Delivering Quality Imaging Services for Children

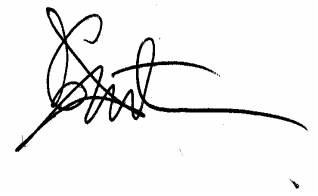
A Report from the National Imaging Board

Gateway reference number: 13732

Foreword

The importance of specialist imaging services for children and young adults has been recognised for many years. This document describes the structure of services that should be commissioned to support the provision of effective paediatric imaging services.

This report was commissioned jointly in our capacities representing Children and Families and Imaging. It is intended to inform commissioners and identify how service providers can offer high quality, innovative, paediatric imaging services.



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'The Department of Health is committed to ensuring the NHS provides a comprehensive service to all, whatever their gender, race, disability, age, sexual orientation, religion or belief. '

Introduction

1. Imaging children provides distinct challenges to radiology departments. The presentation of disease and pathology is unique to children and varies with the age of the child. Effective examination is dependent upon gaining the co-operation of the child, is age dependant and sedation or anaesthesia may be required. The needs of parents or carers should also be understood and addressed when considering any paediatric service.

2. Equipment and facilities suitable for children ranging from premature infants to adult sized teenagers is required and these are often different to those used for adults. Imaging needs to be child focussed and specific to the age of the child. Radiation protection and safeguarding are paramount concerns for this age group. Children must be considered in their own right, and imaging techniques should not be compromised by using techniques akin to imaging small adults.

3. Paediatric radiology is one of the smallest radiology sub-specialties. Historically recruitment has been limited for both radiology and radiography trainees. Evidence from the United States indicates that paediatrics is one of the least popular of all radiology sub-specialties (Factors influencing subspecialty choice among radiology residents: a case study of paediatric radiology. JACR September 2009 & SOS: can we save paediatric radiology? Radiology 2005; 235: 719-722). The evidence from Europe paints a similar picture (the future of paediatric radiology: a European point of view. Radiology 2006; 238(3): 1074-1075). At the time of writing there are unfilled vacancies for Consultant Paediatric Radiologists in at least 3 major teaching hospitals.

4. All radiology training schemes in the United Kingdom should include core paediatric training as part of the Royal College of Radiologists curriculum. Currently there is no sub-specialty training and there is no formally recognised paediatric radiology training beyond core requirements. Interested trainees have to arrange suitable training locally or by out of deanery experience. There is also no definition as to what constitutes training. The British Society of Paediatric Radiology recommends 1-year of paediatric ‘focused’ training for a full time paediatrics consultant or 6-months’ for an general radiologist with an interest in paediatric radiology. It would appear that few trainees express an interest in specialising in paediatrics and as a result few training places are being made available. Core paediatric training involves less than 3 months of practical experience in many centres, which makes it difficult for trainees to gain confidence in paediatric procedures and develop any interest or enthusiasm for paediatric radiology.

5. Paediatric radiography is not recognised as an extended role for state registered radiographers and has no recognition within *Agenda for Change.* Paediatric radiography has no formal career structure and thus there is little incentive for radiographers to specialise in this area. As a result few dedicated paediatric radiographers exist outside specialist children’s units.

6. There are wide variations in the provision of specialist paediatric imaging with comprehensive services concentrated in children's hospitals and major teaching centres. However, the majority of routine, emergency and trauma imaging takes place in district hospitals. This is provided with variable levels of local expertise and variable support from specialist units to smaller hospital imaging departments.

7. Most imaging of children is centred on traditional plain radiography and ultrasound and should continue to be so. However, some areas of imaging such as contrast fluoroscopy are in decline and others such as CT, MRI, Nuclear Medicine and interventional radiology are increasingly necessary in support of routine paediatric care pathways.

8. One commonly expressed view of children's imaging services is that there is little of concern. Children rarely breach the 18-week target. They do not breach the 31-62 day cancer targets and rarely breach the 4-hour A&E target. There are few complaints about paediatric imaging services.

9. This report is set against the background of the recent publication of Standards for Radiological Investigations of Suspected Non-accidental Injury by the Royal College of Radiologists (RCR) and Royal College of Paediatrics and Child Health (RCPCH) and the recent issues raised by the Baby Peter Inquiry [20] and the Birmingham Children's Hospital Inquiry into interventional imaging provision [19].

10. In reviewing children's imaging services it is necessary to balance the need for local imaging, with the need for an integrated service offering specialist support and expertise, which may not necessarily be provided local to the patient's home.

11. This report seeks to define a quality imaging service for children. A service where a child is examined and diagnosis made by specialists with appropriate expertise, is imaged using dedicated facilities and equipment and where the child is at the centre of all decisions made.

12. This report is written at a time of significant change in funding flows and financial constraint in healthcare. There has been no attempt to explore the detailed costs of such service changes and further work will be needed to do this.

Models of Service Delivery for Paediatric Imaging

Establishing Clinical Networks

13. An option for services could be to develop local access wherever appropriate and supported by networks, with units offering specialist paediatric imaging expertise and investigations and advice to local units as needed. Specialist imaging services should support regional paediatric services which should include:

    - Neurosciences
    - Oncology, including PET imaging

- Nephro-urology
- Surgery
- Neonatal care (including surgery)
- Paediatric Intensive Care
- Non Accidental Injury and safeguarding specialist opinion
- Ear, Nose & Throat Services
- Burns & Plastic Surgery
- Cystic Fibrosis & other respiratory services
- Trauma & Orthopaedics
- Gastroenterology / digestive diseases
- Vascular services, including paediatric interventional imaging
- Genetics
- Cardiology & cardiac surgery
- Transplant services
- Ophthalmology
- Rheumatology

Possible Models for Specific Established Paediatric Networks

Cancer Networks

14. A paediatric radiology service should be part of an integrated pathway for the management of site-specific cancers and integrated in the care pathways of Children's Cancer Centres.

Trauma Networks

15. Specialist trauma expertise is important and should be available to teams managing trauma in children. Where patients are transferred to specialist trauma units, access to relevant previous imaging is necessary for accurate diagnosis.

Access to Interventional Paediatric Radiology

16. Access to interventional radiology (IR) services is variable in England, ranging from a few hospitals with no service, at one extreme, to a small number of centres that provide a comprehensive 24/7 service. Although the majority of hospitals offer a service during normal working hours, many of the radiologists providing IR services to children are not currently trained specifically in children's interventional radiology .This may limit access to the required expertise.

17. The report into IR access at Birmingham Children's Hospital (BCH) [highlighted the lack of formal arrangements regarding the transfer of very sick children requiring interventional radiology, both in and out of hours. Even at specialist paediatric hospitals the interventional radiology service out of hours is often ad hoc and based on goodwill. At one dedicated paediatric hospital there are three interventional radiologists, only two of whom are full time.[21] The BCH report identifies the need for provision of interventional radiologists with specialist paediatric skills.

Image Handling for Networks

18. All units within a network should have image and report sharing services. These should provide access to local Picture Archiving and Communication Systems (PACS) integrated with effective teleradiology systems for case review and to support multi-disciplinary teams and shared care pathways between local and tertiary centres. Images and reports of investigations should be available to all legitimately involved in the child's care, regardless of where they are within the network.

The 3 Tier Model of Service Delivery for Paediatric Imaging

19. Commissioning organisations are asked to consider the development of this network approach. The following examples identify the elements of each service tier, which could form the commissioned service specification.

20. The creation of an imaging network similar to existing cancer, trauma and stoke networks is possible for paediatrics. This should be implemented with flexibility to allow local services to develop according to the skills of the local workforce and service needs. Such a model may be based on existing SHA geographical areas or, for some areas, on smaller regions. The network approach will be able to implement and assure standards for all aspects of imaging and service delivery. This should include standardisation of techniques and ensuring staff with the appropriate training are deployed and performance reviewed regularly.

21. In developing or extending the existing networks there is the opportunity to introduce common standards and governance processes. The developments should be linked to the local specialty infrastructure. Three levels of paediatric imaging service are described to give a tiered network approach in order to deliver a high quality imaging service for children of all ages and to support all pathways of care. This model would enhance existing paediatric imaging service provision, offer flexibility and provide a model for sustainability in smaller departments where there may be no access to a specialist paediatric radiologist. It would formalise the links between departments and encourage units to acquire specialist skills locally and provide advice where needed, with opportunities within the workforce for development of specialist paediatric skills.

3 Tier Model - Level 3 Paediatric Imaging Services

22. A level 3 department would provide dedicated facilities and equipment for children to include as a minimum plain radiography and ultrasound services. The design of all paediatric and operating procedures across the complete patient journey should be child and adolescent friendly. As with all paediatric services it should meet the standard for hospital services as identified in the Children's National Service Framework.[1] A typical level 3 Paediatric Imaging department would support a minor injury unit, outpatient, or primary care service but not undertake specialised examinations for ambulatory or inpatients.

23. Level 3 departments should not be independent but operate as a satellite unit linked to a Level 2 or level 1 department for advice and support.

24. Level 3 departments should have robust and diagnostic quality links for PACS and Radiology Information System (RIS) with the level 2 or 1 departments. This will allow images to be reviewed for second opinions and multidisciplinary discussion.

25. Equipment must be optimised for paediatric use and specific paediatric imaging software should be employed.

Traditional Working Day and Out of Hours Services Imaging Service

26. A level 3 department may or may not have an on-site radiologist with specific paediatric training. However, Level 3 departments should have a Service Level Agreement (SLA) which defines the services to be provided and time frame for delivery from the level 2 or 1 department with clear and documented lines of communication and escalation. The objective is that a level 3 service should never deliver paediatric imaging in isolation.

27. Radiologists and Radiographers in level 3 departments should have the same level of training and supervision as those in a level 2 or 1 department. The training should follow the RCR and SCoR recommended curriculum (Appendix i).

28. Vetting procedures, imaging protocols, radiation protection measures and quality assurance should be to the same high standard as the level 2 or 1 department.

3 Tier Model - Level 2 Paediatric Imaging Services

29. A level 2 paediatric imaging department provides the same service as described above for level 3 but with the addition of CT as a minimum. Other services such as paediatric fluoroscopy, MRI and Nuclear Medicine (NM) may also be provided. A level 2 department is likely to reside in a “district general hospital” environment. It will usually provide imaging facilities to support a paediatric clinical service from within a general radiology department.

30. The complexity of paediatric services offered will depend on the clinical services supported and the skills of the radiologists, radiographers and sonographers available. Usually this would include imaging for general practitioners, Accident & Emergency (A&E), out patients and inpatients and may include neonatal services.

31. Protocols and guidance including the British Society of Paediatric Radiologists standards for neonatal imaging (Appendix ii) and specialist children’s imaging should be adopted.

32. Provision of the following specific paediatric pathways should only be undertaken in a level 2 department if there is appropriate local service provision with suitably trained staff following agreed protocols and subject to peer review within the local network:

    - Surgical emergencies requiring specialist paediatric surgical management other than as an initial diagnostic procedure e.g. Intussusception reduction –

requires paediatric anaesthesia, surgery and a sufficient annual case load to justify provision of service
- Formal cancer staging as this requires the centre to be recognised as a paediatric cancer centre
- Complex neuro-imaging as this requires specialised paediatric neurosciences and radiology
- Imaging for suspected non-accidental injury beyond plain radiography required for initial management as specialist paediatric radiology is essential
- Contrast enhanced examination of the upper and or lower Gastro Intestinal tract, such as contrast swallow examinations requires paediatric specialisation and sufficient case load to justify service
- Complex nephro-urology imaging, including Micturating Cysto-Urethrography (MCU) requires paediatric nephro-urology service and a sufficient case load to justify service provision
- Vascular and non-vascular interventional procedures including embolisation and insertion of stents require specific paediatric IR services as described in the BCH report
- Non-renal and non-skeletal nuclear medicine are specialist nuclear medicine services. All nuclear medicine studies should be supervised by an ARSAC (Administration of Radioactive Substances) licence holder

33. A level 2 department should have:

- At least one radiologist with a sub-specialty interest in paediatric radiology that is formally recognised in their job plan.
- Sufficient radiographers trained in a recognised paediatric imaging centre (level 2 or 3) to provide the service at all times.
- Continuous Professional Development (CPD) should take place for all imaging staff to maintain their skills in paediatric practice as a separate developmental need from CPD for adult services.
- Formal safeguarding training to agreed standards for all staff involved in imaging, see safeguarding training matrix (Appendix iv)
- Equipment must be optimised for paediatric use and specific paediatric imaging software should be employed.

34. A level 2 department would ideally have:

- Some child specific and friendly facilities, which as a minimum should include separate changing and feeding areas, child specific décor and toys in waiting areas.
- May support a level 3 department and should have formal links with a local level 1 department. There should be clearly defined escalation pathways for emergency and specialist referral and for safeguarding issues.
- Close links between level 2 and level 1 departments should be developed with formal service level agreements (SLAs)

3 Tier Model - Level 1 Paediatric Imaging Services

35. Specialist paediatric imaging department would provide level 1 services. These would form the specialist centre for a paediatric imaging network and would usually reside in a children's hospital or major teaching centre. Services would include the provision of anaesthesia for children weighing less than 10kg. It would provide imaging services above those described for a level 2 department including:

    - Intussusception reduction
    - Upper & lower contrast gastro-intestinal examinations
    - Micturating cysto-urethrography & voiding cystometry
    - Paediatric interventional radiology to include:
      - Vascular interventional procedures
      - Non-vascular intervention e.g. biopsy and drainage skills
    - Cancer imaging including arrangements for PET provision
    - Neuroradiology
    - Complex Nuclear Medicine

36. A level 1 department should have:

    - Sufficient paediatric radiologists to provide continuous service during the normal opening hours of the imaging department. This should be documented in job plans.
    - An on-call paediatric radiology rota, which could also involve radiologists from level 2 departments. This on call work should be documented in job plans and appropriately remunerated i.e. not ad hoc.
    - Clearly defined protocols for delivering vascular and non-vascular interventional radiology services both for elective and emergency cases (this may be provided in conjunction with an adult interventional service) where staff are appropriately trained.
    - Dedicated paediatric trained radiographers and sonographers at all times of the day including a limited out of hours provision.[8]
    - Dedicated paediatric imaging rooms for plain radiography, ultrasound and fluoroscopy.
    - Dedicated sessions for paediatric cross sectional imaging with CT & MRI, including facilities for the safe administration of sedation and general anaesthesia.
    - Dedicated paediatric waiting areas with specific areas suitable for both young children and adolescents.
    - Equipment must be optimised for paediatric use and specific paediatric imaging software should be employed..
    - Mobile radiography, fluoroscopy and ultrasound equipment be available at all times.
    - All paediatric imaging staff should have level 3 safeguarding training as identified in Safeguarding Training matrix (Appendix iv)

37. As the specialist centre for a paediatric imaging network, a level 1 department should have excellent communication links between it and the level 2 & 3 departments to include robust and high quality image and report sharing. Team working is essential.

38. The level 1 department should act as the centre for training and CPD for paediatric imaging services in the network. Staff from the level 1 department should be available to attend the level 2 & 3 departments from time to time as deemed appropriate or necessary by the network.

Case Examples

39. The two scenarios below have been selected to highlight the potential for effective integration across general and paediatric imaging services to provide high quality paediatric imaging services. These examples demonstrate the effective use of staff and technology with a networked paediatric imaging service.

Case 1 – Safeguarding

A 6-month-old child attends their general practitioner with non- specific symptoms of irritability, poor feeding and crying. The GP is concerned that there may be crackles in the chest indicating infection and refers the child to the practice based minor injuries unit for a chest x-ray. On that day a paediatric radiographer from specialist children's unit is visiting as part of clinical support and quality assurance to the peripheral unit. She supervises the radiographer in taking the chest x-ray giving advice on positioning and technique. On reviewing the chest x-ray the paediatric radiographer is concerned about the appearance of the ribs. She contacts the paediatric radiology department and speaks to a paediatric radiologist. The local radiographer arranges for the image to be immediately transferred electronically to the paediatric radiology department for an urgent opinion. The paediatric radiologist identifies 3 posterior rib fractures and reports the film immediately indicating that there are concerns regarding non-accidental injury. In addition the radiologist contacts the GP and the local safeguarding team. The GP immediately arranges transfer to the paediatric specialist centre for further investigation, including skeletal survey and head CT. The GP is responsible for referring to children’s social care and remains responsible for the case.

Case 2 – Effective Networking

A 3-month-old male infant attends the local District General Hospital emergency department following a febrile convulsion. The child has a high fever and signs of infection. Local investigations include lumbar puncture, blood cultures and urine culture. A chest x-ray performed and is normal. The child is treated with antibiotics and fluids.

Subsequently the cultures revealed that the child has a significant urinary tract infection with sepsis and an unusual organism. An ultrasound scan is performed locally at 48 hours into the admission and shows a swollen left kidney, with mild hydronephrosis. The child improves slowly on antibiotics and is fit for discharge after 5 days.

Under NICE guidance, the child requires micturating cystography within 6 weeks, with follow-up ultrasound and a DMSA nuclear medicine scan within 4 to 6 months.

Since the micturating cystogram is an uncommon and invasive procedure, the child is referred to the specialist children's hospital for these investigations.

The cystogram and ultrasound are performed as a day attendance procedure at 4 weeks after discharge. A diagnosis of a left duplex kidney, with lower pole reflux is made and a posterior urethral valve is excluded. A follow-up DMSA scan is arranged for 5 months time. Medical follow-up is arranged locally with review in the network nephro-urology MDT process.

Developing a Specialist Workforce for Paediatric Imaging

Radiological Staffing

40. There should be identified paediatric specialist radiologists. These may be full time paediatric specialists or radiologists with a sub-specialty interest in paediatrics.

41. There should be an on-call paediatric Radiology service for level 1 departments, with a documented process for referral from levels 2 and 3 into level 1 for advice and specialist reporting of images acquired remote from the level 1 centre.

42. The Paediatric Radiology team should be part of an overall paediatric clinical. network and provide expertise at local and specialist centres where appropriate. The network should offer opportunities to gain experience of low volume, more specialised, investigations to share practice and knowledge.

Radiographic Staffing

43. Paediatric radiography is a demanding subspecialty and it is inappropriate for inexperienced radiographers to undertake unsupervised paediatric radiography for example on call or out of routine department hours. There should be dedicated paediatric radiographers available at all times for level 1 departments

led by a paediatric specialist at Advanced or Consultant Practitioner level. This person should:

- Co-ordinate the training and education of paediatric radiographers and assistant practitioners for the entire network.
- Provide specialist paediatric experience of imaging techniques and image acquisition in children.
- Provide assessment of specialist techniques and equipment and support for quality assurance purposes.
- Offer expertise and share good practice.
- Support processes where children are imaged in specialist neonatal or paediatric intensive care units using mobile equipment.
- Lead the radiography team as part of a paediatric network providing opportunities for sharing of good practice and education across the network.

All Radiographers providing Children's imaging should have specialist training to provide the expertise and judgment required to in this demanding specialist area of radiography.

Training for Paediatric Imaging Workforce

44. The existing sub specialist training in paediatric radiology curriculum may require expansion to support delivery of effective paediatric radiology services. Standards and training programmes would need to be enhanced to allow the creation of a formal subspecialty. For support staff working in paediatric radiology assistant practitioners, health care assistants and other unregistered staff) training curricula need to be developed to allow them to develop to their full potential and provide effective role development opportunities for professional staff.

Imaging Equipment for Paediatrics

45. Departments should be provided with equipment designed specifically for imaging children. This should be located in facilities that are child friendly and support access for children and their carers.

46. Low dose imaging systems should be deployed using digital detection components, optimised for paediatric use, to facilitate dose reduction. Techniques and equipment should be employed to minimise the need for sedation. Where sedation or anaesthesia is required there should be dedicated paediatric specialists and equipment and recovery facilities.

47. There should be a coordinated approach to quality assurance of equipment for imaging across specialities, to ensure all local equipment such as ultrasound scanners and computed radiography for plain film imaging are providing optimum performance and calibration for paediatric use. This is particularly important for imaging of small anatomical structures.

48. Image exchange and transfer systems should be deployed to facilitate double reading and audit processes. The systems should provide both image viewing and the ability to allow transfer of images to PACS and dedicated workstations.

Protocols and procedures

49. Departments should implement protocols on the principles of:

- Optimising visualisation with ALARP (As Low As Reasonably Practical) principles.
- Robust 'justification' processes be implemented to ensure imaging is only undertaken where appropriate.
- Children should not be imaged in adult designed facilities wherever possible.
- Providing dedicated CT, MRI and Nuclear Medicine facilities or defined paediatric CT, MRI allocated sessions sufficient to cover both planned and emergency care.
- There should be no inappropriate use of adult CT imaging protocols e.g. for investigation for trauma or abdominal pain.
- Child appropriate protocols should be documented and adhered to for all modalities.
- There should be access to radiation protection services and advice specific to paediatric imaging.

Applying common standards

50. Radiology and radiography standards have been devised and published including:

- British Society of Paediatric Radiology (BSPR) and Radiography Paediatric Special Interest Group (RPSig)[15]. (see appendix iii)
- The European Guidelines on Quality Criteria for Diagnostic Radiographic Images in Paediatrics. [23]
- The Royal College of Radiologists have produced guidance for 'Making Best Use of a Radiology Department' 6th Edition. [22] The paediatric section gives evidence based guidance for referrers which should be followed.
- Guidelines for the use of PET-CT in Children from the UK PET CT Advisory Board. [25]
- NICE guidelines including Urinary Tract Infection in Children which identify specific imaging requirements.[24]

Specific radiology guidelines are regularly updated by the BSPR and are available on their website. These should be implemented to ensure consistency of approach across common examinations and between institutions [8, 13, 15, 16, 17]

Safeguarding

51. Formal arrangements for safeguarding of children must be implemented and include both radiological and radiographic staff. This should be organised on a regional level in accordance with the recommendations of the joint Royal Colleges of Radiology and Paediatrics and Child Health. [4] The matrix for specific training of staff in safeguarding is included in appendix iii, which is drawn from a

intercollegiate document – Safeguarding Children and Young People: roles and competencies for health care staff. [26]

52. National arrangements could be developed through the implementation of a managed network of specialists in neuro and musculo-skeletal imaging to have sustainable 24/7 access to paediatric radiology with second opinion readily accessible

Increasing Clinical Integration

53. Trusts may wish to consider incorporating paediatric radiology into the clinical paediatrics organisational structure at an operational level to further integrate children's services.

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Conclusions and Recommendations

- There should be a structured career pathway for paediatric radiography
- Paediatric Radiology should be recognised as a Subspeciality, and adequate. training posts should be made available.
- Paediatric radiology should be included within the National Commissioned Specialist Services National Definition Set and be specifically commissioned.
- A 3 tier paediatric radiology network services model based on trauma networks and utilising PACS & teleradiology effectively should be developed.
- Standards for network services including equipment, staff, training and out-of -hours provision should be devised locally and implemented as suggested above.
- Robust processes to ensure ‘safeguarding’ must be in place and working effectively.
- Local services should undertake equality impact assessment to ensure that imaging services for children take account of equality and human rights issues and avoid negative impact and unlawful discrimination.

Appendix i

Structured Training Curriculum for Clinical Radiology – Section 10 – Paediatric Radiology (Published by the Royal College of Radiologists, 2007)

10 PAEDIATRIC RADIOLOGY

10.1 Introduction

10.1.1 This curriculum outlines the training requirements for specialist registrar training in paediatric radiology.

10.1.2 All specialist registrars in clinical radiology will have undergone training in paediatric radiological procedures and interpretation during core training and will already have acquired basic skills.

10.1.3 The period spent in training will vary according to the needs of the trainee. For a person wishing to specialise primarily in paediatric radiology, a period of around 12 months substantially devoted to the subject is recommended.

10.1.4 The aim of subspecialty training in paediatric radiology is to enable the trainee to become clinically competent and to consistently interpret the results of paediatric investigations accurately and reliably. Where appropriate, trainees should also be capable of providing a comprehensive and safe interventional diagnostic and therapeutic service.

10.1.5 Those clinical radiologists who plan to practise paediatric radiology as one of a mixture of activities (albeit that paediatric radiology will be a particular responsibility within those activities) should normally undertake around 6 months of subspecialty training in paediatric radiology.

10.1.6 Earlier, more focussed, individualised training in paediatric radiology may be possible for those trainees with extensive paediatric experience.

10.2 Objectives

10.2.1 The aim of establishing a curriculum for subspecialty training in paediatric radiology is to ensure that trainees:

- consolidate and develop their practical skills
- develop an in-depth understanding of paediatric diseases
- increase their familiarity with children's disease and the practice of children's radiology, emphasising the differences from adult practice
- understand the role of radiology in the management of sick children
- become sufficiently trained to become an integral member of the multidisciplinary teams now required in hospitals providing full services to children
- acquire clinical knowledge relevant to medical and surgical management of paediatric diseases such that the trainee may confidently discuss the appropriate imaging strategy for the clinical problem with the referring clinician
- detailed knowledge of current developments in the specialty
- direct practical exposure with appropriate graded supervision in all forms of paediatric imaging and intervention

- knowledge and skills to enable safe practice of analgesia and sedation

10.2.2 The trainee should be fully competent in paediatric life-support.

10.2.3 Experience will be documented in the Royal College of Radiologists (RCR) Trainee Personal Portfolio (TPP) and procedural numbers recorded in a log book.

10.2.4 The training scheme should arrange an attachment that fulfils the requirements of the subspecialty curriculum.

10.2.5 If experience to fulfil the requirements of subspecialty training cannot be gained
in one training centre, it will be necessary for the trainee to have a period of attachment(s) to other training centres. There are, in any case, advantages for trainees in visiting other departments at home or abroad to follow particular interests in greater depth.

10.2.6 The expected outcome at the end of this subspecialty training will be that the trainee can select the appropriate imaging strategy for paediatric problems, supervise (and perform where appropriate) the examination(s) and accurately report on the findings. The trainee should be competent in all aspects of paediatric imaging and intervention.

10.3 **Overview of training**

10.3.1 The main document, to which this appendix should be viewed as an attachment, *Structured Training in Clinical Radiology*, outlines core knowledge, skills and experience and the optional experience acquired during core training. The trainee undergoing subspecialty training should ideally be actively involved in paediatric radiology within an educational environment with graduated supervision.

10.3.2 The training department must provide access to appropriate computed tomography CT), MR, ultrasound (US), radionuclide imaging and fluoroscopy.

10.3.3 Clinical knowledge will be acquired by a variety of means, including close liaison with appropriate medical, surgical and oncological teams and combined clinical and radiological meetings. Multidisciplinary meetings should be emphasises. The following inter-relationships are important:

- paediatric surgery
- paediatric medicine
- paediatric oncology
- neonatal unit
- obstetric unit
- community paediatrics

Additional clinical knowledge may be acquired through participation in appropriate ward rounds, attending outpatient clinics and theatre sessions. Training may require secondment to an appropriate specialist hospital to gain experience in neonatal radiology and/or paediatric neuroradiology.

10.3.4 The paediatric radiology experience acquired during core training will count towards the total experience of subspecialty training in paediatric radiology.

10.3.5 Paediatric radiology is a mixture of image interpretation and practical procedures and it is essential that the trainee is exposed to appropriate numbers of each of these and to a broad case mix. However, because of variations in case mix between different institutions, it would be inappropriate to dictate specific minimum numbers of diseases or investigations.

10.3.6 The trainee should be encouraged and given the opportunity to attend and lead appropriate clinicoradiological and multidisciplinary meetings.

10.3.7 The trainee should be encouraged and funded to attend appropriate educational meetings and courses.

10.3.8 The trainee should participate in relevant clinical audit, management, and clinical governance, and have a good working knowledge of local and national guidelines in relation to radiological practice.

10.3.9 Trainees will be expected to be familiar with current paediatric radiological literature.

10.3.10 The trainee should be encouraged to participate in research, and to pursue one or more projects up to and including publication. An understanding of the principles and techniques used in research, including the value of clinical trials and basic biostatistics, should be acquired. Presentation of research and audit results at national and international meetings should be encouraged.

10.3.11 The trainee should continue to participate in the specialist registrar on-call rota, with appropriate consultant back-up.

10.3.12 Towards the completion of training, a trainee will be expected to provide expert advice and guidance to clinical colleagues as to the most appropriate imaging methods for investigation of paediatric clinical problems.

10.4 **Requirements of subspecialty training**

10.4.1 A sound understanding of the basis of paediatric imaging including:

- the embryology, anatomy, normal variants, developmental abnormalities and relevant physiology of children
- the pathological processes of both benign and malignant disease in the paediatric age group
- local, national and where appropriate, international imaging guidelines

10.4.2 Knowledge of the full range of radiological diagnostic techniques available, in particular:

- the indications, contra-indications and complications of each imaging method
- the factors affecting the choice of contrast media and radiopharmaceuticals
- the effects and side effects of these agents

Particular emphasis should be placed on the strengths and weaknesses of the different imaging methods in various pathological conditions. The appropriate choice of imaging techniques and/or the appropriate sequence of imaging techniques in the investigation of specific clinical problems should be
emphasised.

10.4.3 Acquisition of specific skills to enable:

- the conduct, supervision and accurate interpretation of all imaging techniques used in the investigation of paediatric diseases to a high professional standard
- where appropriate the safe and effective practice of interventional techniques
- good communication with patients, their parents and professional colleagues
- accurate informed consent to be obtained
- continuing accreditation of paediatric life-support status

Appendix ii

British Society of Paediatric Radiology Recommendation for Safe and Effective Neonatal Imaging (September 2009) – a paper written specifically for this report

1. High quality computed or digital radiography for chest, abdominal & extremity radiography, with optimisation of exposure factors to minimise radiation dose. All neonatal X-rays should be performed by a radiographer with appropriate training and experience, and should be reported by a paediatric radiologist. CR & DR systems should utilise manufacturer software optimised for paediatric examinations where available.

2. Portable ultrasound scanners should be available with an appropriate range of transducers for performing cranial and general ultrasound, including Doppler, at the bedside. Operators should have appropriate training and experience for the examination which they are performing. Equipment should have regular maintenance and calibration. Special care should be taken to minimise the risk of ultrasound transducers transmitting infection between infants. Images should be securely archived and stored, preferably on a PACS, and there should be a formal report of every ultrasound examination recorded on the Radiology Information System and in the patient record. This should include examinations performed by non-radiology staff.

3. There should be access to high quality digital fluoroscopy for gastrointestinal contrast studies and other diagnostic procedures. Pulsed fluoroscopy and other dose reducing techniques should be employed whenever possible. Fluoroscopy equipment should be operated by an appropriately trained radiographer and diagnostic procedures performed by a paediatric radiologist.

4. There should be access to CT and MRI facilities for brain imaging. These facilities should be equipped to accommodate ventilated neonates. If these facilities are in a different hospital, systems must be in place to ensure safe transfer of critically ill neonates, who should be accompanied by appropriately trained medical and nursing staff. CT and MRI brain scans should be reported by paediatric radiologists or neuroradiologists with appropriate training and experience in paediatric neuroimaging.

5. There should be a regular multi-disciplinary meeting with neonatologists and radiologists.

Appendix iii

Standard for skeletal surveys in suspected non-accidental injury (NAI) in children

The British Society of Paediatric Radiology

Introduction

A skeletal survey is a series of radiographic images, which encompass the entire skeleton or anatomical regions appropriate for the clinical indications.
The radiographic skeletal survey is the principal radiological investigation in suspected child abuse. It is frequently critical to diagnosis and is frequently presented as evidence in child protection cases, criminal proceedings and other types of litigation.

The standard is required to help advance the science of radiology and to improve the quality of the radiology service to patients.

Indications

- Suspected physical NAI in infants and young children. Occult injury is rare > 3 yrs age.
- To exclude NAI in siblings (under 3 years of age) of children with proven NAI.

Technical requirements for technique

- Quality of equipment: radiographic equipment should include a general purpose radiographic unit equipped with a small focal spot.
- Film requirements: a high contrast general film system designed for extremity use with a speed of no more than 200 and a limiting resolution of at least 10 line pairs per millimetre is required for all anatomical regions in infants. Increasingly computed radiography systems are being used to obtain X-rays on children. Suitable computed radiography systems (including standard resolution imaging plates) may be used for skeletal surveys if they have dedicated paediatric software. Soft copy reporting is advisable to maximise the image quality of the system. A low absorption cassette or front plate is recommended to maximise radiographic detection. These systems should be used without a grid. Beyond infancy, faster general purpose systems will be required for the thicker body regions e.g. lumbar spine.
- Quality of imaging: the skeletal survey examination should be performed in accordance with principles of high quality diagnostic radiography. These include proper technique factors, positioning, collimation, side markers, image identification, restraining methods and patient shielding.

Personnel requirements

- Radiographers trained in paediatric radiography techniques should perform skeletal surveys in children.
- Appropriately trained radiographic staff must be available in all radiology departments where children are imaged.

Procedural standards

1. The areas that should be demonstrated will depend on the particular clinical indication.
2. Suspected NAI: each anatomical area should be imaged with a separate radiographic exposure to ensure uniform image density and minimise image unsharpness.
3. X-rays should be exposed to show soft tissue and bone detail.
4. The limbs must be straight. Radiographs of each extremity should be at least of the frontal projection. Radiographs of the axial skeleton should be obtained in two projections if an abnormality is suspected (see Table 1).
5. X-rays (in 2 projections) of acute injury e.g. a fractured femur, should be done as an emergency as required. A skeletal survey should be done on the next working day, not as an emergency on call.
6. If practical, the views of the lower legs should be obtained before Gallows traction is applied. If this is not practical, the lower limb x-rays can be obtained at a later time.
7. It is important to obtain high quality radiographs for the skeletal survey, which are best obtained in normal working hours after the child has received adequate analgesia.
8. The paediatrician is responsible for explaining to the child's carers why a skeletal survey is necessary.
9. The skeletal survey should be performed by two people working together, and with the child at all times. The films should have the correct name and correct side markers, and the date and time of the examination should be clearly marked.
10. The radiographer should sign the technical detail card. To ensure continuity of evidence, the person (parent or nurse) identifying the child to the radiographer should also sign the technical detail record (1).
11. The radiographers should bring the films to a designated consultant radiologist for immediate review so that further views may be obtained as required.
12. The radiology report should document all sites of suspected or

definite abnormality. When patterns of injury raise strong suspicion of NAI this should be stated in the report.

13. Doubtful areas should be commented upon and arrangements made for further follow-up films. (eg an interval CXR at 2-3 weeks may reveal healing rib fractures that were not identifiable on the initial CXR, or periosteal reaction in a suspect long bone).

14. Delayed films (1-2 weeks later) may be needed to help date injuries.

15. The report should be communicated urgently to the referring clinician.

Targets for outcome

There is insufficient good quality evidence to set a performance target. A literature search through Medline and Embase revealed one study containing relevant information (2). This study gives an indication of the accuracy level that is attainable in radiographic diagnosis of non-accidental injury in children. These figures relate to screen-film radiography, not digital systems.

Outcome	Indication	(95% confidence intervals)
Accuracy	93%	(88% to 98%)
Sensitivity	80%	(75% to 85%)
Specificity	98%	(95% to 100%)

The number of subjects is small (n=20) and the study population is not representative of the clinical environment of radiographic reporting by clinical radiologists. The study group is not representative because 50% of the cases in the series were proven to be child abuse. The percentage of child abuse cases is much lower in clinical practice. Also there was no measure
of inter-observer variability in the study. The data required to calculate the figures from the study were not published and cannot be checked.

Future development

The development of digital radiographic systems and PACS systems may have an impact on some of the radiographic aspects of the standard.

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Table 1: Skeletal survey in NAI (3):

A single film (‘baby gram’) should be avoided as it gives an unsatisfactory exposure and combined views of chest abdomen pelvis and limbs should also be avoided. Limb detail is poor, with oblique projections of most joints.

Skull (SXR)
AP and lateral, plus Towne's view for occipital injury.
SXRs should be taken with a skeletal survey even if a CT scan has been performed.

Body:
AP/frontal chest (including clavicles)
Oblique views of the ribs (left and right)
AP Abdomen with pelvis and hips

Spine:
Lateral spine - cervical and thoraco-lumbar

Limbs:
AP humeri, AP forearms
AP femurs, AP Tib/fib
PA hands and AP feet
Supplemented by:
- Lateral views of any suspected shaft fracture.
- Lateral coned views of the elbows/wrists/knees/ankles may demonstrate metaphyseal injuries in greater detail than AP views of the limbs alone. The consultant radiologist should decide this, at the time of checking the films with the radiographers.

Brain imaging:
CT (brain and bone windows) is the method of choice in the acute phase.
A linear skull fracture may not be identified on CT (on bone windows) - see SXR above.
Interval MRI may give greater detail of subdural haematomas and parenchymal injury. There is a body of opinion among paediatric neuroradiologists in the UK that a CT brain scan should be included routinely with the skeletal survey in suspected NAI for all pre-mobile young children. It is recommended that a CT brain scan is considered for all small children in whom NAI is suspected - if CT is then judged not worthwhile or indicated in that individual case, it is advisable that this be documented in the notes.

Appendix iv

Safeguarding Training Matrix

Target Audiences

This matrix outlines the need for training linked to an individual's role and contact with children and families. Training should be linked to levels of specialism, complexity of task and level of contact with children, young people and their families.

Training	Staff groups to attend defined by contact with children and specialism	Content of safeguarding training
Awareness Raising On core induction/via written information **Mandatory**	All staff	Basic indicators Local policies and procedures Who to report concerns to
Level 1 Interagency Introduction to Child Protection **Mandatory** Updates in safeguarding **3 yearly**	Those whose work brings them into regular contact with children and families	o Legislative framework o Indicators o CP processes o Evidence base o Duties in safeguarding
Level 2 Practice and Procedures course. **Mandatory** Single Agency updates **Mandatory 3 yearly**	Those whose work entails working with families where there are levels of vulnerability or child protection concerns.	o Problem solving in complex child protection situations o Interagency working o Indepth knowledge of procedures o Report writing o Attending case conferences o Introductions and updates on specific topics in safeguarding
Level 3 Interagency courses focusing on specific issues **Professional development** Local courses conferences and stakeholder forums of LSCB **Professional development**	Health Visitors, School Nurses, Learning difficulties nurses. Those who have completed Level 1 and 2 courses and whose PDP identifies need for more in depth training in a specific safeguarding area	o Course content and objective outlined in interagency training brochure
Level 4 Ongoing professional development in safeguarding	Child Protection Named Doctors/Nurses Staff involved in child protection supervision	o Supervisory skills o Analytical and risk management skills o Managing conflict o Governance in safeguarding o National conferences
Level 5 Ongoing specialist professional development	Designated and lead professionals	o Leadership o Strategy o BASPCAN o NSPCC o National conferences

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