Cyprus,
and Institute of Anatomy, University of
Bern, Bern, Switzerland
anagnostopoulou.pinelopi@ucy.ac.cy

Sherlynn Ang
Telethon Kids Institute, Perth, Australia
sherlynn.ang@telethonkids.org.au

Tobias Ankermann
Universitätsklinikum Schleswig-
Holstein Campus Klinik für Kinder- und
Jugendmedizin I, Kiel, Germany
ankermann@pediatrics.uni-kiel.de

Michael B. Anthracopoulos
Respiratory Unit, Dept of Paediatrics,
University of Patras, Patras, Greece
manthra@otenet.gr

Juan Antón-Pacheco
Hospital Universitario 12 de Octubre,
Madrid, Spain
juan.antonpacheco@salud.madrid.org

Stefania Arasi
Allergy Unit, Bambino Gesù Children’s
Hospital, IRCCS, Rome, Italy
stefania.arasi@yahoo.it

Cristina Ardura-Garcia
Institute of Social and Preventive
Medicine, University of Bern, Bern,
Switzerland
cristina.ardura@ispm.unibe.ch

Maria Cristina Artesani
Allergy Unit, Bambino Gesù Children’s
Hospital, IRCCS, Rome, Italy
maria.c.artesani@opbg.net

Paul Aurora
Respiratory, Critical Care and
Anaesthesia Section, UCL Great Ormond
Street Institute of Child Health, and
Dept of Respiratory Medicine, Great
Ormond Street Hospital for Children
NHS Foundation Trust, London, UK
p.aurora@ucl.ac.uk

Eugenio Baraldi
Dept of Women's and Children's Health,
University of Padua, Padua, Italy
eugenio.baraldi@unipd.it

Jürg Barben
Division of Respiratory Medicine,
Children's Hospital of Eastern
Switzerland, St Gallen, Switzerland
juerg.barben@kispisg.ch

Nilay Bas Ikizoglu
Division of Pediatric Pulmonology,
Sureyyapasa Chest Diseases and Chest
Surgery Training and Research Hospital,
Istanbul, Turkey
nilaybas@yahoo.com

Meinrad Beer
Dept of Diagnostic and Interventional
Radiology, University Hospital Ulm,
Ulm, Germany
meinrad.beer@uniklinik-ulm.de

Laura Berdah
Pediatric Pulmonology Dept,
Reference center for rare lung diseases
(RespiRare), Armand Trousseau
Hospital, Assistance Publique Hôpitaux
de Paris (AP-HP), Paris, France
laura.berdah@aphp.fr

Georg Berding
Dept of Nuclear Medicine, Hannover
Medical School, Hannover, Germany
berding.georg@mh-hannover.de

Silke Besier
University Hospital Frankfurt, Goethe
University, Institute for Medical
Microbiology and Infection Control,
Frankfurt am Main, Germany
Silke.Besier@kgu.de

Nicole Beydon
Functional Unit of Pulmonary Function
Testing and Sleep Medicine, Armand
Trousseau Hospital, Paris, France
nicole.beydon@aphp.fr

Jayesh Mahendra Bhatt
Paediatric Respiratory Medicine,
Nottingham Children's Hospital, Queens
Medical Centre, Nottingham, UK
jayesh.bhatt@nuh.nhs.uk

Osvaldo Borrelli
Dept of Paediatric Gastroenterology,
Division of Neurogastroenterology and
Motility, Great Ormond Street Hospital
for Children, ICH University College of
London, London, UK
Osvaldo.Borrelli@gosh.nhs.uk

Rossa Brugha
Paediatric Respiratory Medicine, Great
Ormond Street Hospital, London, UK
rossabrugha@nhs.net

Katherine Burke
Dept of Neonatal Medicine, University
Hospital of Wales, Cardiff, UK
Katherine.Burke@wales.nhs.uk

Andrew Bush
Dept of Paediatric Respiratory Medicine,
Royal Brompton Hospital, London, UK
a.bush@imperial.ac.uk

Colin Butler
Dept of Otolaryngology, Great Ormond
Street Hospital, London, UK
colin.butler@ucl.ac.uk

Valeria Caldarelli
Pediatric Unit, Azienda Unita Sanitaria
Locale di Reggio Emilia - IRCCS, Reggio
Emilia, Italy
vale.caldarelli@gmail.com

Claudia Calogero
Paediatric Pulmonary Unit, Anna Meyer
Paediatric University Hospital, Florence,
Italy
claudia.calogero@meyer.it

Jennifer Calvert
Dept of Neonatal Medicine, University
Hospital of Wales, Cardiff, UK
Jennifer.Calvert@wales.nhs.uk

Giulia Cangiano
ULSS Scaligera, Verona, Italy
giuliacangiano.gc@gmail.com

Julia Carlens
Dept of Pediatrics, Pediatric
Pneumology, Allergology and
Neonatology, Hannover Medical School,
Hannover, Germany
Carlens.Julia@mh-hannover.de

Silvia Carraro
Unit of Paediatric Allergy and
Respiratory Medicine, Dept of Women's
and Children's Health, University of
Padua, Padua, Italy
silvia.carraro@unipd.it

Salvatore Cazzato
Dept of Mother and Child Health, Salesi
Children's Hospital, Ancona, Italy
salvatore.cazzato@ospedaleiruniti.
marche.it

Charmaine Chai
Dept of Paediatric Gastroenterology,
Division of Neurogastroenterology and
Motility, Great Ormond Street Hospital
for Children, ICH University College of
London, London, UK
charmaine.chai@gmail.com

Anne B. Chang
Dept of Respiratory and Sleep Medicine,
Queensland Children's Hospital,
Queensland University of Technology,
Brisbane, and Division of Child Health,
Menzies School of Health Research,
Darwin, Australia
annechang@ausdoctors.net

Claudio Cherchi
Pneumology Unit, Dept of Pediatric
Medicine, Bambino Gesù Children's
Hospital, IRCCS, Rome, Italy
claudio.cherchi@opbg.net

Pierluigi Ciet
Dept of Pediatric Pulmonology and
Allergology, Erasmus MC Sophia
Children's Hospital, and Dept of
Radiology and Nuclear Medicine,
Erasmus MC, Rotterdam,
The Netherlands
p.ciet@erasmusmc.nl

Giovanna Cilluffo
Istituto per la Ricerca e l'Innovazione
Biomedica (IRIB), Consiglio Nazionale
delle Ricerche (CNR), Palermo, Italy
giovanna.cilluffo@irib.cnr.it

Annick Clement
Pediatric Pulmonology Dept,
Reference center for rare lung diseases
(RespiRare), Armand Trousseau
Hospital, Assistance Publique Hôpitaux
de Paris (AP-HP), Sorbonne Université
and Inserm UMR_S933 Childhood
Genetic Disorders, Paris, France
annick.clement@aphp.fr

Giovanni Cobellis
Surgery Unit, Dept of Mother and Child
Health, Salesi Children's Hospital,
Ancona, Italy
giovannicobellis@tiscali.it

Joanne Cooke
Dept of Paediatric Otolaryngology, Great
Ormond Street Hospital, London, UK
jo.cooke@gosh.nhs.uk

Vanessa E. Craven
Dept of Paediatric Respiratory Medicine,
Sheffield Children's Hospital, Sheffield,
UK
vanessacraven2@gmail.com

Renato Cutrera
Pneumology Unit, Dept of Pediatric
Medicine, Bambino Gesù Children's
Hospital, IRCCS, Rome, Italy
renato.cutrera@opbg.net

Fernando Maria de Benedictis
Salesi Children's Hospital Foundation,
Ancona, Italy
pediatria@fmdebenedictis.it

Jacques de Blic
Pediatric Pulmonology and Allergology
Dept, Necker-Enfants Malades Hospital,
and Université de Paris, Paris, France
deblicj@gmail.com

Giovanna De Castro
Paediatric Allergology Service, Dept
of Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
giovanna.decastro@uniroma1.it

Fabio Decimo
Università degli studi della Campania
"Luigi Vanvitelli", Naples, Italy
fabio.decimo@unicampania.it

Paolo de Coppi
Surgery Dept, Great Ormond Street
Hospital, London, UK
Paolo.DeCoppi@gosh.nhs.uk

Christophe Delacourt
Pediatric Pulmonology Dept, Necker-
Enfants Malades Hospital, and Paris
University, Paris, France
christophe.delacourt@aphp.fr

Thierry de Trey
Paediatric Surgery, University of Basel
Children's Hospital (UKBB), Basel,
Switzerland
thierry.detrey@ukbb.ch

Greta Di Mattia
Paediatric Emergency Service, Dept
of Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
greta.di.mattia@gmail.com

Iolo Doull
Dept of Paediatric Respiratory Medicine,
Children's Hospital for Wales, Cardiff,
UK
doullij@cf.ac.uk

Konstantinos Douros
Faculty of Medicine, National and
Kapodistrian University of Athens,
and Attikon General Hospital, Athens,
Greece
costasdouros@gmail.com

Ela Erdem Eralp
Division of Pediatric Pulmonology,
Marmara University, Istanbul, Turkey
elaerdem@yahoo.com

Refika Ersu
Division of Respiriology, University of
Ottawa, Children's Hospital of Eastern
Ontario, Ottawa, ON, Canada
rersu@yahoo.com

Melania Evangelisti
School of Medicine and Psychology,
Sapienza University, S. Andrea Hospital,
Rome, Italy
melania.evangelisti@uniroma1.it

Mark L. Everard
Dept of Paediatric Respiratory Medicine,
University of Western Australia, Perth,
Australia
mark.everard@uwa.edu.au

Brigitte Fauroux
Paediatric Noninvasive Ventilation
and Sleep Unit, Necker University
Hospital, AP-HP, and Paris University EA
VIFASOM, Paris, France
brigitte.fauroux@aphp.fr

Giuliana Ferrante
Dept of Health Promotion, Mother
and Child Care, Internal Medicine and
Medical Specialities, University of
Palermo, Palermo, Italy
giuliana.ferrante@unipa.it

Valentina Ferraro
Unit of Paediatric Allergy and
Respiratory Medicine, Dept of Women's
and Children's Health, University of
Padua, Padua, Italy
ferrarovalentina@hotmail.com

Vincenzo Fierro
Allergy Unit, Bambino Gesù Children's
Hospital, IRCCS, Rome, Italy
Vincenzo.fierro@opbg.net

Dimitrios Filippiadis
2nd Dept of Radiology, University
Hospital "Attikon", National and
Kapodistrian University of Athens,
Athens, Greece
dfilippiadis@yahoo.gr

Alessandro Giovanni Fiocchi
Allergy Unit, Bambino Gesù Children's
Hospital, IRCCS, Rome, Italy
alessandro.fiocchi@allegriallergia.net

Louise J. Fleming
Dept of Paediatric Respiratory Medicine,
Royal Brompton Hospital, and National
Heart and Lung Institute, Imperial
College, London, UK
l.fleming@rbht.nhs.uk

Sotirios Fouzas
Respiratory Unit, Dept of Paediatrics,
University of Patras, Patras, Greece
sfouzas@gmail.com

Antonella Frassanito
Paediatric Emergency Service, Dept
of Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
antonella.frassanito@uniroma1.it

Bettina Sarah Frauchiger
Paediatric Respiratory Medicine,
Children's University Hospital of Bern,
University of Bern, Bern, Switzerland
bettina.frauchiger@insel.ch

Oliver Fuchs
Inselspital Bern, Universitätsklinik für
Kinderheilkunde, Dept of Paediatric
Respiratory Medicine, Bern, Switzerland
oliver.fuchs@insel.ch

Monika Gappa
Children's Hospital and Research
Institute, Evangelisches Krankenhaus,
Düsseldorf, Germany
monika.gappa@evk-duesseldorf.de

Alvaro Gimeno Díaz de Aza
Hospital Universitario 12 de Octubre,
Madrid, Spain
alvaro.gimeno@salud.madrid.org

Pierre Goussard
Dept of Paediatrics and Child Health,
Stellenbosch University, Cape Town,
South Africa
pgouss@sun.ac.za

Myrofora Goutaki
Institute of Social and Preventive
Medicine, University of Bern, and
Paediatric Respiratory Medicine,
University Children's Hospital,
University of Bern, Bern, Switzerland
myrofora.goutaki@ispm.unibe.ch

Hartmut Grasmann
Division of Respiratory Medicine, Dept
of Pediatrics, The Hospital for Sick
Children, Toronto, ON, Canada
hartmut.grasmann@sickkids.ca

Matthias Gries
Dr von Hauner Children's Hospital,
University of Munich, Dept of Pediatrics,
German Center for Lung Research (DZL)
and European Management Platform
Childhood Interstitial Lung Disease
(chILD-EU), Munich, Germany
Matthias.Gries@med.
Munich.de

Print European Respiratory Society Publications (reader.ersjournals.com)

Jonathan Grigg
Centre for Genomics and Child Health,
Blizard Institute, Queen Mary University
of London, London, UK
j.grigg@qmul.ac.uk

Roberto Guidi
Pediatric Unit, Dept of Mother and
Child Health, Salesi Children's Hospital,
Ancona, Italy
robertoguidi@yahoo.it

Alice Hadchouel
Pediatric Pulmonology Dept, Necker-
Enfants Malades Hospital, and Paris
University, Paris, France
alice.hadchouel-duverge@aphp.fr

Susanne Halken
Odense University Hospital, Hans
Christian Andersen Children's Hospital,
Odense, Denmark
susanne.halken@rsyd.dk

Graham L. Hall
Telethon Kids Institute, and School of
Physiotherapy and Exercise Science,
Curtin University, Perth, Australia
graham.hall@telethonkids.org.au

Elpis Hatziaorou
Pediatric Pulmonology and Cystic
Fibrosis Unit, Aristotle University of
Thessaloniki, School of Health Sciences,
Hippokratia General Hospital,
Thessaloniki, Greece
elpcon@otenet.gr

Helge Hebestreit
Paediatric Dept, University Hospital
Würzburg, Würzburg, Germany, and
member of ERN-LUNG
Hebestreit_h@ukw.de

Gunilla Hedlin
Dept of Women's and Children's Health,
Karolinska Institutet, Stockholm,
Sweden
gunilla.hedlin@ki.se

Richard Hewitt
Dept of Otolaryngology, Great Ormond
Street Hospital, London, UK
Richard.Hewitt@gosh.nhs.uk

Michael Hogardt
University Hospital Frankfurt, Goethe
University, Institute for Medical
Microbiology and Infection Control,
Frankfurt am Main, Germany
Michael.Hogardt@kgu.de

Dominic Hughes
National Heart and Lung Institute,
Imperial College London, London, UK
d.hughes2@rbht.nhs.uk

Iulia Ioan
Lung Function Testing Lab, University
Children's Hospital of Nancy; EA3450
DevAH, University of Lorraine, Nancy,
France
ic.ioan@chru-nancy.fr

Maxim Itkin
Center for Lymphatic Disorders,
Perelman School of Medicine, University
of Pennsylvania, Philadelphia, PA, USA
itkinmax@gmail.com

Hettie M. Janssens
Dept of Paediatrics, Division of
Respiratory Medicine and Allergology,
Erasmus MC Sophia Children's Hospital,
University Hospital Rotterdam,
Rotterdam, The Netherlands
h.janssens@erasmusmc.nl

Pierre-Henri Jarreau
Neonatal Intensive Care Unit, Cochin-
Port Royal Hospital, and Paris University,
Paris, France
pierre-henri.jarreau@aphp.fr

Andreas Jung
Children's University Hospital Zurich,
Division of Pulmonology, Zurich,
Switzerland
Andreas.Jung@kispi.uzh.ch

Athanasios G. Kaditis
School of Medicine, National and
Kapodistrian University of Athens,
and Aghia Sophia Children's Hospital,
Athens, Greece
kaditia@hotmail.com

Ahmad Kantar
Pediatric Asthma and Cough Centre,
Istituti Ospedalieri Bergamaschi,
University and Research Hospitals,
Bergamo, Italy
kantar@unich.it

From: European Respiratory Society Publications (reader.ersjournals.com)

Matthias Kappler
Dr von Hauner Children's Hospital,
University of Munich, Dept of Pediatrics,
German Center for Lung Research (DZL)
and European Management Platform
Childhood Interstitial Lung Disease
(chILD-EU), Munich, Germany
Matthias.kappler@med.
uni-muenchen.de

Sonia Khirani
Paediatric Noninvasive Ventilation
and Sleep Unit, Necker University
Hospital, AP-HP, Paris; Paris University
EA VIFASOM, Paris; and ASV Santé,
Gennevilliers, France
sonia_khirani@yahoo.fr

Elisabeth Kieninger
Inselspital Bern, Universitätsklinik für
Kinderheilkunde, Dept of Paediatric
Respiratory Medicine, Bern, Switzerland
elisabeth.kieninger@insel.ch

John A. King
Dept of Paediatric Respiratory Medicine,
Royal Brompton Hospital, London, UK
J.King2@rbht.nhs.uk

Jon Konradsen
Dept of Women's and Children's Health,
Karolinska Institutet, Stockholm,
Sweden
jon.konradsen@ki.se

Sailesh Kotecha
Dept of Child Health, School of
Medicine, Cardiff University, Cardiff, UK
KotechaS@cardiff.ac.uk

Václav Koucký
Paediatric Pulmonology, Paediatric
Dept, 2nd Faculty of Medicine of the
Charles University and University
Hospital Motol, Prague, Czech Republic
vaclav.koucky@seznam.cz

Claudia E. Kuehni
Institute of Social and Preventive
Medicine, University of Bern, and
Paediatric Respiratory Medicine,
Children's University Hospital of Bern,
Bern, Switzerland
claudia.kuehni@ispm.unibe.ch

Stefania La Grutta
Istituto per la Ricerca e l'Innovazione
Biomedica (IRIB), Consiglio Nazionale
delle Ricerche (CNR), Palermo, Italy
stefania.lagrutta@irib.cnr.it

Adeline Y.L. Lim
Dept of Respiratory and Sleep,
Queensland Children's Hospital,
Brisbane, Australia
Adeline.Lim@health.qld.gov.au

Norrice Liu
Centre for Genomics and Child Health,
Blizard Institute, Queen Mary University
of London, London, UK
n.liu@qmul.ac.uk

Enrico Lombardi
Paediatric Pulmonary Unit, Anna Meyer
Paediatric University Hospital, Florence,
Italy
enrico.lombardi@meyer.it

Jane S. Lucas
Primary Ciliary Dyskinesia Centre,
and NIHR Southampton Biomedical
Research Centre, University of
Southampton and University Hospital
Southampton NHS Foundation Trust,
Southampton, UK
jluucas1@soton.ac.uk

Carmen Luna-Paredes
Hospital Universitario 12 de Octubre,
Madrid, Spain
lunalavin1@yahoo.es

Julie M. Marchant
Dept of Respiratory and Sleep Medicine,
Queensland Children's Hospital,
Queensland University of Technology,
Brisbane, Australia
jm.marchant@qut.edu.au

Argyro Mazioti
2nd Dept of Radiology, University
Hospital "Attikon", National and
Kapodistrian University of Athens,
Athens, Greece
argyromazioti@yahoo.gr

Maurizio Mennini
Allergy Unit, Bambino Gesù Children's
Hospital, IRCCS, Rome, Italy
maurizio.mennini@opbg.net

Michele Miraglia del Giudice
Università degli studi della Campania
"Luigi Vanvitelli", Naples, Italy
michele.miraglia@unicampania.it

Alexander Moeller
Division of Respiratory Medicine,
University Children's Hospital Zurich,
Zurich, Switzerland
alexander.moeller@kispi.uzh.ch

Corrado Moretti
Paediatric Intensive Care Service, Dept
of Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
corrado.moretti@uniroma1.it

Laura Moschino
Dept of Women's and Children's Health,
University of Padua, Padua, Italy
lauramoschino13@gmail.com

Antonella Muraro
Food Allergy Referral Centre Veneto
Region, Dept of Women and Child
Health, Padua General University
Hospital, Padua, Italy
muraro@centroallergiealimentari.eu

Nadia Nathan
Pediatric Pulmonology Dept,
Reference center for rare lung diseases
(RespiRare), Armand Trousseau
Hospital, Assistance Publique Hôpital
de Paris (AP-HP), Sorbonne Université
and Inserm UMR_S933 Childhood
Genetic Disorders, Paris, France
nadia.nathan@aphp.fr

Raffaella Nenna
Paediatric Emergency Service, Dept
of Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
raffaella.nenna@uniroma1.it

Ambra Nicolai
Dept of Translational Medicine,
Università della Campania "L. Vanvitelli",
Naples, Italy
ambra10.nic@gmail.com

Thomas Nicolai
University Children's Hospital, Ludwig
Maximilians University Munich, Munich,
Germany
thomas.j.nicolai@gmail.com

Chinedu Nwokoro
Centre for Genomics and Child Health,
Blizard Institute, Queen Mary University
of London, London, UK
c.nwokoro@qmul.ac.uk

Marc-Alexander Oestreich
Inselspital Bern, Universitätsklinik für
Kinderheilkunde, Dept of Paediatric
Respiratory Medicine, Bern, Switzerland
marc-alexander.oestreich@insel.ch

Sedat Oktem
Division of Pediatric Pulmonology,
Medipol University, Istanbul, Turkey
sedatoktem@hotmail.com

Rishi Pabary
Dept of Paediatric Respiratory Medicine,
Royal Brompton Hospital, London, UK
R.Pabary@rbht.nhs.uk

Paola Papoff
Paediatric Emergency Service, Dept
of Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
paola.papoff@uniroma1.it

James Paton
School of Medicine, College of Medical,
Veterinary and Life Sciences, University
of Glasgow, Glasgow, UK
james.paton@glasgow.ac.uk

Laura Petrarca
Paediatric Emergency Service, Dept
of Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
laurapetrarca85@gmail.com

Andreas Pflieger
Division of Paediatric Pulmonology and
Allergology, Dept of Paediatrics and
Adolescent Medicine, Medical University
of Graz, Graz, Austria
andreas.pflieger@medunigraz.at

Giorgio Piacentini
Dept of Surgery, Dentistry, Paediatrics
and Gynaecology, University of Verona,
Verona, Italy
giorgio.piacentini@univr.it

Mariëlle Pijnenburg
Dept of Paediatrics, Division of
Respiratory Medicine and Allergology,
Erasmus MC, University Medical Centre
Rotterdam, Rotterdam, The Netherlands
m.pijnenburg@erasmusmc.nl

Marco Poeta
Dept of Translational Medical Sciences,
Federico II University, Naples, Italy
po3ta.89@gmail.com

Petr Pohunek
Paediatric Pulmonology, Paediatric
Dept, 2nd Faculty of Medicine of the
Charles University and University
Hospital Motol, Prague, Czech Republic
petr.pohunek@lfmotol.cuni.cz

Caroline Poulter
Paediatric Respiratory Medicine,
Nottingham Children's Hospital, Queens
Medical Centre, Nottingham, UK
caroline.poulter@nhs.net

Kostas N. Priftis
Faculty of Medicine, National and
Kapodistrian University of Athens,
and Attikon General Hospital, Athens,
Greece
kpriftis@otenet.gr

Frederic Proulx
Division of Respiriology, Centre Mère-
Enfant Soleil du Centre Hospitalier de
l'Université Laval, Québec, QC, Canada
frederic.proulx.1@ulaval.ca

Thomas Radtke
Division of Occupational and
Environmental Medicine, Epidemiology,
Biostatistics and Prevention Institute,
University of Zurich and University
Hospital Zurich, Zurich, Switzerland
thomas.radtke@uzh.ch

Ashok Daya Ram
Dept of Paediatric Surgery, Norfolk and
Norwich University Hospitals, Norwich,
UK
ashokdram14@gmail.com

Christina Rapp
Dr von Hauner Children's Hospital,
University of Munich, Dept of Pediatrics,
German Center for Lung Research (DZL)
and European Management Platform
Childhood Interstitial Lung Disease
(chILD-EU), Munich, Germany
christina.rapp@med.uni-muenchen.de

Nicolas Regamey
Division of Paediatric Respiratory
Medicine, Cantonal Hospital of Lucerne,
Lucerne, and University of Bern, Bern,
Switzerland
Nicolas.regamey@luks.ch

Michael Riccabona
Dept of Radiology, Division of Paediatric
Radiology, University Hospital LKH and
Medical University of Graz, Graz, Austria
michael.riccabona@medunigraz.at

Paul D. Robinson
Dept of Respiratory Medicine, The
Children's Hospital at Westmead, and
Discipline of Paediatrics and Child
Health, University of Sydney, Sydney,
Australia
dr.pdrobinson@gmail.com

Charles C. Roehr
Dept of Paediatrics, University of Oxford,
John Radcliffe Hospital, NHS Foundation
Trust, Oxford, UK
Charles.Roehr@ouh.nhs.uk

Emmanuel Roilides
Infectious Disease Unit, 3rd Dept of
Pediatrics, Medical Faculty, Aristotle
University of Thessaloniki, School of
Health Sciences, Hippokration General
Hospital, Thessaloniki, Greece
roilides@med.auth.gr

Bruna Rubbo
Primary Ciliary Dyskinesia Centre,
and NIHR Southampton Biomedical
Research Centre, University of
Southampton and University Hospital
Southampton NHS Foundation Trust,
Southampton, UK
B.Rubbo@soton.ac.uk

Bruce K. Rubin
Dept of Pediatrics, Virginia
Commonwealth University, and the
Children's Hospital of Richmond at VCU,
Richmond, VA, USA
bruce.rubin@vcuhealth.org

Franca Rusconi
Unit of Epidemiology, Meyer Children's
University Hospital, Florence, Italy
franca.rusconi@meyer.it

Anna Rybak
Dept of Paediatric Gastroenterology,
Division of Neurogastroenterology and
Motility, Great Ormond Street Hospital
for Children, ICH University College of
London, London, UK
Anna.Rybak@gosh.nhs.uk

Oliviero Sacco
Pulmonary Disease Dept, G. Gaslini
Institute, Genoa, Italy
olivierosacco@gaslini.org

Yasmin Salem Mahmoud
Inselspital Bern, Universitätsklinik für
Kinderheilkunde, Dept of Paediatric
Respiratory Medicine, Bern, Switzerland
yasmin.salemmahmoud@insel.ch

Francesca Santamaria
Dept of Translational Medical Sciences,
Federico II University, Naples, Italy
santamar@unina.it

Matthias C. Schaal
Dept of Diagnostic and Interventional
Radiology, University Hospital Ulm,
Ulm, Germany
matthias.schaal@uniklinik-ulm.de

Bianca Schaub
Pediatric Allergology, Dept of Pediatrics,
Dr von Hauner Children's Hospital,
University Hospital, LMU Munich,
Member of the German Center for Lung
Research (DZL), Munich, Germany
Bianca.Schaub@med.uni-muenchen.de

Amalia Schiavetti
Paediatric Oncology Service, Dept
of Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
amalia.schiavetti@uniroma1.it

Johannes C. Schittny
Institute of Anatomy, University of Bern,
Bern, Switzerland
johannes.schittny@ana.unibe.ch

Nicolaus Schwerk
Dept of Pediatrics, Pediatric
Pneumology, Allergology and
Neonatology, Hannover Medical School,
Hannover, Germany
schwerk.nicolaus@mh-hannover.de

Elizabeth Scotney
Dept of Paediatric Respiratory Medicine,
Royal Brompton Hospital, London, UK
e.scotney@rbht.nhs.uk

Carly E. Seeber
Neonatal Directorate, King Edward
Memorial Hospital, Perth, Australia
carly.seeber@health.wa.gov.au

Elias Seidl
Dr von Hauner Children's Hospital,
University of Munich, Dept of Pediatrics,
German Center for Lung Research (DZL)
and European Management Platform
Childhood Interstitial Lung Disease
(chILD-EU), Munich, Germany
elias.seidl@med.uni-muenchen.de

Louise Selby
Dept of Paediatric Respiratory Medicine,
Royal Brompton Hospital, London, UK
l.selby@rbht.nhs.uk

Mary J. Sharp
Neonatal Directorate, King Edward
Memorial Hospital; Telethon Kids
Institute; and School of Paediatrics and
Child Health, University of Western
Australia, Perth, Australia
Mary.Sharp@health.wa.gov.au

Anita K. Simonds
Royal Brompton and Harefield NHS
Foundation Trust, London, UK
A.Simonds@rbht.nhs.uk

Shannon J. Simpson
Telethon Kids Institute, and School of
Physiotherapy and Exercise Science,
Curtin University, Perth, Australia
shannon.simpson@telethonkids.org.au

Florian Singer
Paediatric Respiratory Medicine,
Children's University Hospital of Bern,
University of Bern, Bern, Switzerland
florian.singer@insel.ch

Samatha Sonnappa
Dept of Paediatric Respiratory Medicine,
Royal Brompton Hospital, and Imperial
College, London, UK
s.sonnappa@rbht.nhs.uk

Kevin W. Southern
Alder Hey Children's Hospital NHS
Foundation Trust, Liverpool, UK
kwsouth@liv.ac.uk

Vanessa Stadlbauer
Dept of Gastroenterology and
Hepatology, Medical University of Graz,
Graz, Austria
vanessa.stadlbauer@medunigraz.at

Philippe Stock
Altona Children's Hospital, Hamburg,
Germany
philippe.stock@kinderkrankenhaus.net

Volker Strenger
Dept of Pediatrics and Adolescent
Medicine, Medical University of Graz,
Graz, Austria
volker.strenger@medunigraz.at

Daniel Studer
Paediatric Orthopaedics, University of
Basel Children's Hospital (UKBB), Basel,
Switzerland
danielstuder19@gmail.com

Giancarlo Tancredi
Paediatric Cardiology Service, Dept
of Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
giancarlo.tancredi@uniroma1.it

Laura Tenero
Dept of Surgery, Dentistry, Paediatrics
and Gynaecology, University of Verona,
Verona, Italy
laura.tenero@univr.it

Johanna Theodorou
Pediatric Allergology, Dept of Pediatrics,
Dr von Hauner Children's Hospital,
University Hospital, LMU Munich,
Member of the German Center for Lung
Research (DZL), Munich, Germany
johanna.theodorou@med.
uni-muenchen.de

Harm A.W.M. Tiddens
Dept of Pediatric Pulmonology and
Allergology, Erasmus MC Sophia
Children's Hospital, and Dept of
Radiology and Nuclear Medicine,
Erasmus MC, Rotterdam,
The Netherlands
h.tiddens@erasmusmc.nl

Daniel Trachsel
Paediatric Intensive Care and
Pulmonology, University of Basel
Children's Hospital (UKBB), Basel,
Switzerland
daniel.trachsel@ukbb.ch

Ha Trang
University of Paris; AP-HP, University
Hospital Robert Debré; Paediatric Sleep
Centre, Centre of reference for CCHS,
Paris, France
ha.trang@aphp.fr

John Tsanakas
Pediatric Pulmonology and Cystic
Fibrosis Unit, Aristotle University of
Thessaloniki, School of Health Sciences,
Hippokration General Hospital,
Thessaloniki, Greece
tsanakasj@gmail.com

Steve Turner
Child Health, University of Aberdeen,
Aberdeen, UK
s.w.turner@abdn.ac.uk

Wytse B. van den Bosch
Dept of Paediatrics, Division of
Respiratory Medicine and Allergology,
Erasmus MC Sophia Children's Hospital,
University Hospital Rotterdam,
Rotterdam, The Netherlands
w.b.vandenbosch@erasmusmc.nl

Marcel van Straten
Dept of Radiology and Nuclear
Medicine, Erasmus MC, Rotterdam,
The Netherlands
marcel.vanstraten@erasmusmc.nl

Giulia Varrasso
Paediatric Oncology Service, Dept
of Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
g.varrasso@policlinicoumberto1.it

Maria Pia Villa
School of Medicine and Psychology,
Sapienza University, S. Andrea Hospital,
Rome, Italy
mariapia.villa@uniroma1.it

Horst von Bernuth
Pediatric Pneumology, Immunology and
Intensive Care Medicine, Charité Berlin,
Berlin, Germany
horst.von-bernuth@charite.de

Erika von Mutius
Dr von Hauner Children's Hospital,
Ludwig Maximilian University Munich,
Munich, Germany
erika.von.mutius@med.lmu.de

Marlies Wagner
Division of Paediatric Pulmonology and
Allergology, Dept of Paediatrics and
Adolescent Medicine, Medical University
of Graz, Graz, Austria
Marlies.Wagner@klinikum-graz.at

Colin Wallis
Respiratory Unit, Great Ormond Street
Hospital, London, UK
colin.wallis@gosh.nhs.uk

Charlotte Wells
Dept of Paediatric Respiratory Medicine,
Royal Brompton Hospital, London, UK
c.wells2@rbht.nhs.uk

Piotr Wielopolski
Dept of Radiology and Nuclear
Medicine, Erasmus MC, Rotterdam,
The Netherlands
p.wielopolski@erasmusmc.nl

Christoph Corin Willers
Inselspital Bern, Universitätsklinik für
Kinderheilkunde, Dept of Paediatric
Respiratory Medicine, Bern, Switzerland
corin.willers@insel.ch

Hepsi Xavier
Child Health, University of Aberdeen,
Aberdeen, UK
h.xavier.18@aberndeen.ac.uk

Sophie Yammine
Paediatric Respiratory Medicine,
Children's University Hospital of Bern,
University of Bern, Bern, Switzerland
sophie.yammine@insel.ch

Anna Maria Zicari
Paediatric Allergology Service, Dept
of Maternal, Infantile and Urological
Sciences, Sapienza University, Rome,
Italy
annamaria.zicari@uniroma1.it

Conflicts of interest

Disclosures for all authors are given at
<https://doi.org/10.1183/9781849841313.coi>

Preface

“Education is not the filling of a pail, but the lighting of a fire.”
(Uncertain source)

Dissemination of knowledge and medical and public education constitute fundamental objectives of the ERS mission, and the ERS aims to provide excellence in respiratory medicine education. In 2005, the ERS School started the very ambitious HERMES (Harmonised Education in Respiratory Medicine for European Specialists) project. Since then, HERMES Task Forces have formed to standardise training and education within different specialties of respiratory medicine. To support the implementation of various educational activities, the ERS has produced a series of *Handbooks* as educational tools, with the first edition of the *ERS Handbook of Respiratory Medicine* launched in 2010.

Starting in 2007, the paediatric respiratory medicine task force, using a formal consensus process and working with numerous experts throughout Europe, developed a HERMES syllabus (description of the competencies required) and a HERMES curriculum (description of how competencies should be taught, learned and assessed), as well as a voluntary European examination in paediatric respiratory medicine. With the content reflecting the HERMES syllabus and curriculum (published in 2009 and 2010, respectively), the first edition of the *ERS Handbook of Paediatric Respiratory Medicine* was published in 2013 and, as a compact state-of-the-art textbook, provided a comprehensive update for specialists within this field of respiratory medicine.

This second edition of the *ERS Handbook of Paediatric Respiratory Medicine* reflects the updated European paediatric respiratory medicine syllabus (published in 2019), which has been streamlined and made more relevant to current practice. The *Handbook* again consists of concise, peer-reviewed chapters written by experts in the field. We hope that this second edition will not only inform our trainees and be a valuable resource for those preparing for the paediatric HERMES examination but also provide an easily accessible and comprehensive update for colleagues at all levels of seniority, across paediatric respiratory medicine. Thus, this updated *Handbook* is intended to make a significant contribution to increasing the standards of training in paediatric respiratory medicine throughout and outside of Europe and, ultimately, to improving the care of children with respiratory disease.

We are grateful to the ERS Education Council and to the ERS publications staff who so thoroughly and thoughtfully curated the second edition of this *Handbook*, and last, but not least, to all the contributors who have shared their knowledge and experience with you.

Ernst Eber and Fabio Midulla
Chief editors

Purchased by ,
From: European Respiratory Society Publications (reader.ersjournals.com)

List of abbreviations

AHI	Apnoea-hypopnoea index
AIDS	Acquired immunodeficiency syndrome
BAL	Bronchoalveolar lavage
BMI	Body mass index
BPD	Bronchopulmonary dysplasia
CF	Cystic fibrosis
CFTR	Cystic fibrosis transmembrane conductance regulator
COPD	Chronic obstructive pulmonary disease
CPAP	Continuous positive airway pressure
CT	Computed tomography
ECG	Electrocardiogram
ENT	Ear, nose and throat
FEV ₁	Forced expiratory volume in 1 s
FRC	Functional residual capacity
FVC	Forced vital capacity
GOR	Gastro-oesophageal reflux
HIV	Human immunodeficiency virus
HRCT	High-resolution computed tomography
ILD	Interstitial lung disease
K _{CO}	Transfer coefficient of the lung for carbon monoxide
LCI	Lung clearance index
MRI	Magnetic resonance imaging
NIV	Noninvasive ventilation
OSA(S)	Obstructive sleep apnoea (syndrome)
P _{aCO₂}	Arterial carbon dioxide tension
P _{aO₂}	Arterial oxygen tension
PCD	Primary ciliary dyskinesia
PCR	Polymerase chain reaction
PEEP	Positive end-expiratory pressure
PFT	Pulmonary function test
PSG	Polysomnography
P _{tcCO₂}	Transcutaneous carbon dioxide tension
RV	Residual volume
S _{aO₂}	Arterial oxygen saturation
S _{pO₂}	Oxygen saturation measured by pulse oximetry
TB	Tuberculosis
TLC	Total lung capacity
T _{LCO}	Transfer factor of the lung for carbon monoxide
V _E	Minute ventilation

Purchased by ,

From: European Respiratory Society Publications (reader.ersjournals.com)

Conflicts of interest

Tobias Ankermann reports lecture fees from AbbVie, Allergopharma, Chiesi, Infectopharm, Novartis and Nutricia, and personal fees from Allergopharma for a safety board of a paediatric allergen specific immunotherapy study, all outside the submitted work.

Laura Berdah reports support by grants from the Institut National de la Santé et la Recherche Médicale (INSERM), the Legs Poix from the Chancellerie des Universités, Paris (grants 2013 no. 1305, 2014 no. 1405, 2015 no. 1015, 2016 no. 2077 and 2017 no. DP2017/1860), the European Union's Seventh Framework Program (FP7-ChILD-EU 2007-2013) under grant agreement no. 305653, as well as funding from the patient organisations Respirer c'est Grandir and Belleherbe Association. The ILD cohort was developed in collaboration with the Rare Cohort Disease (RaDiCo)-ILD project (ANR-10-COHO-0003), the FP7-305653-child-EU project and the COST Action European network for translational research in children's and adult interstitial lung disease (COST-ILD) project (CA16125).

Jayesh Mahendra Bhatt reports lecture fees for an international educational meeting organised by Vertex Pharmaceuticals, outside the submitted work.

Andrew Bush is an emeritus NIHR Senior Investigator and is funded by the Asthma UK Centres for Applied Research and the Centre for Allergic Mechanisms in Asthma.

Anne B. Chang reports multiple grants relating to cough, bronchiectasis and PBB from the National Health and Medical Research Council (NHMRC, Australia), a grant from the NHMRC Centre for Research Excellence in Lung Health of Aboriginal and Torres Strait Islander Children (APP1040830), and an NHMRC Practitioner Fellowship (APP1058213), all related to the submitted work; as well as support from GSK for being a member of a data monitoring committee relating to an unlicensed vaccine, support from Up to Date for being an author of sections on paediatric chronic cough, support for being an author of the chronic cough guidelines for the American College of Chest Physicians, and support (to her institution) from the BMJ Evidence Centre for being an author of two chapters on paediatric asthma, all outside the submitted work.

Annick Clement reports support by grants from the Institut National de la Santé et la Recherche Médicale (INSERM), the Legs Poix from the Chancellerie des Universités, Paris (grants 2013 no. 1305, 2014 no. 1405, 2015 no. 1015, 2016 no. 2077 and 2017 no. DP2017/1860), the European Union's Seventh Framework Program (FP7-ChILD-EU 2007-2013) under grant agreement no. 305653, as well as funding from the patient organisations Respirer From: European Respiratory Society Publications (reader.ersjournals.com)

c'est Grandir and Belleherbe Association. The ILD cohort was developed in collaboration with the Rare Cohort Disease (RaDiCo)-ILD project (ANR-10-COHO-0003), the FP7-305653-child-EU project and the COST Action European network for translational research in children's and adult interstitial lung disease (COST-ILD) project (CA16125).

Louise J. Fleming is an Asthma UK Senior Clinical Fellow and reports a grant from Asthma UK (AUK-SCF-2017-399). She reports grants and speaker fees from Boehringer Ingelheim, speaker fees and fees for expert consultation from AstraZeneca and Novartis, fees for expert consultation from GSK, Sanofi and Respiro, and speaker fees from Teva, all paid direct to her institution and outside of the submitted work.

Jonathan Grigg reports honoraria for advisory boards and talks from GSK, Vifor Pharmaceuticals, Novartis and AstraZeneca, outside the submitted work.

Susanne Halken reports personal fees and non-financial support from ALK-Abelló, as a member of a steering committee for the Grasax Asthma Prevention (GAP) study, published 2017.

Graham L. Hall reports grants and personal fees from USA CF Foundation, grants from the Australian National Health and Medical Research Council, and non-financial support from Vertex and ndd, outside the submitted work.

Helge Hebestreit reports grants from a Vertex Innovation Award and Mukoviszidose eV, to support the ACTIVATE-CF Trial, outside the submitted work.

Maxim Itkin reports a grant and speaking fees from the Guerbet Group, related to the submitted work.

Hettie M. Janssens reports participating in a study supported by an unrestricted research grant from Vectura, receiving travel expenses and speakers fees from Vertex, as well as receiving the Vertex Innovation Award for investigator-initiated research, outside the submitted work.

Pierre-Henri Jarreau reports personal fees from Abbvie France as a member of the neonatology board, related to the submitted work; as well as personal fees and non-financial support from Chiesi France (course for Chiesi staff, participation in an observational study, invitations for congresses), outside the submitted work.

Jon Konradsen reports grants from Stockholm County Council, related to the submitted work; he has also provided material to perform IgE analysis for Thermo Fisher Scientific, and has received lecture fees from Meda AB and Novartis, outside the submitted work.

Václav Koucký reports a grant from the Ministry of Health, Czech Republic (conceptual development of research organisation, University Hospital Motol, Prague, Czech Republic; grant number 00064203), related to the submitted work.

Enrico Lombardi reports grants from Restech and Sanofi, personal fees from Angelini, Boehringer, GSK, Omron and Vifor, personal fees and non-financial support from Chiesi, Lusofarmaco, Novartis and Vertex, and non-financial support from AbbVie, outside the submitted work.

Jane S. Lucas reports personal fees from Aerocrine/Circassia for work on the PCD advisory board, as well as expenses to attend meetings, research monies and honoraria from Aerocrine/Circassia, all outside the submitted work.

Julie M. Marchant reports support from Up to Date for being an author of sections on paediatric chronic cough, outside the submitted work.

Antonella Muraro reports speaker's fees from Nestlè Purina, Aimmune and DVB, outside the submitted work.

Nadia Nathan reports support by grants from the Institut National de la Santé et la Recherche Médicale (INSERM), the Legs Poix from the Chancellerie des Universités, Paris (grants 2013 no. 1305, 2014 no. 1405, 2015 no. 1015, 2016 no. 2077 and 2017 no. DP2017/1860), the European Union's Seventh Framework Program (FP7-ChILD-EU 2007-2013) under grant agreement no. 305653, as well as funding from the patient organisations Respirer c'est Grandir and Belleherbe Association. The ILD cohort was developed in collaboration with the Rare Cohort Disease (RaDiCo)-ILD project (ANR-10-COHO-0003), the FP7-305653-child-EU project and the COST Action European network for translational research in children's and adult interstitial lung disease (COST-ILD) project (CA16125).

Petr Pohunek reports a grant from the Ministry of Health, Czech Republic (conceptual development of research organisation, University Hospital Motol, Prague, Czech Republic; grant number 00064203), related to the submitted work.

Nicolas Regamey reports educational grants from Novartis, Vifor, Mylan, Actavis, Healthmg, Vertex, Resmed, Philips and GSK, which have been provided to his institution; additionally, he has received consultation fees from Novartis, Vifor and Zambon.

Michael Riccabona reports non-financial support, travel cost refunds and honoraria from Siemens Heathineers/Acuson, travel cost refunds and honoraria from Bracco, and non-financial support, travel cost refunds and honoraria from GE Healthcare/Kretz (or respective local dealers such as IDS Med in Thailand), outside the submitted work.

Bianca Schaub reports grants from the DFG (German Research Foundation) and BMBF (German Federal Ministry of Education and Research), outside the submitted work.

Johannes C. Schittny reports grants from the Swiss National Science Foundation, related to the submitted work.

Florian Singer reports personal fees from Vertex and Novartis, outside the submitted work.

Purchased by ,

From: European Respiratory Society Publications (reader.ersjournals.com)

Harm A.W.M. Tiddens reports that the “Sophia Research BV” of the Erasmus MC Sophia Children’s Hospital has, in the past 5 years, received unconditional research grants from Gilead Sciences Inc., Chiesi pharmaceuticals, Novartis, Vertex, Vectura and Roche, as well as research grants from the Innovative Medicines Initiative, the Cystic Fibrosis Foundation, the European Cystic Fibrosis Society and the Sophia foundation. H.A.W.M. Tiddens also reports honoraria and travel expenses for lectures and participation in expert panels from Novartis, Gilead, Roche, Pharmaxis, Insmid and Vertex; a joint patent with Perth for PRAGMA-CF that has been submitted; and that FLUIDDA has developed computational fluid dynamic modelling based on chest CTs obtained from Erasmus MC Sophia Children’s Hospital for which royalties are received by Sophia Research BV.

Marcel van Straten reports non-financial support from Siemens Healthineers, outside the submitted work.

Erika von Mutius reports personal fees for consultancy services from OM Pharma SA, Peptinnovate Ltd and Pharmaventures Ltd, speaker fees from Boehringer Ingelheim International GmbH, and speaker travel fees from Nestlé Deutschland AG, all outside the submitted work. In addition, E. von Mutius has a patent pending, application number LU101064, “Barn dust extract for the prevention and treatment of diseases”; a patent with publication number EP2361632 “Specific environmental bacteria for the protection from and/or the treatment of allergic, chronic inflammatory and/or autoimmune disorders”, with royalties paid to Protectimmun GmbH; a patent with publication number EP1411977 “Composition containing bacterial antigens used for the prophylaxis and the treatment of allergic diseases”, licensed to Protectimmun GmbH; a patent with publication number EP1637147 “Stable dust extract for allergy protection”, licensed to Protectimmun GmbH; and a patent with publication number EP1964570 “Pharmaceutical compound to protect against allergies and inflammatory diseases”, licensed to Protectimmun GmbH.

Sophie Yammine reports personal fees from Vertex, outside the submitted work.

The following authors have no disclosures to declare:

Efthymia Alexopoulou
Annalisa Allegorico
Alessandro Amaddeo
Pinelopi Anagnostopoulou
Sherlynn Ang
Michael B. Anthracopoulos
Juan Antón-Pacheco
Stefania Arasi
Cristina Ardura-Garcia
Maria Cristina Artesani
Paul Aurora
Eugenio Baraldi
Jürg Barben
Nilay Bas Ikizoglu
Meinrad Beer
Georg Berding
Silke Besier
Nicole Beydon
Osvaldo Borrelli
Rossa Brugha
Katherine Burke
Colin Butler
Valeria Caldarelli
Claudia Calogero
Jennifer Calvert
Giulia Cangiano
Julia Carlens
Silvia Carraro
Salvatore Cazzato
Charmaine Chai
Claudio Cherchi
Pierluigi Ciet
Giovanna Cilluffo
Giovanni Cobellis
Joanne Cooke
Vanessa E. Craven
Renato Cutrera
Fernando Maria de Benedictis
Jacques de Blic
Giovanna De Castro
Fabio Decimo
Paolo de Coppi
Christophe Delacourt
Thierry de Trey
Greta Di Mattia
Iolo Doull
Konstantinos Douros
Ernst Eber
Ela Erdem Eralp
Refika Ersu
Melania Evangelisti

Mark L. Everard
Brigitte Fauroux
Giuliana Ferrante
Valentina Ferraro
Vincenzo Fierro
Dimitrios Filippiadis
Alessandro Giovanni Fiocchi
Sotirios Fouzas
Antonella Frassanito
Bettina Sarah Frauchiger
Oliver Fuchs
Monika Gappa
Alvaro Gimeno Díaz de Atauri
Pierre Goussard
Myrofora Goutaki
Hartmut Grasmann
Matthias Gries
Roberto Guidi
Alice Hadchouel
Elpis Hatziaorou
Gunilla Hedlin
Richard Hewitt
Michael Hogardt
Dominic Hughes
Iulia Ioan
Andreas Jung
Athanasios G. Kaditis
Ahmad Kantar
Matthias Kappler
Sonia Khirani
Elisabeth Kieninger
John A. King
Sailesh Kotecha
Claudia E. Kuehni
Stefania La Grutta
Adeline Y.L. Lim
Norrice Liu
Carmen Luna-Paredes
Argyro Mazioti
Maurizio Mennini
Fabio Midulla
Michele Miraglia del Giudice
Alexander Moeller
Corrado Moretti
Laura Moschino
Raffaella Nenna
Ambra Nicolai
Thomas Nicolai
Chinedu Nwokoro
Marc-Alexander Oestreich
Sedat Oktem

Purchased by
From: European Respiratory Society Publications (reader.ersjournals.com)

Rishi Pabary
Paola Papoff
James Paton
Laura Petrarca
Andreas Pfleger
Giorgio Piacentini
Mariëlle Pijnenburg
Marco Poeta
Caroline Poulter
Kostas N. Priftis
Frederic Proulx
Thomas Radtke
Ashok Daya Ram
Christina Rapp
Paul D. Robinson
Charles C. Roehr
Emmanuel Roilides
Bruna Rubbo
Bruce K. Rubin
Franca Rusconi
Anna Rybak
Oliviero Sacco
Yasmin Salem Mahmoud
Francesca Santamaria
Matthias C. Schaal
Amalia Schiavetti
Nicolaus Schwerk
Elizabeth Scotney
Carly E. Seeber

Elias Seidl
Louise Selby
Mary J. Sharp
Anita K. Simonds
Shannon J. Simpson
Samatha Sonnappa
Kevin W. Southern
Vanessa Stadlbauer
Philippe Stock
Volker Strenger
Daniel Studer
Giancarlo Tancredi
Laura Tenero
Johanna Theodorou
Daniel Trachsel
Ha Trang
John Tsanakas
Steve Turner
Wytse B. van den Bosch
Giulia Varrasso
Maria Pia Villa
Horst von Bernuth
Marlies Wagner
Colin Wallis
Charlotte Wells
Piotr Wielopolski
Christoph Corin Willers
Hepsi Xavier
Anna Maria Zicari