

Emergency Medicine



AN ILLUSTRATED COLOUR TEXT

Edited by
Paul Atkinson
Richard Kendall
Lee van Rensburg

Foreword by Jerome R. Hoffman



Emergency Medicine

AN ILLUSTRATED COLOUR TEXT

Edited by

Paul Atkinson BSc(Hons) MB BCh BAO MRCP FCEM

Consultant in Emergency Medicine, Addenbrooke's Hospital, Cambridge;
Associate Lecturer, University of Cambridge, UK

Richard Kendall BSc(Hons) MBBS FCEM

Consultant in Emergency Medicine, Addenbrooke's Hospital, Cambridge;
Associate Lecturer, University of Cambridge, UK

Lee Van Rensburg MBBCh FRCS(Orth)

Consultant in Trauma and Orthopaedics, Addenbrooke's Hospital,
Cambridge, UK

Section Editor

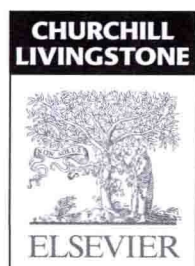
Duncan McAuley MBBChir MA FRCS(Ed) MRCP FCEM DipIMC

Consultant in Emergency Medicine, Addenbrooke's Hospital, Cambridge, UK

Foreword by

Jerome R. Hoffman MA MD

Professor of Medicine/Emergency Medicine, UCLA School of Medicine;
Attending Physician, UCLA Emergency Medicine Center;
Director, The Doctoring Program, UCLA School of Medicine, Los Angeles, USA



CHURCHILL
LIVINGSTONE
ELSEVIER

First published 2010 © Elsevier Limited. All rights reserved.

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 publisher. 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. You may also complete your request online via the Elsevier website at <http://www.elsevier.com/permissions>.

ISBN 9780443069628

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

Notice

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 Editors assume any liability for any injury and/or damage to persons or property arising out of 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

Working together to grow
libraries in developing countries

www.elsevier.com | www.bookaid.org | www.sabre.org

ELSEVIER

BOOK AID
International

Sabre Foundation

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

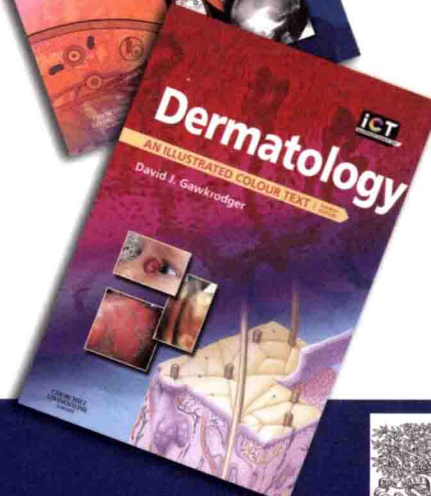
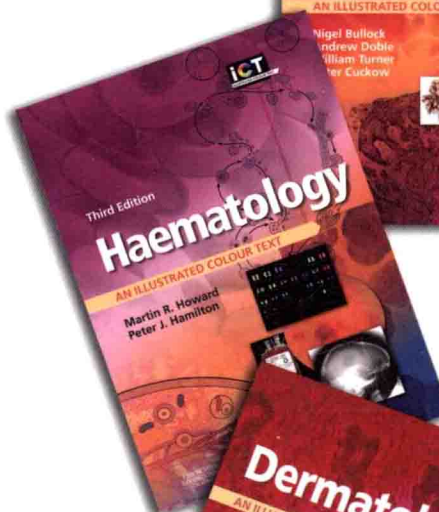
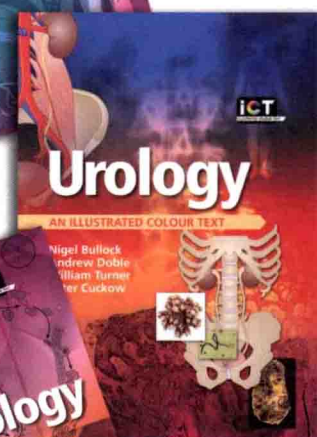
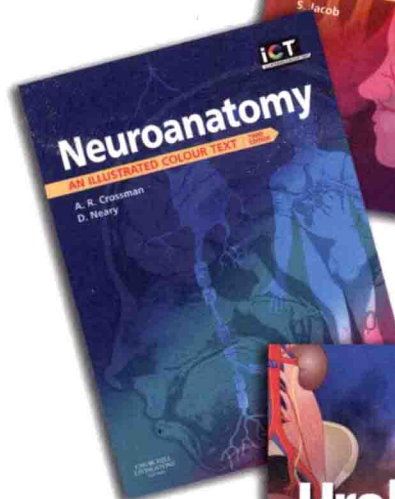
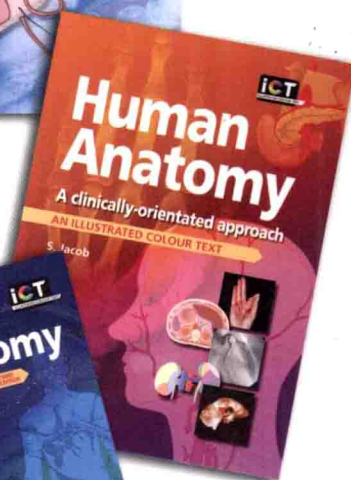
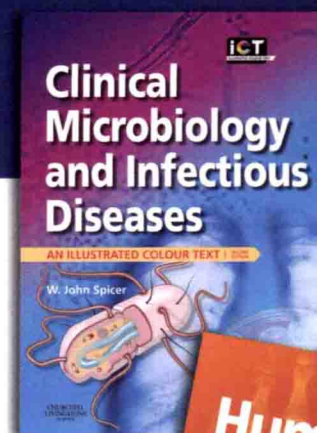
Ideal for integrated, systems-based and problem-based medical courses

Series Features:

- **Concise and comprehensive text** – perfect as a subject introduction, or revision aid
- **Colour photographs, radiographs and line diagrams** help with visualisation of complex topics
- **Key point boxes and summaries** help with quick revision
- **Double-page overviews** let readers view a topic summary without cross-referencing to other pages

Titles available in the ICT series:

- | | |
|---|---|
| ● Intensive Care | ● Clinical Biochemistry, 3rd edition |
| ● Urology | ● Obstetrics and Gynecology |
| ● Human Anatomy | ● Gastroenterology |
| ● Haematology, 3rd edition | ● General Practice |
| ● Complementary and Alternative Medicine | ● Perioperative Care, Anaesthesia, Pain Management and Intensive Care |
| ● Ear, Nose and Throat and Head and Neck Surgery, 3rd edition | ● Respiratory Medicine |
| ● Clinical Endocrinology and Diabetes | ● Clinical History Taking and Examination, 2nd edition |
| ● Neuroanatomy, 3rd edition | ● Psychiatry |
| ● Neurology, 2nd edition | ● Orthopaedics and Trauma |
| ● Cardiology | ● Clinical Microbiology and Infectious Diseases, 2nd edition |
| ● Medical Imaging | ● Oncology |
| ● Embryology | ● Dermatology, 4th edition |
| ● Ophthalmology, 2nd edition | |
| ● Psychology and Sociology Applied to Medicine, 2nd edition | |



Available from your local medical bookshop, or visit www.elsevierhealth.com/series/ict to order



Emergency Medicine

AN ILLUSTRATED COLOUR TEXT

For Elsevier

Commissioning Editor: Laurence Hunter

Development Editor: Lulu Stader

Project Manager: Emma Riley/Frances Affleck

Designer: Kirsteen Wright

Illustration Manager: Gillian Richards

Illustrator: Graeme Chambers

Foreword

In medicine's version of geologic time, Emergency Medicine is still an infant. That's true even in North America, where although well established as both a clinical and academic discipline, it remains one of the very youngest specialties. For a generation of practitioners, however, it has been around for most of our career – and thus it is exciting for me to watch as it develops and matures in many parts of the world. The publication of a new text in EM always represents a further step in that process – particularly when it represents the work of a group as talented and committed as the editors of 'Emergency Medicine – An Illustrated Colour Text' – whom I was fortunate enough to get to know, and work with, during my year-long sabbatical at Cambridge University.

To some of us, EM is both the most exciting and the most challenging of specialties. To understand why I believe this – and why I think those of you to whom this book is directed, early on in your medical career, may come to agree with me – we need to explore a little where EM came from, and how its derivation was different from that of other medical specialties.

When the first neurologists decided to concentrate on diseases of the nervous system, it was surely because there was a particular *body of knowledge* that was becoming more and more complex, and demanded the full attention of those who wished to become expert. The same was true for cardiologists, or gynaecologists, or radiation oncologists, etc. But that *wasn't* the case for EM. Don't misunderstand – this is not because EM doesn't have a special body of knowledge – as even a glance at this book will demonstrate. Expertise in resuscitation, and diagnostic decision-making, and trauma care, and pre-hospital systems, and medical toxicology are a few of the areas that immediately jump to mind. EM *shares* some aspect of these with other specialties, but the same is generally true of every specialty.

Surgical specialties tend to be a little different. Training in neurosurgery is a great deal longer than training in neurology, and in cardiac surgery a lot longer than in cardiology. This is *not*

because their body of knowledge is larger – if anything, the opposite is likely to be true. It's because surgical training is about acquiring *skills* (rather than simply *knowledge*). The same is fundamentally true, I believe, about EM – it is a set of *skills* that makes one a specialist in EM (as we will address shortly). Even so, EM didn't arise because a group of us decided to concentrate on the special skills it requires; EM was born because patients demanded it. The discovery of penicillin made it clear that *acute treatment* of infectious disease was possible, and important; wartime advances in surgery did the same for trauma (spawning the UK notion of 'casualty' and 'accident and emergency'). Patients soon understood that *many* symptoms would benefit from acute attention, and that they didn't need to suffer while waiting for a delayed visit to a doctor. This was true not only for a host of life threatening conditions – acute MI, hyperkalaemia, overdose, dehydration in an infant, or 3rd-degree heart block, etc but also for less serious, but nevertheless *treatable* conditions; there was no reason to suffer without medical attention from a ureteric stone, or a moderate asthma attack, or even a headache or sore throat. This patient-centered realization had added force in a society like the US, which both had a faltering primary care safety net at the time that EM began to develop, and a population less likely to share the capacity for patience and forbearance famous on the other side of the Atlantic.

So EM arose, de facto, from patient demand. But as more and more, and sicker and sicker, patients began to show up, it became eminently clear that ministering to their needs was no simple matter, and couldn't be left in the hands of those without training, or appropriate skills. Patients created the need for EDs; EDs created the need for the *specialty* of EM.

While procedural skills have a role in EM (and sometimes seem its most exciting aspect, to beginners), it is quintessentially a diagnostic specialty that is relatively unique in that *undifferentiated* disease presentation is a core feature. That's why the book

you're holding is organized around *symptoms* and *findings* – unlike standard textbooks in almost every other medical specialty, which are organized around *disease entities*. Imagine if patients came to the ED with a complaint of 'I'm having a pulmonary embolism' or 'I need care for my acute heart failure' or 'it's an exacerbation of COPD,' or 'this time it's pneumonia' – instead of 'I can't breathe' which could be any one, or two, or *all* of the above, among many other things; that would make EM a whole lot easier ... and a whole lot less interesting!

The *skills* needed by an EM specialist also involve appropriate decision-making in the face of a number of rather extraordinary stresses. An emergency physician (EP) not only has to establish priorities rapidly in any given patient, he has to do the same *among* a large group of patients, where in a busy ED several may have an obvious need for emergency intervention, but the same is *possible* in many others, even if far less apparent. The EP also doesn't have the luxury of taking a history, and doing an exam, and reviewing the records, and ordering labs, etc, in the orderly fashion we learn about in medical school; she has to *act* entirely out of order, based on brief interactions, and rapid assessment, without time to gather much of the information that could be helpful. As if that weren't complicated enough, she's got to do this with a patient she's never met before, and who may be not be at his best – frightened, or in pain, or demanding, or altered, or intoxicated, or all of the above. The patient's never met you before either, so there's a level of trust that has to be earned. And you may not be at your very best (every shift), either. And finally, choices have to be made, and acted upon, while other (potentially unstable) patients wait.

In the midst of such turmoil, perhaps the most important trait of an expert EP is the ability to remain calm. Not because you don't find it *exciting* but because staying levelheaded is absolutely essential if you want to make good decisions. EM is not for everyone; if you're not comfortable

with uncertainty, or capable of calm amidst controlled chaos, you will never be a good fit for EM. But being born with the right temperament – while necessary – is not sufficient; this is also a *skill* that takes time and experience to develop. (Don't be discouraged; if you thrive on trying to spin several plates at once, *and* you are helped to learn, in a safe environment where patients will not be harmed ... *and* are patient with yourself ... it will happen.)

If it is ironic that personal serenity is an essential element of expert emergency care, it will seem equally so that another key skill is the ability to use *time* in your favor ... to *do nothing* – 'don't just do something, stand there!' This isn't the case for every ED patient, of course, but for a great many of them it is essential to understand that you indeed have time and to allow that time to provide the answer to key questions ('Is this early appendicitis?' or 'Can I send this patient home without a CT scan, as long as there is good follow-up?' or 'Will pain relief be adequate as the only treatment in this case?' etc).

Many people are attracted to EM because of the very sick patients – the so-called 'true emergencies.' But only a

small minority of our patients are acutely unstable, and in fact it is the *other* patients who can be the most challenging. It's relatively easy to take care of a crashing patient with a stab wound to the abdomen; it can be very hard to pick the epidural abscess needle out of the low back pain haystack. Furthermore, sending a patient away from medical care – which we do with the large majority of 'minor' ED patients – can be the toughest decision one ever has to make in medicine.

Which is why another skill you will need to learn is the EM *approach* to differential diagnosis. This is addressed in the Introduction to Emergency Medicine chapter.

A specialist in EM is someone who's learned these skills well, as they relate to the entire broad set of problems seen in a typical ED. This may seem daunting at first – but we develop expertise in anything through a combination of *training* and *experience*. I expect my residents in EM to be as skilled as anyone in medicine at dealing with the emergency airway – because over time they have lots of training, and lots of experience, with just that issue. Same for head trauma

(minor as well as severe), and the diagnosis of abdominal pain, and undifferentiated 'dizziness,' and ... all the things we do (and learn, and teach) every day. (They can't be great at *everything* – which is why in EM we can't take out the inflamed appendix we just diagnosed, or fix a blocked V-P shunt, or take care of chronic renal disease, or ...)

This book cannot substitute for the training, or the experience, that are essential to developing the skills of a specialist; no book can, of course. Still, no amount of training and experience is enough, without being based on a framework of knowledge. It is precisely such a framework that every good text should endeavour to provide. Knowing everything in this book (if that were even possible) wouldn't make you a specialist in EM ... but becoming familiar with what it has to teach you can help you think about and organize the experiences you have in the ED – and that is certainly a worthwhile place to start!

Jerome R Hoffman
Los Angeles
2010

Preface

Emergency Medicine: An Illustrated Colour Text is a readily accessible, up-to-date resource that we hope those beginning on their journey into the exciting new specialty of emergency medicine will find useful. Medical students and newly-graduated doctors will have knowledge and experience of the core specialties that look after patients. They may not, however, have an approach to, or experience of, the undifferentiated patient who approaches the nurse, paramedic or doctor with a problem. Yes, a problem; not a diagnosis or a disease. This book aims to take a look at medicine from the front door of the hospital and as such we have tried to make this book as symptom-based as possible.

The first section introduces the purpose of emergency medicine and outlines the way to approach an emergency patient. This is followed by a section on resuscitation – the core skill of the emergency practitioner. We then look at the principal investigations commonly used in the emergency department. The remainder of the book is divided into sections representing problems and disease categorized both by type of injury or illness and by regions of the body. In common with other titles in the series, each of these sections is subdivided into single or double page spreads looking at particular presenting problems. Each topic has a box highlighting key points and also,

where relevant, points specific to children. There is a separate paediatric section outlining common and important paediatric emergencies. Finally we look at violence and social problems, all too common but often overlooked topics.

We hope that this text will help to introduce this exciting specialty to a new generation of medical students and junior doctors and enable them to be better equipped at dealing with all manner of emergency presentations.

PA, RK, LVR, DM

*The only true wisdom is in knowing
you know nothing*
Socrates

Acknowledgements

We are grateful to all of our friends, colleagues and family members who have helped and encouraged us during the writing and preparation of this book. In particular we would like to thank those in the Emergency Department and Medical Photography Department at Addenbrooke's Hospital for their patience and cooperation during the taking and re-taking of the many photographs (Fig. 1, p. 2; Fig. 1, p. 4; Fig. 4, p. 5; Fig. 1, p. 6; Fig. 2, p. 9; Fig. 1, p. 35; Fig. 1, p. 36; Figs 2 and 3, p. 36; Fig. 3, p. 38; Figs 1 and 2, p. 40; Fig. 1, p. 42; Fig. 3, p. 43; Fig. 2b, p. 50; Fig. 1, p. 52; Figs 3 and 4, p. 55; Fig. 4, p. 85; Fig. 1, p. 110; Fig. 2, p. 161; Fig. 1, p. 168).

Photos in the 'Plant and animal toxins' section (pp. 112–113) are by Elke Rohn (Fig. 1), Stefanie Leuker (Fig. 2), José Antonio de Assis (Fig. 3), Andrew Lee (Fig. 4) and Jeffrey Collingwood (Fig. 5). Photos in the 'Electrical and water induced injury' section (pp. 116–117) are by James Stratton (Fig. 1) and Benjamin Earwicker (Fig. 3).

We are grateful for permission from Elsevier to reproduce figures and tables from other titles in the 'Illustrated Colour Text' series as follows: Fig. 2 (p. 3), Figs 1 and 2 (p. 16&17), Fig. 2

(p. 31), Fig. 2 (p. 33), Fig. 4 (p. 39), Fig. 3 (p. 127) from M Avidan et al (2003) *Perioperative Care, Anaesthesia, Pain Management and Intensive Care*; Fig. 2 (p. 19), Fig. 1 (p. 64), Fig. 2 (p. 67), Fig. 2 (p. 142), Fig. 2 (p. 165) from D E Newby and N Grubb (2005) *Cardiology*; Figs 2, 3 and 4 (p. 57), Figs 3, 4 and 5 (p. 151&152), Fig. 1 (p. 154) from R S Dhillon and C A East (2006) *Ear, Nose and Throat and Head and Neck Surgery*, 3rd edn; Fig. 1 (p. 73), Figs 1 and 3 (p. 94&95), Table 1 (p. 100), Fig. 1 (p. 102), Table 1 (p. 102) from G Fuller and M Manford (2005) *Neurology*, 2nd edn; Fig. 2 (p. 78), Figs 3 and 4 (p. 133), Fig. 1 (p. 142) from P D Welsby (2002) *Clinical History Taking and Examination*, 2nd edn; Fig. 3 (p. 79), Fig. 2 (p. 80) from G P Butcher (2003) *Gastroenterology*; Fig. 3 (p. 81), Fig. 3 (p. 83), Figs 1 and 2 (p. 88&89) from P Renton (2004) *Medical Imaging*; Fig. 2 (p. 85), Figs 1, 2, 3 and 4 (p. 90&91), Fig. 1 (p. 124), Figs 1, 2, 3 and 4 (p. 126&127) from N Bullock et al (2008) *Urology*; Fig. 1 (p. 118), Figs 3 and 4 (p. 119), Fig. 1 (p. 122) from R McRae and A W G Kinninmonth (1997) *Orthopaedics and Trauma*; Fig 1 (p. 130) and Figs 1 and 2 (p. 132) from D J Gawkrödger (2008) *Dermatology*, 4th edn; Fig. 2 (p. 137),

Figs 2, 3 and 4 (p. 142&143), Figs 1 and 3 (p. 144&145) from M Batterbury and B Bowling (2005) *Ophthalmology*, 2nd edn; Fig. 1 (p. 139) from M R Howard and P J Hamilton (2008) *Haematology*, 3rd edn; Figs 1 and 2 (p. 146&147) from J Pitkin et al (2003) *Obstetrics and Gynaecology*.

Fig. 2 (p. 11) is reproduced courtesy of GlideScope®. Fig. 2 (p. 13), Fig. 2 (p. 131) and Fig. 1 (p. 166) are reproduced courtesy of the Resuscitation Council UK. Fig. 2 (p. 62) is reproduced from W Köstler, P C Strohm and N P Südkamp (2004) *Acute compartment syndrome of the limb. Injury* 35(12): 1221–1227 (Fig. 2), with permission from Elsevier. Fig. 2 (p. 111) is reproduced courtesy of the Health Protection Agency (June 2008) and Fig. 2 (p. 155) is reproduced with kind permission of the Meningitis Society.

We could not have completed this text without the patience of our families, especially our wives – thank you Julie, Katie, Gemma and Sharon-Anne.

Cover Image: GlideScope® Video Laryngoscope, with kind permission of Verathon Ltd.

PA, RK, LVR, DM

Contributing authors

Oshaani Abeyakoon BSc(Hons) MBBS
Clinical Fellow in Emergency Medicine,
Addenbrooke's Hospital, Cambridge,
UK

Vazeer Ahmed BM MRCP FCEM
Consultant in Emergency Medicine,
Addenbrooke's Hospital, Cambridge,
UK

Paul Atkinson BSc(Hons)
MB BCH BAO MRCP FCEM
Consultant in Emergency Medicine,
Addenbrooke's Hospital, Cambridge,
UK

Jonathan Baird BSc(Hons) MBChB
MRCS(Ed) MCEM
Specialty Registrar in Emergency
Medicine, Addenbrooke's Hospital,
Cambridge, UK

Berto Bauza-Rodriguez MD MRCS
Specialist Registrar in Emergency
Medicine, Addenbrooke's Hospital,
Cambridge, UK

Adrian Boyle BM MRCP FCEM
MPhil MD
Consultant in Emergency Medicine,
Addenbrooke's Hospital, Cambridge,
UK

Catherine Hayhurst BMBCh
MA(Cantab) MRCP DTM&H
Specialist Registrar in Emergency
Medicine, Addenbrooke's Hospital,
Cambridge, UK

Peter Heinz State Exam Med MD
MRCP(UK) MRCPCH
Consultant in Acute Paediatrics and
Paediatric Emergency Medicine,
Addenbrooke's Hospital, Cambridge,
UK

Jerome R. Hoffman MA MD
Professor of Emergency Medicine and
Internal Medicine, University of
California, Los Angeles, USA

Mike Iacovou MBBS MRCS
Specialist Registrar in Emergency
Medicine, Addenbrooke's Hospital,
Cambridge, UK

Wayne Kark MBBS MCEM
Specialty Registrar in Emergency
Medicine, Addenbrooke's Hospital,
Cambridge, UK

Richard Kendall BSc(Hons) MBBS
FCEM
Consultant in Emergency Medicine,
Addenbrooke's Hospital, Cambridge,
UK

David Lewis MBBS FRCS FCEM
Consultant in Emergency
Medicine, Ipswich Hospital,
London, UK

Simon Lewis BSc(Hons) MBBS
MCEM DIMC RCSEd
Specialist Registrar in Emergency
Medicine, Addenbrooke's Hospital,
Cambridge, UK

Duncan McAuley MBBChir MA
FRCS(Ed) MRCP FCEM DipIMC
Consultant in Emergency Medicine,
Addenbrooke's Hospital, Cambridge,
UK

Sharon-Anne McAuley MB BCH
BAO MSc MRCP MRCPCH
Specialist Registrar in Paediatrics,
Addenbrooke's Hospital, Cambridge,
UK

Sarah MacFarlane MB BCH BAO
MRCS(Ed)
Clinical Fellow in Emergency Medicine,
Addenbrooke's Hospital, Cambridge,
UK

Russell E. McLaughlin MB BCH
BAO FRCSI FCEM MMedSci
Clinical Director in Emergency
Medicine, Royal Victoria Hospital,
Belfast Trust, Belfast, UK

Chris Maimaris MBChB FRCS FCEM
Consultant in Emergency Medicine,
Addenbrooke's Hospital, Cambridge,
UK

Rhys Roberts MBBChir BA(Hons)
MA MRCP PhD
Research Fellow in Neurology,
Addenbrooke's Hospital, Cambridge,
UK

Susan Robinson BM FRCP FRCS(Ed)
FCEM
Consultant in Emergency Medicine,
Addenbrooke's Hospital, Cambridge,
UK

Steffen Schickerling MRCS(A&E)
DRCOG DCH DTM&H(Liverpool)
Specialist Registrar in Emergency
Medicine, Addenbrooke's Hospital,
Cambridge, UK

Daniel Stanciu DM MRCS(Ed)
Specialist Registrar in Emergency
Medicine, Addenbrooke's Hospital,
Cambridge, UK

John Sutherland MBChB
FRCS(A&E) FCEM
Consultant in Emergency Medicine,
Redland Hospital, Queensland,
Australia

Catriona Thompson BM
MRCS(Eng) FCEM
Consultant in Emergency Medicine,
Peterborough District Hospital,
UK

Lee Van Rensburg MBBCh
FRCS(Orth)
Consultant in Trauma and
Orthopaedics, Addenbrooke's
Hospital, Cambridge, UK

Dhakshinamoorthy Vijayasankar
MBBS, MRCS(A&E) FCEM
Consultant in Emergency Medicine,
Peterborough District Hospital, UK

Contents

Introduction to emergency medicine 1

Introduction to emergency medicine 2 Learning in emergency medicine 4 Good clinical care and communication skills 6

Resuscitation and initial management 7

Pre-hospital care and major incidents 8

Resuscitation 10

Airway management and ventilation 10	Arrhythmias and defibrillation 14	Acid-base and fluid balance 18
Cardiac arrest 12	Shock 16	Coma 20

Common emergency investigations 22

Plain radiographs 22	CT and MRI 26	Haematology, biochemistry and other emergency blood investigations 30
Emergency ultrasound 24	The electrocardiogram 28	

Anaesthesia 32

Pain management and procedural sedation 32	Local anaesthesia 34
--	----------------------

Common emergency procedures 36

Casts and splints 36	Central venous catheterization 38	Intercostal drain insertion 40
----------------------	-----------------------------------	--------------------------------

Trauma 41

Initial approach to the trauma patient 42	Abdominal trauma 48	Maxillofacial trauma 56
Head and spinal trauma 44	Lower limb and pelvic trauma 50	Burns 58
Cardiothoracic trauma 46	Upper limb trauma 52	Wound management 60
	Hand injuries 54	Compartment syndrome 62

Emergency presentations 63

Cardiovascular and respiratory emergencies 64

Chest pain 64	Thromboembolic disease 72	Aortic, vascular and hypertensive emergencies 76
Acute coronary syndromes 66	Blackouts and syncope 74	
Breathlessness 68		

Abdominal and gastrointestinal emergencies 78

Acute abdominal pain 78	Gastrointestinal bleeding 82	Vomiting and diarrhoea 84
Jaundice and hepatic disorders 80		

Renal and genito-urological conditions 86

Acute renal failure 86	Urinary tract problems 88	Male genital problems 90
------------------------	---------------------------	--------------------------

Neurological and psychiatric emergencies 92

Headache 92	Weakness and sensory loss 98	The patient with disturbed behaviour 104
Seizures 94	Confusion 100	
Vertigo and giddiness 96	Meningitis and encephalitis 102	

Toxicology and environmental emergencies 106

The poisoned patient and toxidromes 106	Plant and animal toxins 112	Electrical and water induced injury 116
Hazardous material and CBRN incidents 110	Heat and cold emergencies 114	

Musculoskeletal emergencies 118

The painful joint 118	Non-traumatic musculoskeletal emergencies 120	Back pain 122
-----------------------	---	---------------

Infectious diseases 124

Sepsis 124	Human immunodeficiency virus (HIV), blood-borne and sexually transmitted infections 126	Tropical diseases and fever in the returning traveller 128
------------	---	--

Allergy and skin conditions 130

Allergy and anaphylaxis 130	Common rashes in adults 132
-----------------------------	-----------------------------

Endocrinology, haematology and oncology 134

Diabetic emergencies 134	Anaemia and bleeding disorders 138	Oncology emergencies 140
Biochemical and endocrine emergencies 136		

Other emergencies 142

The acute red eye and common eye trauma 142	Obstetrics and gynaecology 146	Ear, nose and throat, and facial emergencies 150
Acute loss of vision 144	Dental emergencies 148	

Emergency paediatric presentations 153

Fever and sepsis in children 154	Vomiting and diarrhoea in children 160	Limb injuries and the limping child 164
Coma and seizures in children 156	Rashes in children 162	Neonatal emergencies 166
Cough and breathlessness in children 158		Child protection 168

Social issues 169

Violence 170	Alcohol and drug related problems 172	Legal and ethical aspects of emergency medicine 174
--------------	---------------------------------------	---

Appendix 1 175

Treatment of status epilepticus in children 175

Index 176

Introduction to emergency medicine

*The fact that your patient gets well does not prove that
your diagnosis was correct*

Samuel J. Meltzer

Introduction to emergency medicine

Overview and history

Emergency medicine, one of the youngest specialties, has grown to become a challenging and increasingly popular career choice. It is the specialty defined by its patients rather than by any physician-derived classification system. It challenges the traditional medical model of maximizing knowledge of ever decreasing areas of the disease spectrum and in doing so challenges its practitioners to safely and expertly provide care for the broadest possible spectrum of disease.

Emergency care is an essential part of any healthcare system and as such must be available 24 hours per day. The number of patients presenting to emergency departments (Fig. 1) in the developed world has been increasing significantly over recent years and departments have had to develop strategies to deal with overcrowding, difficulties with admitting patients into hospital beds and changes in workforce such as decreased doctors' hours of work.

Although emergency medicine has been practised for decades, if not centuries, it has taken until the later third of the twentieth century for the specialty to establish itself independently. The Casualty Surgeons Association was formed in London in 1967. In 1972 the UK Department of Health funded thirty consultant posts creating a new specialty, *accident and emergency medicine*. In 1979, emergency medicine became the twenty-third recognized medical specialty in the USA, and was recognized as a medical specialty in Australia in 1993 and in New Zealand in 1995. In 2004, the name *emergency medicine* became official in the UK.

Emergency medicine:

'To evaluate, manage, treat and prevent unexpected illness and injury.' Society of Academic Emergency Medicine

The challenges faced in the emergency care system include:

- availability at any time for any complaint
- unfamiliarity of patients

- a wide spectrum of presentations
 - simple to complex problems
 - neonates to the very elderly
 - patients and relatives
- a need to be able to act on limited information and lack of patient records
- expertise in trauma management
- time pressures and unpredictable numbers of patients
- differentiating trivia from subtle symptoms of serious disease.

The approach to the emergency patient

All these challenges, not least the lack of prior knowledge of the patient, mean that each patient's problem requires careful attention, thoughtful enquiry and honest informed opinion.

When dealing with the patient who is actually or potentially critically ill or injured, an approach that differs from the traditional model is required. To take a full history, perform a full examination, and order and review appropriate tests in a patient who may require immediate intervention and treatment, may threaten their very survival. Irrespective of the nature of the clinical emergency, maintenance of adequate oxygenation and ventilation, adequate blood pressure and adequate blood flow to vital organs are important guiding principles. The approach adopted by the various life-support courses is the one used instinctively by emergency teams (Fig. 2) for all patients:

- The primary survey (ABCDE)
 - Airway (with cervical spine control in trauma)

- Breathing and oxygenation
- Circulation (with haemorrhage control)
- Disability (neurology)
- Exposure and environment
- Resuscitation and treatment of life threats
- Secondary survey – history and examination
- Emergency treatment and investigations
- Disposition and definitive care.

This approach ensures that the most immediately life-threatening problems are recognized and treated in the order of their likely impact.

Treat first what kills first.

The ability to be able to treat recognized problems, even without a diagnosis, is key to the practice of emergency medicine. The mark of an emergency physician is the ability to manage the airway (intubate, provide a surgical airway), to manage the breathing of a patient (perform emergency respiratory interventions: ventilation, chest decompression) and to be able to provide cardiovascular support (such as Advanced Life Support).

The 'Emergency Medicine (EM) approach' to differential diagnosis

This is often phrased in terms of 'worst first' – in the emergency department, acute coronary syndrome (ACS) is at the top of the differential of chest pain, and common things like costochondritis almost nowhere to be



Fig. 1 The emergency department – front door of the hospital.

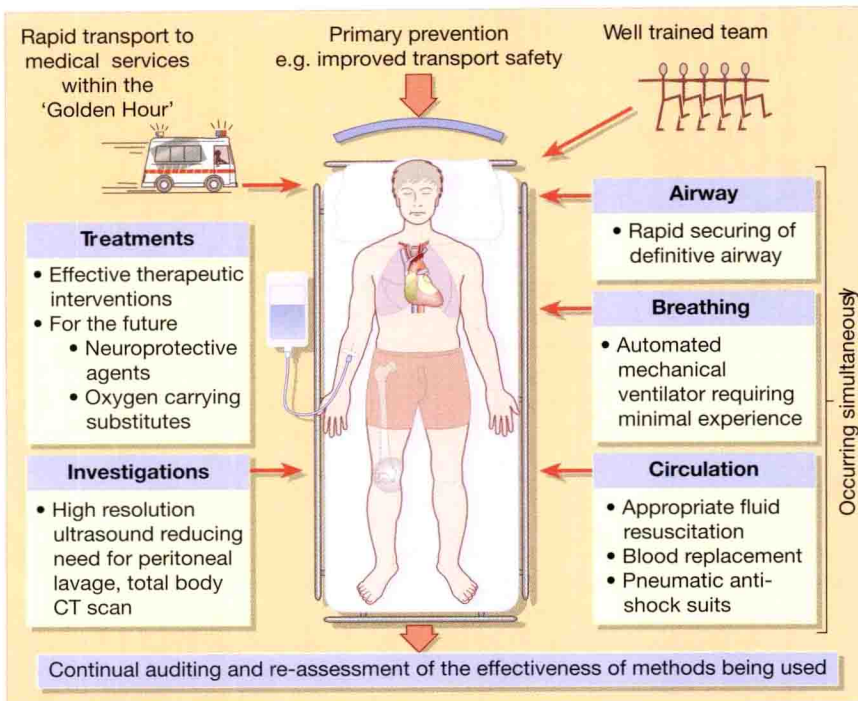


Fig. 2 Modern resuscitation.

found. But that's not nearly all of it; we also emphasize disease that is at least reasonably *likely* (which is why Boerhaave's Syndrome is rarely part of that same list). In addition, it has to be *treatable* (so end-stage metastatic disease is only peripherally a topic in EM). And finally (and perhaps most important) it has to matter that you diagnose and treat it *today*, rather than tomorrow (which is why a brain tumor is not high on the differential of headache ... but bleeding into a tumor, with acute rise in ICP, most certainly is.)

All of these considerations lead the expert emergency physician to use a diagnostic approach that centers around *red flags* – the cardinal signs and symptoms – in back pain, or skin rash, or 'dizzy,' or any patient presentation imaginable – that make us look further, right now. Only when such red flags are eliminated can you consider discharging a patient ... away from medical care.

Tests in emergency medicine

A test is useful only if interpreted in the appropriate clinical setting, and used to address a specific question. Aim to undertake the test that will provide the best answer to your clinical question, rather than the test that is easiest to arrange.

Tests tend to fall into two broad categories: those used for screening and

those used for diagnosis. Screening tests are designed to identify the possibility that disease *might be* present and to prompt further evaluation in those who screen positive. Diagnostic tests provide the user with some certainty that a disease is present.

Sensitivity and specificity

Sensitivity of a test is a measurement of how well a test identifies all with a particular condition. A sensitivity of 100% means that the test recognizes all sick people. The specificity is the proportion of individuals without the condition who are correctly identified by the test as not having it. A specificity of 100% means that the test recognizes all well people. (SpIN and SnOUT – SPecificity rules IN and SeNsitivity rules OUT.)

Positive and negative predictive values

Sensitivity and specificity are characteristics of how accurate a test is. A patient is more likely to want an answer to the questions 'If my test result is positive, what is the likelihood that I have the disease?' or 'If my result is negative, what is the likelihood I don't have the disease?' These values are the positive and negative predictive value (PPV/NPV) of the test.

Unlike sensitivity and specificity, the PPV and NPV will change depending on how common the disease is in the

population. For rare diseases, the PPV will always be low, even when a test is near perfect in terms of sensitivity and specificity.

Likelihood ratios (LR)

The positive likelihood ratio (LR^+) and negative likelihood ratio (LR^-) for a test combine the sensitivity and specificity results into single measures that tell us how useful a positive or negative test result is in clinical practice.

Pre- and post-test probabilities

To apply likelihood ratios, it is important to have an estimate of the probability that a condition is present before the test is done (pre-test probability). For example:

- If a patient is seen who is unconscious, what is the probability that he has a severe head injury?
- If a young man is seen at midnight and he smells of alcohol what is the probability that he has a severe head injury?
- If a young man is seen at midnight, he smells of alcohol, and has blood pouring out of his ear, what is the probability that he has a severe head injury?

Once an estimate has been made, the use of a screening or diagnostic test with a known likelihood ratio can then provide a post-test probability, aiding formulation of a safe treatment plan. As the pre-test probability rises, to be able to rule out disease, the LR^- needs to be low (e.g. a normal CT scan of the head).

Key points

- Treat life-threatening problems first.
- Treatment can proceed initially without an exact diagnosis.
- Use appropriate tests, always have a pre-test probability for the disease/finding.
- Be cautious with high risk groups (elderly, very young).
- Focus the examination on the key systems involved, being aware that a broad screening examination of other systems may be required.
- Review all available documents (paramedic, nursing, previous notes).
- Think of abuse and violence.
- Document everything clearly.
- Practise within your abilities and ask for help when needed.

Learning in emergency medicine

The emergency department is an invaluable learning environment. It is essential to develop strategies for learning rather than to depend passively on scheduled teaching sessions. Nowhere else in the hospital setting will a medical student or doctor gain exposure to such a wide variety of patients, in terms of age, symptoms and signs, severity, procedures and underlying diagnoses. The key concept that should be embraced is that learning is the responsibility of the individual.

Learning objectives

Try to set learning objectives, ideally as part of a formal appraisal with a mentor. When setting objectives the question should be asked as to whether it is knowledge, skill or attitude development that is being sought. These are learned in different ways:

Knowledge

This is probably the most testable form of learning and, at its most crude, represents the retention and regurgitation of facts. Doctors who have a good knowledge base will do well in multiple choice question (MCQ) examinations but this is often a poor measure of their actual clinical ability. We accumulate knowledge actively by reading or casually by experience.

Skills

These can be broken down into psychomotor skills (doing) and

deductive skills (reasoning).

Psychomotor skills, such as suturing or scanning, are learned by repetition (Fig. 1). Deductive skills, such as x-ray interpretation, are a higher order of thinking; a synthesis of knowledge and experience. Skills can be tested in a number of ways including Objective Structured Clinical Examinations (OSCEs) and Directly Observed Procedural Skills (DOPSs).

Attitude

Similar to deductive skills, attitude cannot easily be learned from a book or taught on a course. Attitude is developed by reflection and feedback from positive role models. Attitude is tested in a number of ways including formal testing at interview or informally by casual observation of workplace interaction.

As part of the learning strategy one must endeavour to appreciate the different approaches required to achieve certain objectives. To pass an MCQ a considerable amount of reading is required. To learn how to place a chest drain is more difficult as it requires knowledge, supervision, skill and enough clinical exposure to allow the opportunity to arise.

Pitfalls

There are a number of common pitfalls that may occur despite the best intentions of a well-motivated learner. These pitfalls may represent a clinical risk as well as an education loss.

Pitfall: Failure to actively pursue knowledge-gaps in clinical situations;

for example being too busy to follow up clinical outcomes.

Solution: When encountering a knowledge-gap in a clinical situation ask a senior colleague or look it up at the time. Keep a record of difficult cases and follow them up to confirm/refute your initial clinical impression.

Pitfall: Reliance on self-contained knowledge in stressful situations. We naturally struggle to recall essential knowledge in very stressful situations.

Solution: Some knowledge is best kept outside of your head, on posters, PDAs or department handbooks. This strategy is known as 'cognitive load reduction'.

Pitfall: Lack of constructive feedback. Traditionally the feedback loop in emergency medicine was long and non-constructive, informing a doctor of their error three weeks previously. Timely and constructive feedback is essential for skills eminence and good patient care.

Solution: Seek regular feedback from your colleagues not just at appraisal time (Fig. 2).

Pitfall: Passive learning. This is where doctors expect to be given knowledge and skills during protected teaching sessions without the need to contribute. This is demoralizing for teacher and learner.

Solution: Use your teaching programme as a syllabus to your background reading and come prepared to teaching sessions. This leads to a much more rewarding teaching session for both parties.



Fig. 1 'Hands on' learning for a practical skill.