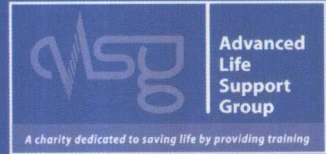


THIRD EDITION

# PRE-HOSPITAL PAEDIATRIC LIFE SUPPORT

A PRACTICAL APPROACH TO EMERGENCIES



# Pre-Hospital Paediatric Life Support

## A Practical Approach to Emergencies

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Advanced Life Support Group

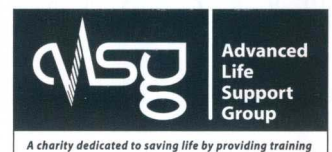
EDITED BY

Alan Charters

Hal Maxwell

Paul Reavley

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# Working group

- Alan Charters** RGN, RSCN, RNT, D Health Sci, MA Ed, BSc (Hons), PgDip Ed  
Lead Consultant for Paediatric Emergency Care, *Portsmouth*
- Sandrine Dénéreáz** Paramedic, Emergency School Director, *Lausanne, Switzerland*
- Tony Little** BSc  
Senior Resuscitation Practitioner/Critical Care Paramedic, *London*
- Fiona Mair** MBChB, MRCP (Assoc), DIMC (RCSEd), MRCEM (Assoc)  
Emergency Medicine Associate Specialist, *Aberdeen*; member BASICS Scotland
- Jeremy Mauger** MStJ, BSc(Hons), MBBS, FRCA, FFICM  
Consultant in Anaesthetics and Intensive Care, *Bury St Edmunds*; HEMS Consultant, East Anglian Air Ambulance
- Hal Maxwell** BMSc (Hons), MBChB, DRCOG, FRCGP, DIMC (RCSEd)  
Locum GP, Rural Dispensing Practice; member BASICS Scotland
- Michael Page** BSc (Hons), Dip Sp Prac, DIMC (RCSEd), CertEd  
Operational Lead (Adult) Resuscitation Services, University Hospitals Bristol NHS Foundation Trust, *Bristol*; Critical Care Paramedic, South Western Ambulance Service NHS Foundation Trust
- Paul Reavley** MBChB, FRCEM, FRCS(A&E)Ed, MRCPGP, Dip Med Tox, RAMC  
Consultant in Military Emergency and Pre-Hospital Care; Paediatric Emergency Medicine Consultant, Bristol Royal Hospital for Children, *Bristol*
- Julian M. Sandell** MBBS, MRCPI, FRCPCH, FRCEM  
Consultant in Paediatric Emergency Medicine, Poole Hospital NHS Trust, *Poole*
- Ronald de Vos** MD  
Anesthesiologist, University Medical Center Groningen (UMCG), *Groningen, the Netherlands*
- Susan Wieteska** CEO, ALSG, *Manchester*
- Mark Woolcock** Consultant Paramedic, *Cornwall*

# Contributors to third edition

- Jim Blackburn** MBBS, BSc, MRCEM, FRCA, FIMC (RCSEd), ST5  
Anaesthesia and Prehospital Emergency Medicine, *Bristol*
- Vicki Brown** MCPPara, MSC, DIMC (RCSEd)  
Specialist Paramedic in Critical Care, Great Western Air Ambulance
- Alan Charters** RGN, RSCN, RNT, D Health Sci, MA Ed, BSc (Hons), PgDip Ed  
Lead Consultant for Paediatric Emergency Care, *Portsmouth*
- Phil Cowburn** BSc (Hons), MBChB, FRCS, FCEM, DIMC (RCSEd)  
Consultant in Emergency Medicine, Medical Director (Acute Care) Southwest Ambulance Service  
NHS Foundation Trust
- Tony Little** BSc  
Senior Resuscitation Practitioner/Critical Care Paramedic, *London*
- Fiona Mair** MBChB, MRCGP (Assoc), DIMC (RCSEd), MRCEM (Assoc)  
Emergency Medicine Associate Specialist, *Aberdeen*; member BASICS Scotland
- Jeremy Mauger** MStJ, BSc(Hons), MBBS, FRCA, FFICM  
Consultant in Anaesthetics and Intensive Care, *Bury St Edmunds*; HEMS Consultant, East Anglian  
Air Ambulance
- Hal Maxwell** BMSc (Hons), MBChB, DRCOG, FRCGP, DIMC (RCSEd)  
Locum GP, Rural Dispensing Practice; member BASICS Scotland
- Michael Page** BSc (Hons), Dip Sp Prac, DIMC (RCSEd), CertEd  
Operational Lead (Adult) Resuscitation Services, University Hospitals Bristol NHS Foundation Trust,  
*Bristol*; Critical Care Paramedic, South Western Ambulance Service NHS Foundation Trust
- Paul Reavley** MBChB, FRCEM, FRCS(A&E)Ed, MRCGP, Dip Med Tox, RAMC  
Consultant in Military Emergency and Pre-Hospital Care; Paediatric Emergency Medicine  
Consultant, Bristol Royal Hospital for Children, *Bristol*
- Julian M. Sandell** MBBS, MRCPI, FRCPCH, FRCEM  
Consultant in Paediatric Emergency Medicine, Poole Hospital NHS Trust, *Poole*
- Ronald de Vos** MD  
Anesthesiologist, University Medical Center Groningen (UMCG), *Groningen, the Netherlands*
- Matthew J. C. Thomas** MBChB, FRCA, MRCP, DICM, EDIC, DIMC (RCSEd), FFICM  
Consultant in Intensive Medicine, Lead Doctor, Great Western Air Ambulance
- James Tooley** MBBS, MRCP, FRCPCH, DIMC (RCSEd)  
Consultant in Neonatal and Paediatric Retrieval, Clinical Development Lead, Great Western Air  
Ambulance, *Bristol*
- Christopher J. Vallis** BSc, FRCA, FRCPCH, MFSEM, CertMedEd  
Consultant Paediatric Anaesthetist (retired), Royal Victoria Infirmary, *Newcastle upon Tyne*
- Susan Wieteska** CEO, ALSG, *Manchester*
- Mark Woolcock** Consultant Paramedic, *Cornwall*

# Contributors to first and second editions

- A. Charters** Emergency Nursing, *Portsmouth*
- T. Hodgetts** Emergency Medicine, *MOD*
- F. Jewkes** General Practitioner and Paediatrician, *Berwickshire*
- S. Levene** Child Accident Prevention Trust, *London*
- P. Lubas** Resuscitation Training/Paramedic, *Cardiff*
- I. Maconochie** Paediatric Emergency Medicine, *London*
- J. Mauger** Anaesthetics, *Bury St Edmonds*
- H. Maxwell** General Practitioner, *Ballantrae*
- K. McCusker** Resuscitation Training/Paramedic, *Cardiff*
- J. Mooney** ALSG, *Manchester*
- F. Moore** Emergency Medicine, Ambulance Service Medical Director, *London*
- P. Oakley** Anaesthetics/Trauma, *Stoke*
- B. Phillips** ALSG, *Manchester*
- P. Reavley** Emergency Medicine, *Bristol*
- J. Robson** Paediatric Emergency Medicine, *Liverpool*
- B. Stewart** Paediatric Emergency Medicine, *Liverpool*
- M. Vander** Ambulance Service A&E Development Manager, *London*
- S. Wieteska** ALSG CEO, *Manchester*
- M. Woolcock** Pre-Hospital Practitioner, *Truro*
- M. Woollard** Pre-Hospital Emergency Medicine, *Middlesbrough*

# Preface to third edition

The preface to the first edition of the *Pre-Hospital Paediatric Life Support* (PHPLS) manual explained that children could be saved and morbidity prevented by early and appropriate intervention. This course continues in response to that need and the need to provide a consistent, high-quality and evidence-based approach to the care of the seriously ill or injured child.

When the first course was written it grew out of the then well-established Advance Paediatric Life Support (APLS) course. As a result some of the teaching was not always transferable to the pre-hospital practitioner and their environment. Subsequent development of the course reflects the changes in resuscitation practice and recognises the demands and limitations faced by practitioners working outside hospital.

This course is aimed at the level 5 pre-hospital practitioner. An example of change is the de-emphasis of intubation and re-emphasis on good, core airway skills. The course acknowledges the role of high capability pre-hospital teams but focuses on pragmatic care delivered by the level 5 staff.

Other changes in this course reflect the introduction of current evidence-based and consensus guidelines such as the use of tranexamic acid in haemorrhage, the principle of minimal handling and the de-emphasis on cervical collars and immobilisation. The overall aim has been to maintain the high quality of the material but also reflect the changing evidence base and practice when providing care in the challenging environment that is found in the pre-hospital arena.

As always, we have aimed to keep the material consistent with the text of the current edition of the sister APLS course and some of what we have introduced in this edition of PHPLS is now being mirrored in the latest iteration of the APLS course. All knowledge is dynamic and changes will continue at pace. The Advance Life Support Group (ALSG) and its working groups will continue to develop its teaching as required.

Many, many thanks to all those who have helped with preparation and given us ideas and feedback. Thanks in advance to those of you who will continue to do so as this will ensure we keep the course relevant to your needs.

Perhaps too much has been made of the 'difficulty' of treating children in the past. Very importantly we wish to encourage you that despite fears and anxieties, you already have the knowledge and skills to help children, they are after all still members of the human race. We hope that this manual and the PHPLS course will develop you further and supply the confidence you require to treat the child in urgent need of care.

We hope you will find it useful, enjoyable and that your patients will benefit from this.

Alan Charters, Hal Maxwell and Paul Reavley  
Co-Chairs PHPLS Working Group, 2017

# Preface to first edition

*Pre-Hospital Paediatric Life Support: The Practical Approach* was written as a sister publication to *Advanced Paediatric Life Support: The Practical Approach*. It has the same objective of improving the emergency care of children, but concentrates on the first critical minutes prior to arriving at hospital.

It has been developed to fill a void in the training of personnel who have sometimes had to deal with these children with little knowledge or experience of paediatrics. Members of the pre-hospital life support working group, all of whom have extensive experience of working with children in both the pre-hospital and the hospital environments, have developed the manual in conjunction with the Joint Colleges and Ambulance Liaison Committee (JCALC) working party on paediatrics.

This manual also forms the core text of the PHPLS course, which is designed to give both medical and paramedical staff the skills and knowledge to deal with paediatric trauma and medical emergencies. The editors feel that by training together these multidisciplinary groups will both complement each other and reduce potential barriers thus developing a seamless care approach to these events.

The course is designed to dovetail with the therapies presented in APLS, building upon established and tested interventions that we hope will ultimately provide an improvement in patient outcomes.

The layout of this book begins with background information on the aetiology of illness and disease in children, followed by the assessment and basic life support of children. Specific pre-hospital considerations are then covered followed by practical skills to apply your new-found knowledge.

Emergencies in children can generate a great deal of anxiety in the children, parents and medical personnel who have to deal with them. We hope that this book will enlighten the reader on the subject of pre-hospital paediatric emergency care and provide some support to help all involved. Read it as part of the PHPLS course or as a stand-alone publication, refer to it frequently, and hopefully it will help to achieve its aim of improving the standards of paediatric life support within the pre-hospital setting.

Fiona Jewkes, Paul Lubas and Kevin McCusker  
*Editorial Board, December 1998*



# Acknowledgements

A great many people have put a lot of hard work into the production of this book and the accompanying course. The editors would principally like to thank all of the working party and contributors for their monumental efforts in the delivery of this text.

We are greatly indebted to Kirsten Baxter and Jane Mooney for their exceptional hard work and dedication towards this publication; their encouragement and guidance throughout the process has been gratefully received.

The editors gratefully acknowledge the written information and guidance received from the Great Western Ambulance Service, in particular the quick reference drugs guides reproduced in the back of the book.

We would like to thank, in advance, all of those who attend the Pre-Hospital Paediatric Life Support Course and others using this text for their continued constructive comments regarding the future development of both the course and manual.

# Contact details and further information

ALSG: [www.alsg.org](http://www.alsg.org)

For details on ALSG courses visit the website or contact:

Advanced Life Support Group  
ALSG Centre for Training and Development  
29–31 Ellesmere Street  
Swinton, Manchester  
M27 0LA  
Tel: +44 (0)161 794 1999  
Fax: +44 (0)161 794 9111  
Email: [enquiries@alsg.org](mailto:enquiries@alsg.org)

Clinicians practising in tropical and under-resourced healthcare systems are advised to read *International Maternal and Child Health Care – A Practical Manual for Hospitals Worldwide* ([www.mcai.org.uk](http://www.mcai.org.uk)) which gives details of additional relevant illnesses not included in this text.

## Updates

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The material contained within this book is updated on a 5-yearly cycle. However, practice may change in the interim period. We will post any changes on the ALSG website, so we advise that you visit the website regularly to check for updates ([www.alsg.org/uk/phpls](http://www.alsg.org/uk/phpls)). The website will provide you with a new page to download.

## References

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All references are available on the ALSG website [www.alsg.org/uk/phpls](http://www.alsg.org/uk/phpls)

## On-line feedback

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It is important to ALSG that the contact with our providers continues after a course is completed. We now contact everyone 6 months after their course has taken place asking for on-line feedback on the course. This information is then used whenever the course is updated to ensure that the course provides optimum training to its participants.

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# Pre-Hospital Paediatric Life Support

THIRD EDITION

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## CHAPTER 1

# Introduction

### Learning outcomes

After reading this chapter, you will be able to:

- Describe the focus of the PHPLS course
- Identify the important differences in children and the impact of these on the management of emergencies

Over the last two decades there has been a substantial reduction in childhood mortality across the world. This has been related to improvements in many areas such as maternal education, access to clean water, access to food, immunisation against an increasing number of infectious conditions and improved access to healthcare services. Even conditions such as human immunodeficiency virus (HIV) infections have potentially come under control with the development of highly effective antiretroviral therapeutic regimens. However, children across the world continue to suffer potentially life-threatening acute illness (sometimes on a background of chronic illness) and injury. The Pre-Hospital Paediatric Life Support (PHPLS) course is directed at training healthcare workers to recognise life-threatening illness or injury in children; to provide effective emergency intervention; and to ensure that children are directed to the appropriate place for ongoing definitive management of the condition as soon as possible. This approach is potentially applicable in many different settings across the world.

### 1.1 Principles

There are a number of principles that underpin this approach. Pre-hospital healthcare professionals must:

- Be reassured that acquired experience and skills are transferable to children's illness and trauma management but be aware of the important areas of difference and your own development needs
- Adopt and rehearse a structured approach to the assessment and management of children's illness and injury
- Ensure appropriate paediatric equipment is carried and be familiar with its use
- Include paediatric training and education in professional development and clinical governance processes

### Physiological differences

Most clinical medicine is taught with the underlying assumption that adults best exemplify 'normal' in health. This is perhaps justified by the reality that in most parts of the world the majority of the population is made up of adults, but in poorer countries up to 40% of the population may be made up of children (depending on how children are defined). Thus it is important to highlight where children are different to adults in terms of physiology, pathophysiology and responses to various interventions (see Section 1.2). A key area of successful paediatric care is understanding that children physiologically compensate extremely well in acute illness and injury. A consequence of this is that an inexperienced practitioner may not recognise the early stages of disease or injury, and without intervention the child may deteriorate to the point of decompensation. In children decompensation is rapid and difficult to reverse; paediatric cardiac arrest represents the end of a long and missed opportunity to intervene. Thus particular attention has to be paid to timely and effective support of the respiratory and cardiovascular systems in particular.

Children come in a range of sizes, and a consequence of this is the constant requirement to adjust all therapy, interventions and selection of equipment or consumable to the size of the particular patient (see Table 1.1).

### Relationship between disease progression and outcomes

The further a disease process is allowed to progress, the worse the outcome is likely to be. The outcomes for children who have a cardiac arrest out of hospital are generally poor because cardiac arrest is rarely related to a sudden cardiac arrhythmia, but more commonly is a sequel of hypoxaemia and/or shock with associated organ damage, dysfunction and often irreversible decompensation (Figure 1.1). By the time that cardiac arrest occurs, there has already been substantial damage to end organs. This is in contrast to situations (more common in adults) where the cardiac arrest was the consequence of cardiac arrhythmia – with preceding normal perfusion and oxygenation. Thus the focus of the course is on early recognition and effective management of potentially life-threatening problems before there is progression to respiratory and/or cardiac arrest.

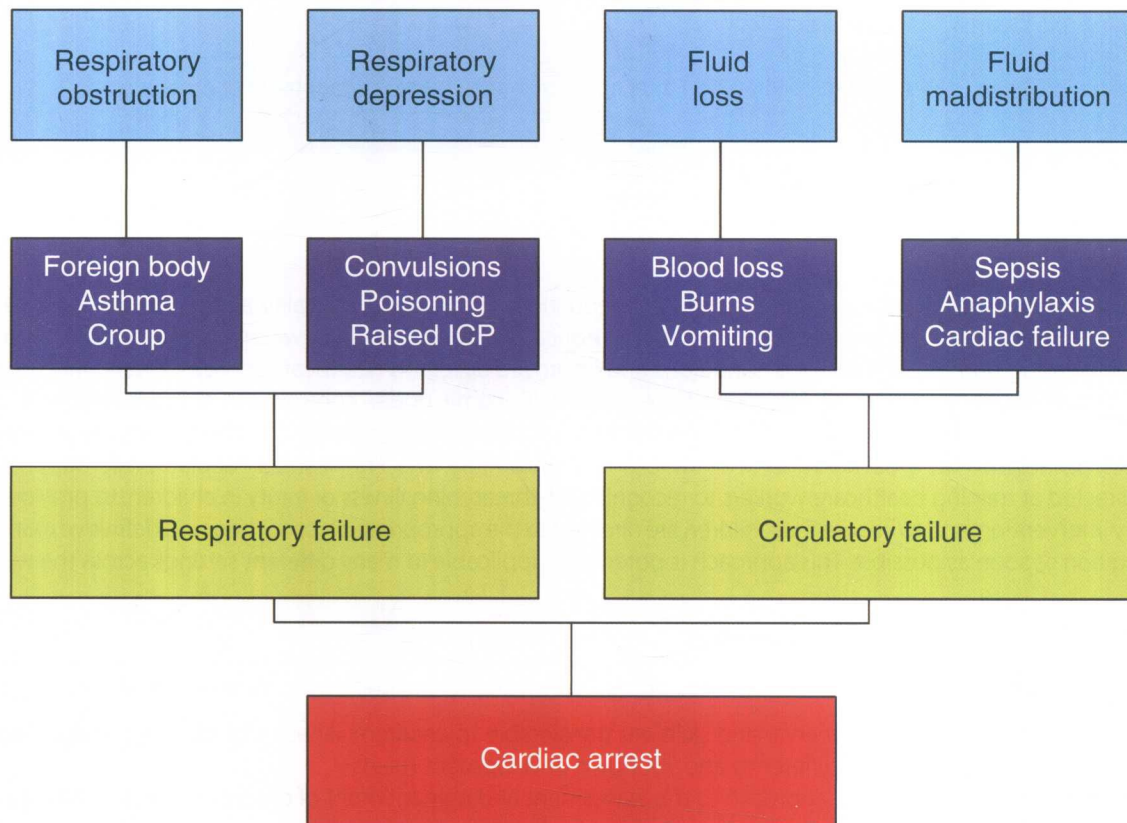


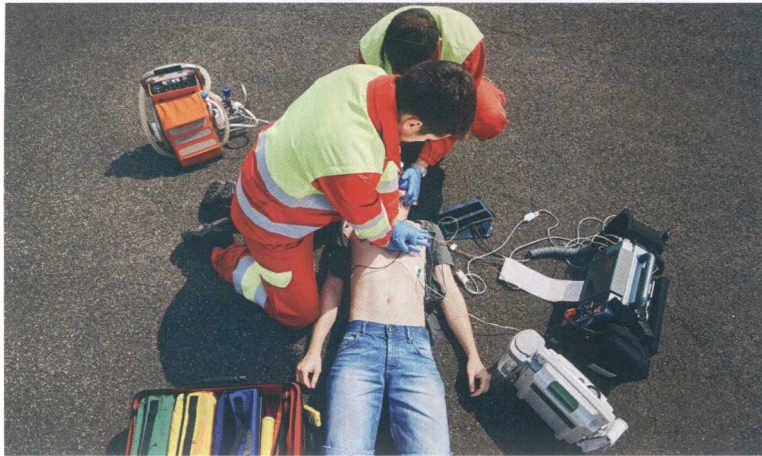
Figure 1.1 Pathways to cardiac arrest. ICP, intracranial pressure

### Standardised structure for assessment and stabilisation

The use of a standardised structure for resuscitation provides benefits in many areas. Firstly it provides a structured approach to a critically ill child who may have multiple problems. The standardised approach enables the provision of a standard working environment, ensuring that all the necessary equipment is available as required. By focusing attention on life-threatening issues and dealing with these in a logical sequence it is possible to stabilise the child's condition quickly. The use of the standardised structure enables the entire team to know what is likely to be expected of them and in what sequence.

There may well be discussion around the optimum sequence of resuscitation, but in this course a particular approach has been accepted as being reasonable, and most in keeping with the available research information. It is likely that aspects of this approach will change over time, and in fact it may be appropriate to modify the approach in particular working environments and contexts.

Once basic stabilisation has been achieved, it is then appropriate to investigate the underlying diagnoses and proceed to definitive therapy. Occasionally, definitive therapy (such as surgical intervention) may be a component of the resuscitation.



**Figure 1.2 PHPLS in action**

### Resource management

There is increasing realisation that provision of effective emergency treatment depends on the development of teams of healthcare providers who are able to work together in a coordinated and appropriately directed way (Figure 1.2). Thus part of training in paediatric life support must focus on understanding how the human resources available for a particular resuscitation episode can be utilised most effectively.

### Early transfer to appropriate teams for definitive management

It is clear that within the pre-hospital setting you are unlikely to be able to provide anything other than initial assessment and early resuscitative measures (pre-hospital critical care teams may be able to provide more than this). Definitive management will need to be provided in the most appropriate setting available. This will require decisions about where to transfer, what mode of transfer (i.e. road ambulance or helicopter) or whether to seek a retrieval team to assist. These will all depend on particular circumstances in which you find yourself.

## 1.2 Important differences in children

Children vary in weight, size, shape, intellectual ability and emotional response. At birth a child is, on average, a 3.5 kg, 50 cm long individual with small respiratory and cardiovascular reserves and an immature immune system. They are capable of limited movement, exhibit limited emotional responses and are dependent upon adults for all their needs. Fourteen or more years later at the other end of childhood, the adolescent may be a 50 kg, 160 cm tall person who looks physically like an adult, is often exhibiting a high degree of independent behaviour but who may still require support in ways that are different to adults.

Competent management of a seriously ill or injured child who may fall anywhere between these two extremes requires a knowledge of these anatomical, physiological and emotional differences and a strategy of how to deal with them.

### Weight

The most rapid changes in weight occur during the first year of life. An average birth weight of 3.5 kg will have increased to 9.5 kg by the age of 1 year. After that time weight increases more slowly until the pubertal growth spurt.

As most drugs and fluids are given as the dose per kilogram of body weight, it is important to determine a child's weight as soon as possible. Clearly the most accurate method for achieving this is to weigh the child on scales; however, in an emergency, this may be impracticable. Very often, especially with infants, the child's parents or carer will be aware of a recent weight. If this is not possible, various formula or reference guides are available, e.g. the Joint Royal Colleges and Ambulance Liaison Committee (JRCALC) page per age handbook or the page per age resource included in the Appendix to this manual. Various formulae may also be used although they should be validated to the population in which they are being used.



**Table 1.1** Normal ranges

Age	Guide weight (kg)	RR At rest Breaths per minute 5th–95th centile	HR Beats per minute 5th–95th centile	BP Systolic		
				5th centile	50th centile	95th centile
Birth	3.5	25–50	120–170	65–75	80–90	105
1 month	4.5					
3 months	6.5	25–45	115–160	70–75	85–95	
6 months	8	20–40	110–160			
12 months	9.5	20–35	100–155	70–80	85–100	110
18 months	11					
2 years	12	20–30	100–150	80–90	90–110	110–120
3 years	14		90–140			
4 years	16		80–135			
5 years	18		80–130			
6 years	21					
7 years	23					
8 years	25	15–25	70–120	90–105	100–120	125–140
9 years	28					
10 years	31					
11 years	35					
12 years	43	12–24	65–115	90–105	100–120	125–140
14 years	50		60–110			
Adult	70					

BP, blood pressure; HR, heart rate; RR, respiratory rate.

If a child's age is known the normal ranges table here will provide you with an approximate weight (Table 1.1). This will allow you to then prepare the appropriate equipment and drugs for the child's arrival in hospital. Whatever the method, it is essential that the carer is sufficiently familiar with it to be able to use it quickly and accurately under pressure. When arriving at an incident, you should quickly review the child's size to check if it is much larger or smaller than predicted. If you have a child that looks particularly large or small for their age, you can go up or down one age group.

As the child's weight increases with age the size, shape and proportions of various organs also change (Figure 1.3).

Physiological differences in different sized children include the following.

### **Respiratory**

The infant has a relatively greater metabolic rate and oxygen consumption. This is one reason for an increased respiratory rate. However, the tidal volume remains relatively constant in relation to body weight (5–7 ml/kg) through to adulthood. The work of breathing is also relatively unchanged at about 1% of the metabolic rate, although it is increased in the pre-term infant.

The infant's compliant chest wall leads to prominent sternal and subcostal recession when the airways are obstructed or lung compliance decreases. It also allows the intrathoracic pressure to be less 'negative'. This reduces small-airway patency. As a result, the lung volume at the end of expiration is similar to the closing volume (the volume at which small-airway closure starts to take place).