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Improving Paediatric Interventional Radiology services in the UK

Dr Alex M Barnacle

Consultant Paediatric Interventional Radiologist

Foreword



Dr Katherine Halliday
President, RCR

I wholly support the recommendations of this report on paediatric interventional radiology (PIR).

The benefits of minimally invasive procedures, such as rapid recovery, decreased time in hospital and innovative healthcare solutions are vitally important for children and their families and yet very few young people have access to IR compared to adult patients.

Workforce challenges in interventional radiology have been well documented in RCR publications but nowhere are these issues more keenly felt than in the field of PIR with only 12 specialist PIR consultant posts in the UK. In comparison to some other developed countries, we are lagging far behind in this important area.

In this report Dr Barnacle, one of the UK's leading specialists, assesses where we are as a country in terms of PIR and identifies many opportunities for health systems to expand service provision.

In order to provide this essential service to the UK's children we must immediately begin to address the issues by enacting this report's recommendations in full. I look forward to taking this challenge forward during my term as President of the RCR.

The benefits to the UK's children will be vast. There is no time to waste.

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Endorsements



Dr Russell Perkins

Vice-President, The Royal College of Anaesthetists

I am delighted to have been asked to write an endorsement for the policy report by the Royal College of Radiologists: Improving paediatric interventional radiology services in the U.K. I am a career paediatric anaesthetist, working in a large tertiary centre and I have experienced first-hand the difficulties of managing the care of children requiring interventional radiology, often outside of a children's hospital. The difficulties are magnified when parents, children and staff all have to travel long distances to get treatment.

Equity of access to care across the entire U.K. is one of the founding principles of the NHS but there is clear evidence presented here that for PIR this is not the case. This report must be taken seriously by policy-makers and its recommendations enacted if we are to improve children's' healthcare.

The council of the Royal College of Anaesthetists was unanimous in its support and we welcome the recognition of the interdependency of paediatric anaesthesia and PIR. For a safe and effective service to be developed, resource and expertise must include the relevant chapters of the Guidelines for the Provision of Anaesthetic Services: GPAS.



Mr Ian Sugarman

President, The British Association of Paediatric Surgeons

As President of British Association of Paediatric Surgeons, I am very happy to endorse the vision and proposals set out in this important document. The interaction between Paediatric Radiology and Paediatric Surgery has always been strong and this document explains how, with the development of Paediatric Interventional Radiology, the relationship will continue in the future.

Whilst this is clearly an ambitious aim, the reasons for this are fully explained and will, without doubt, improve the care of the child, which is the underlying premise of all of us who are involved in looking after children.



Mr Matthew Shaw

Chief Executive, Great Ormond Street Hospital for Children

Children and young people deserve as good a service nationally in IR as adults. Building hubs with the expertise and infrastructure to do this is crucial to achieving excellence in this vulnerable population. GOSH has seen the huge benefits a team like this can bring and we hope others continue to push for significant improvements in the delivery of what is a fast moving and dynamic speciality.

Acknowledgements

Dr Jai Patel

Chair, Royal College of Radiologists' IR Committee

Dr Priya Suresh

(Current) Clinical Radiology Medical Director for Education and Training, The Royal College of Radiologists

Dr Stephen Harden

(Former) Clinical Radiology Medical Director for Education and Training, The Royal College of Radiologists

Dr Robert Morgan

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Senior Policy Advisor, The Royal College of Radiologists

The British Society of Interventional Radiology Paediatric Interventional Radiology special interest group committee:

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Organisations and bodies involved

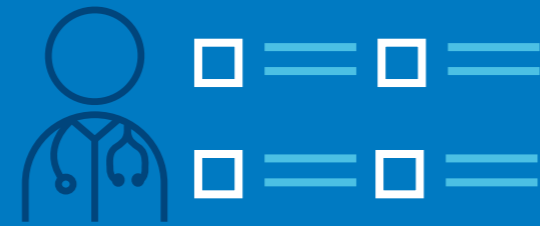
British Society of Interventional Radiology

The Royal College of Radiologists' Interventional Radiology Committee

Key Messages

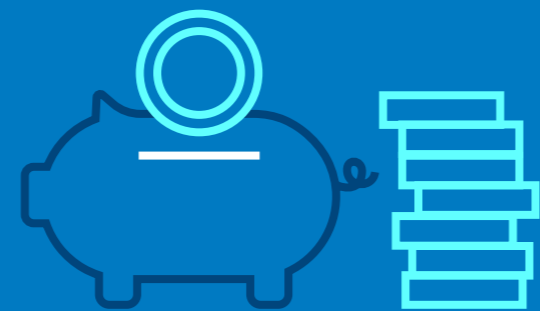
Paediatric interventional radiology (PIR) delivers clear benefits:

- a significant reduction in risk for many life-saving procedures
- shorter hospital stays
- quicker recovery times
- financial savings for the NHS.



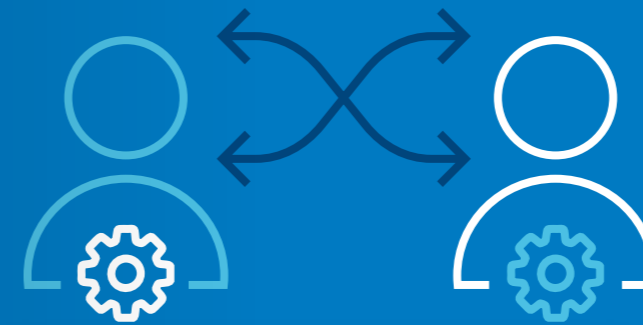
There are just 12 consultant posts across the UK

in which PIR forms a major component of the job plan; 7 of these are in London, which means children across all four nations are missing out on vital care



Comprehensive PIR investment

in all tertiary paediatric centres is imperative to provide specialist care for children with rare or more complex diseases and to develop national PIR expertise



Cross-skilling of a range of other clinical specialists

to deliver certain PIR procedures is essential to provide more generalised IR care or a baseline range of IR interventions for children across all four nations to close the service gap



Raising awareness

of the benefits of PIR among the wider health community is key to driving PIR referrals and service development



Accurate outcome data

to evidence the extent of improved paediatric care outcomes from IR investment is vital to its success; and needs a central registry



Provision

of interventional radiology across the UK should be comprehensive and equitable for all age groups, including very young children

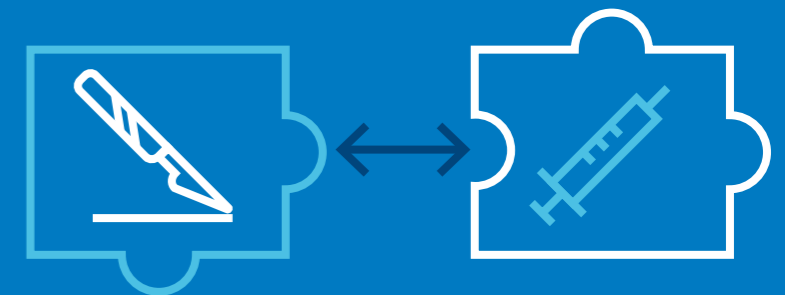


PIR service specification

in paediatric and adult/paediatric mixed Major Trauma Centre contracts needs to be clearly delivered and audited

Interdependency

with anaesthetic and paediatric surgical services is essential and should be part of ongoing workforce planning



Executive Summary

Interventional radiology (IR) is an innovative subspecialty of clinical radiology which delivers curative, palliative and life-changing image-guided surgery through 'pin-hole' incisions.

It is integral to the delivery of care to patients in both elective and emergency settings for a wide variety of pathologies, including vascular and cancer treatments. Paediatric interventional radiology (PIR) focuses specifically on providing this care for children. PIR is more than just IR in children, and requires specific skills, staff and infrastructure to be done right. Current PIR services in the UK are inadequate, as evidenced by the lack of staff, facilities, investment, and specialty recognition in most hospitals. This is leading to severe inequalities and shortfalls in paediatric care (Appendix 1). The purpose of this report is to identify how PIR services can be expanded and improved and to highlight the significant benefits of PIR service improvement for patients, families and the UK healthcare system. The report explains what PIR is and how it brings value. It sets out the current barriers to PIR growth in the UK before suggesting solutions and providing illustrative case studies for commissioners, healthcare leaders and hospitals to draw from when considering how they can incorporate PIR within their organisations.

This report is highly relevant now. Over the last 12 years, a number of national policy documents have stated the need for comprehensive IR care and/or PIR service provision specifically. In 2010, the Royal College of Radiologists (RCR) and the Royal College of Paediatrics & Child Health (RCPCH) collaborated on the report "Improving paediatric interventional radiology services".¹ That document reviewed the provision of PIR services across the UK. It argued that PIR service provision must be adequately resourced and supported. The report made a cogent set of recommendations on how to deliver high-quality services for children and young people. However, there are serious concerns amongst the radiology, paediatric and surgery communities that very few of those recommendations have been implemented in the 12 years since publication.

The 2010 report from the Department of Health's National Imaging Board 'Interventional radiology: guidance for service delivery' re-iterated that access to paediatric IR services is variable, ranging from a few hospitals with no service, at one extreme, to a small number of centres that provide a comprehensive 24/7 service, and that many of

the radiologists providing IR services for children are not trained specifically in paediatric IR.² The report recognised that even in specialist paediatric hospitals the interventional radiology service out of hours is often ad hoc and based on staff goodwill. It recommended that specialist paediatric radiology departments should all offer PIR, with clearly defined protocols for delivering interventional radiology services both for elective and emergency cases. The 2019 NHS England and NHS Improvement (NHSE) 'Paediatric critical care and surgery in children review' and the 2019 NHS Long Term Plan³ committed to the development of paediatric healthcare networks and emphasised the importance of getting pathways right for children and their families, ensuring that all patients can access the right care, in the right place, at the right time.⁴ It is fundamental that these policy commitments now include PIR.

The current healthcare system in the UK lacks enough PIR specialist centres to deliver gold standard paediatric care, sufficient resources, and policies in non-specialist centres to ensure safe care for acutely unwell children, and any ambition to develop PIR services in the coming years (Appendix 1). There is a surprising and alarming lack of PIR specialists in fully funded PIR posts and inadequate national capacity to train new staff. For context, in the latest RCR workforce census the UK has had 728 consultant interventional radiologists in post but only 12 of these in formal paediatric interventional radiology posts*. National strategies, such as those for trauma care provision, woefully under-recognise the need for PIR as part of such services. Robust data on existing PIR provision is almost impossible to source. Collectively, these failings mean that in centres across the UK, children and families are routinely denied modern healthcare solutions that are considered standard practice for adults.

When fully resourced, a PIR service directly impacts patient outcomes and vastly improves the range, efficiency and quality of care provided by wider paediatric care teams. Crucially, timely intervention in children is often cost-effective in reducing the future health burden in adulthood, so the advantages of good PIR care extend far beyond paediatrics.

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The current healthcare system in the UK lacks enough PIR specialist centres to deliver gold standard paediatric care

Summary of key recommendations to improve PIR provision across the UK:



Increase in number of PIR consultant posts across the four nations



Uplift in tariffs applied to PIR procedures



Expansion of national capacity for PIR training



PIR inclusion in all relevant NHS service specifications and PIR policies in all hospitals that treat children



More accurate and systematic methods of PIR data collection



Development of an interventional radiology GIRFT report



A cohesive course of training to cross-skill appropriate neighbouring clinical teams to deliver PIR services in innovative ways



Commitment by the RCR, RCoA and BSIR to stipulate the standards of infrastructure, funding and staffing required to deliver various tiers of PIR care in all hospitals developing a PIR service

* For the purposes of this document, a paediatric interventional radiology post has been defined as a post with a job plan that includes paediatric IR in at least 50% of the direct clinical sessions delivered.

Background

Interventional radiologists (IRs) are specialised doctors with a background in medical imaging and diagnostics who treat patients using image-guided, minimally invasive surgical 'pinhole' techniques. IR specialists intricately manoeuvre highly specialised wires, needles and catheters through the body, navigated on screen in real time using X-ray, computerised tomography (CT), ultrasound or magnetic resonance imaging (MRI), to explore and treat areas of disease or trauma. These specialists are distinct from *diagnostic* radiologists who conduct and/or interpret medical imaging to make a diagnosis or to follow a patient's disease progress.

Interventional radiology (IR) provides alternatives to conventional surgical approaches to treating disease. The minimally invasive nature of IR treatments offers significant benefits for patients. It has revolutionised the management of many diseases that were previously only treatable with high risk, complex or lengthy surgery.

Without IR, many modern clinical services including emergency medicine, oncology, vascular surgery, kidney dialysis, organ transplantation and surgical services could not function. In some instances, it also offers treatment possibilities where surgical intervention is not feasible or where all other options have failed. For example, embolisation has become the preferred treatment for failed endoscopic therapy in upper gastrointestinal bleeding, with surgery now rarely performed, and image-guided tumour ablation has become the 'fourth pillar' of treatment for cancer patients, alongside chemotherapy, surgery and radiotherapy.

PIR focuses specifically on providing this care for children.⁵ There is no question that it can significantly impact and improve patient care across children's services. All of the reasons why IR is a game-changer in adult healthcare apply equally in paediatric care. For children, minimally invasive pinhole procedures and shorter hospital stays mean a less distressing patient experience, less time away from school for the child or away from work for parents, minimal scarring, and preservation of organs and blood vessels that need to remain in good working order for another 70 years.⁶

Whilst many PIR procedures can be performed by adult IRs

or by diagnostic radiologists, the input of specialist paediatric interventional radiologists is essential. Children are not simply small adults. Just as paediatric heart surgeons are required alongside adult heart surgeons, specialist paediatric IR teams have an intimate working knowledge of complex and rare children's diseases, most of which do not occur in adults. Adults are often affected by diseases of degeneration of previously healthy body systems, whereas in sick children the body's systems or processes have often developed abnormally and require a very different approach. In addition, specialist paediatric IR teams understand what procedure duration and complexities a young child's body can tolerate, know what medical equipment can be modified for use in very small children and can adjust IR techniques to minimise radiation exposure to children who are far more susceptible to radiation effects than adults.⁷

In 2010, the Royal College of Radiologists (RCR) and the Royal College of Paediatrics & Child Health (RCPCH) collaborated on the report "Improving paediatric interventional radiology services".¹ That document highlighted the lack of provision of PIR services across the UK and made recommendations on improving this service provision.

This publication assesses the present status of PIR services within the UK, in light of the recommendations made in 2010, and outlines the need for change to bring PIR service provision in the UK into the 21st century.

Benefits of IR techniques

- Diagnosing complex disease deep inside the body with minimal risk to the patient.
- Providing a wide range of therapies for almost all organs of the body.
- Avoiding many of the risks of open surgery, such as less risk of collateral damage to delicate surrounding structures, less risk of bleeding and almost no scar because there is no surgical incision.
- Shorter operating times, as procedures are performed through a pinhole rather than a careful open surgical exploration of the area to be treated. This means highly efficient, cost-effective use of operating theatre and anaesthetic time and shorter patient waiting lists.
- Very short recovery times. Patients can get up and walk very shortly after most procedures are done.
- Reduction in the use of inpatient beds and other resources, resulting in reduced costs and freeing up of high demand resources.



Examples of IR procedures

Bleeding patients:

- Plugging bleeding vessels to save the lives of trauma patients, usually quicker and in a more controlled way than a trauma surgeon could by opening the abdomen to get to the point of bleeding.

Patients with sepsis:

- Drainage of deep-seated infections within body cavities which are either inaccessible to or high risk for surgical drainage.

Cancer patients:

- Enabling biopsy and treating cancers deep in the body's organs that cannot be seen, and therefore sampled, with the naked eye by a surgeon.
- Delivering high dose chemotherapy directly into the very centre of tumours, without exposing the rest of the body to its toxic effects, so that stronger and more effective cancer therapies can be used.
- Providing alternatives to open surgery to definitively treat tumours through a variety of pinhole techniques.

Enabling holistic management of patients with complex needs by placing:

- Feeding tubes
- Long-term central venous access devices into the circulation for safe and efficient delivery of drugs, chemotherapy or kidney dialysis via the bloodstream.

Other patients with life or limb threatening emergencies:

- Deploying delicate yet strong flexible stents into the airway to allow patients to breathe again.
- Dissolving or retrieving clots in small blood vessels in the brain to reverse an acute stroke.
- Restoring blood flow to diseased arteries by reconstructing blood vessels from the inside.



Overview

Current state of paediatric IR services and practice

Providing access to high quality care for children is an essential component of a modern National Health Service that meets the needs of the entire UK population. The RCR and RCPCH "Improving paediatric interventional radiology services" report from 2010 identified the greatest challenges as:

- Equitable PIR service provision and capacity
- Training and maintaining competencies
- Out-of-hours and emergency service provision
- Recognition of the need for PIR within the wider healthcare system
- Adequacy of PIR facilities, support staff and equipment
- Unavoidable interdependency with anaesthetic services

In the decade since publication, many of those challenges and obstacles remain and the 2010 recommendations have prompted almost no change.¹

Service provision and capacity

Widespread adoption of paediatric IR has failed in the UK so far. While there are some centres currently providing good quality PIR care delivered by skilled multidisciplinary teams, almost all these units are having to work with inadequate facilities, underfunding and a lack of institutional support (Appendix 1). Despite these setbacks, pockets of good PIR practice exist in limited centres. This document is in no way meant to destabilise these services but instead seeks to enhance support for those providing PIR without adequate resources, to draw attention to large areas of the UK without access to any PIR and to develop robust networks of care to ensure equity of access to all levels of PIR for children of all ages.

There are currently only 12 dedicated consultant PIR posts in the UK designed solely for the delivery of PIR, only five of these are outside London.⁸ For a country with a population of 12.7 million children aged under 16, this equates to one paediatric interventional radiologist per million children.⁹ In the USA, the ratio is one per 342,000 children.¹⁰ For comparison, in the UK there is roughly one adult interventional radiologist per 74,000 adults.⁸

Current service models in the UK vary widely and include the following:

1. The entire PIR service is delivered by paediatric IRs.
2. Some PIR services are delivered by adult IRs, some by paediatric diagnostic radiologists and some by paediatric IRs.
3. Some, but not all, PIR services are delivered by adult IRs; other PIR cases are formally commissioned to another centre.
4. Some PIR services are delivered in-house by a variable combination of the above teams; no regional provision made for PIR services that are not available in-house.
5. No PIR services available and no networked provision for PIR services elsewhere.

Models 1-3 are able to provide comprehensive PIR services to a population, but require greater support and funding to develop infrastructure and personnel. Models 4-5 constitute wholly inadequate or failure of service provision and need to be addressed urgently.

Training and maintaining competencies

It takes time and investment to build experience and expertise in PIR, either as an individual or as a department. There is already a worryingly high shortage of radiologists in general in the UK with a shortfall in posts of 29%, which translates to 1,669 consultant posts.⁸ With insufficient training places to meet current or future NHS needs, this is predicted to increase to 39%, (3,166 consultant posts) by 2026. These workforce shortages in the two career pathways that are the main routes into PIR specialisation radically weaken the speed and breadth of PIR growth in the UK.

At the same time, there are only two dedicated, fully funded PIR-specific training posts in the UK, with another three posts offering some exposure to PIR. Not all of these are open to trainees across the four nations. This situation leaves PIR simply unable to grow (Appendix 1, case study 1). To add to this, there is very little mention of PIR in UK training curricula and no formalised list of required competencies, although the latest 2021 RCR IR curriculum does acknowledge PIR as a specialist area of IR.^{11,12} This means there is no inbuilt incentive for those who plan and deliver diagnostic radiology and/or IR training programmes to consider incorporating PIR into a trainee's learning if they express a wish to do so.

Finally, the relative invisibility of PIR means that medical students and junior doctors are largely unaware of PIR as a career option until their training pathways are complete and alternative career choices cemented.

Out-of-hours and emergency service provision

The 2010 report from the Department of Health's National Imaging Board 'Interventional radiology: guidance for service delivery' recommended that specialist paediatric radiology departments should all offer PIR, with clearly defined protocols for delivering interventional radiology services both for elective and emergency cases.² The 2019 NHS England and NHS Improvement 'Paediatric critical care and surgery in children review' and the 2019 NHS Long Term Plan both committed to the development of paediatric healthcare networks, ensuring that all patients can access the right care, in the right place, at the right time.^{3,4} The 2010 "Improving paediatric interventional radiology services" document highlighted the lack of out of hours PIR provision for children and stated that every hospital in the UK must have a strategy to deal with out-of-hours emergencies requiring PIR.¹

Not every hospital can or should offer PIR on site and not every centre with some PIR provision has to provide a 24/7 service. But all hospitals should be aware of where the value of PIR lies for their patients and when it is needed. It should then follow that there are robust arrangements in place, when required, to transfer sick children to regional or national centres with PIR experience, in the same way that the NHS currently works to provide expert care for patients with other emergency health needs, such as for stroke thrombectomy, abdominal aortic aneurysm repair and vein of Galen embolisation.

Finally, the provision of emergency trauma care services has long been a key focus of the NHS. The lack of PIR provision within UK paediatric trauma care networks is detailed on pages 16-19.

“...the relative invisibility of PIR means that medical students and junior doctors are largely unaware of PIR as a career option until their training pathways are complete...”

Recognition of PIR within the system

Although image-guided IR treatments are widely considered the gold standard of care in many established adult treatment pathways such as adult cancer care, this is still not acknowledged in the UK for children. For example, a high proportion of children with cancer in the UK undergo invasive open surgery for both cancer biopsy and for vascular catheter placement for subsequent chemotherapy. These procedures, and a number of other operations that could be delivered by paediatric interventional radiologists, are performed by paediatric surgeons. Shouldering this workload takes the surgeons away from other specialist work they should be focusing on and limits surgical operating theatre availability for other services. In addition, there is clear evidence that if these procedures are performed 'open' (using a surgical approach), there is an increased risk of complications and the length of hospital stay for the child is longer than delivering them using a minimally invasive IR approach.^{8-11,13,14,15,16}

Limitations to PIR delivery also lie in the design of national policies and the structure of regional service delivery. Trauma management is a prime example of this. IR offers the opportunity to manage traumatic solid-organ haemorrhage more quickly than open surgery in many cases, with less invasive, faster and more targeted control of blood vessel injury and, critically, often stemming a single bleeding point while preserving blood flow to the rest of the organ. Interventional radiologists also have the ability to support trauma surgeons by providing the means for temporary haemorrhage control until the patient is stable enough to proceed to more definitive surgical treatment – a superb example of two specialties working together as a team. In this way, IR is recognised as critical to an adult major trauma centre (MTC) service. Hence IR is included in the national service specifications for adult trauma.

In the UK, there are three types of MTC: those that treat only adults, those that treat only children and those who can treat both adults and children. In England, there are 27 adult MTCs, 10 adult + paediatric MTCs and 5 standalone paediatric MTCs. The service specifications for these three types of MTC are the same. The standard (by which they are assessed as adequate) states that IR care must be available for all MTC patients within 60 minutes.¹⁷

For years, every MTC except one failed to meet that standard because they did not have 24/7 PIR on site. Rather than address this gap by developing a PIR service, local exemptions were put in place instead. More recently, the assessment standard was changed to specify that 'surgery or IR must be available within 30 minutes' - which means there is currently no onus on an MTC to develop a PIR service for children with trauma. All MTCs meet this new standard but in different ways: adult centres can almost all provide comprehensive 24/7 adult IR within the specified 30 min period. But only 1 paediatric MTC out of 5 is able to provide a similar PIR service. Two paediatric MTCs in England still do not have any PIR available. In order to provide the care stipulated within the service specifications, there are three main options for an MTC that includes paediatric care: that 24-hour PIR provision is available; that the centre develops an early and robust onward referral policy, or that the centre puts in place a policy to not take PIR-related cases at all. This last option, however, has its own limitations. For example, in a region in the north of England, urgent paediatric cases that are likely to require PIR are currently routed past a paediatric MTC and on to an adult + paediatric MTC 36 miles away, where PIR is available, with inevitable delays in diagnosis and treatment and significant risk to patients. See Appendix 1, case study 2, for another example.

“
...only 1 paediatric MTC out of 5 is able to provide a similar PIR service. Two paediatric MTCs in England still do not have any PIR available.



MTCs that treat children which have a 24/7 IR service

SERVICE KEY

- Full 24/7 service
- 24/7 service with limitations (incomplete rota covered by locum)
- No 24/7 service
- No IR service

HOSPITAL KEY

England

1. Addenbrooke's Hospital
2. The James Cook University Hospital
3. John Radcliffe Hospital
4. Leeds General Infirmary
5. The Queen's Medical Centre
6. Royal Victoria Infirmary
7. Manchester Royal Infirmary

8. Southampton General Hospital
9. Bristol Royal Hospital for Children
10. Birmingham Children's Hospital
11. Sheffield Children's NHS Foundation Trust
12. Alder Hey Children's Hospital - Liverpool

London

13. St George's Hospital, Tooting
14. King's College Hospital NHS Foundation Trust
15. St Mary's Hospital
16. Royal London Hospital



These maps were derived from a survey undertaken by the BSIR PIR special interest group in 2020. A nominated lead for the MTCs was identified by BSIR. All centres replied. Results were confirmed by telephone follow-up in July 2022.

MTCs that would or could treat 5-10 year olds for trauma-related bleeding

HAEMORRHAGE CONTROL KEY

- Yes
- Possibly - decided on case-by-case basis, according to size of child, scenario, experience of IR, and advice from peers.
- No
- No IR service

HOSPITAL KEY

England

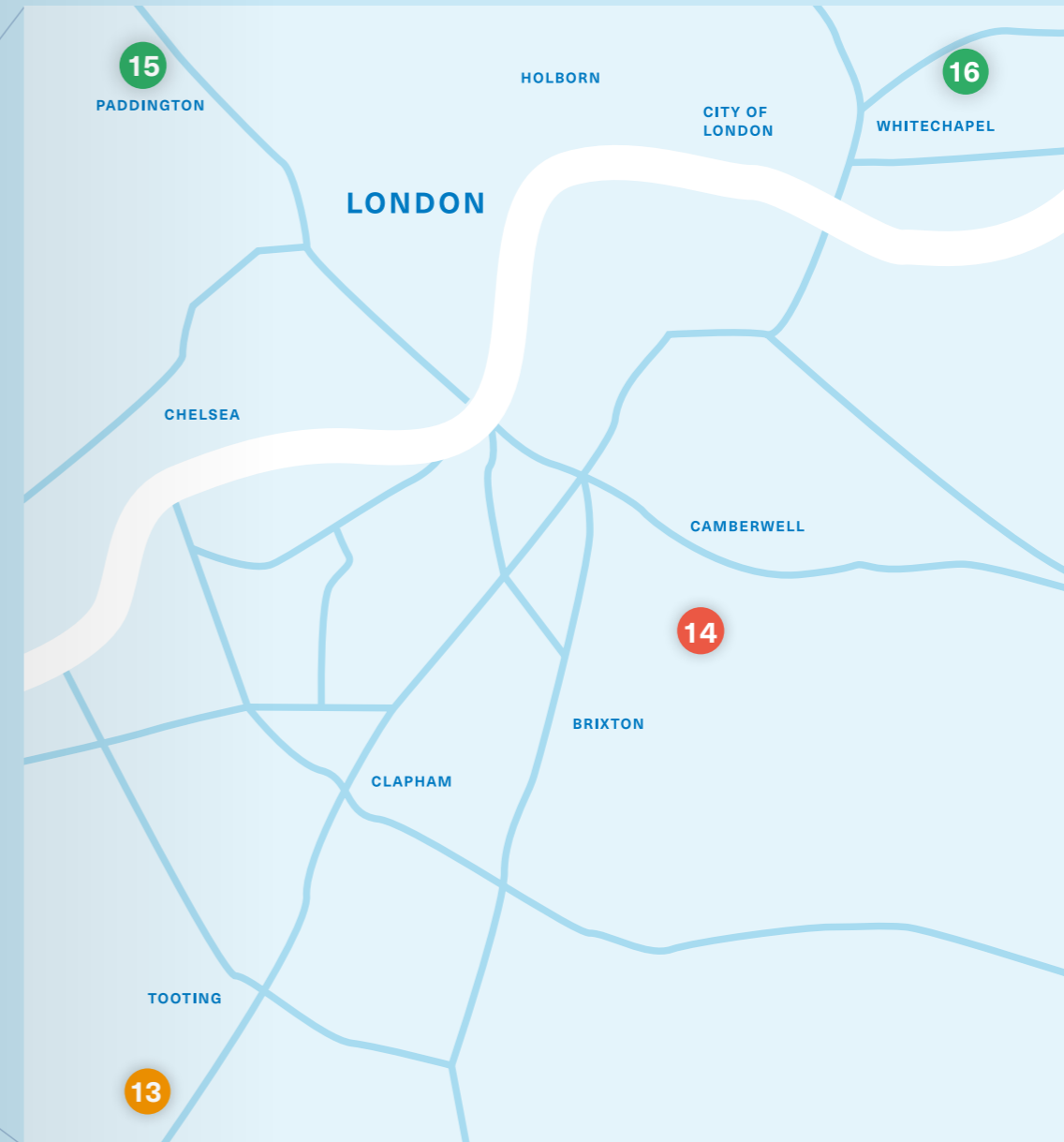
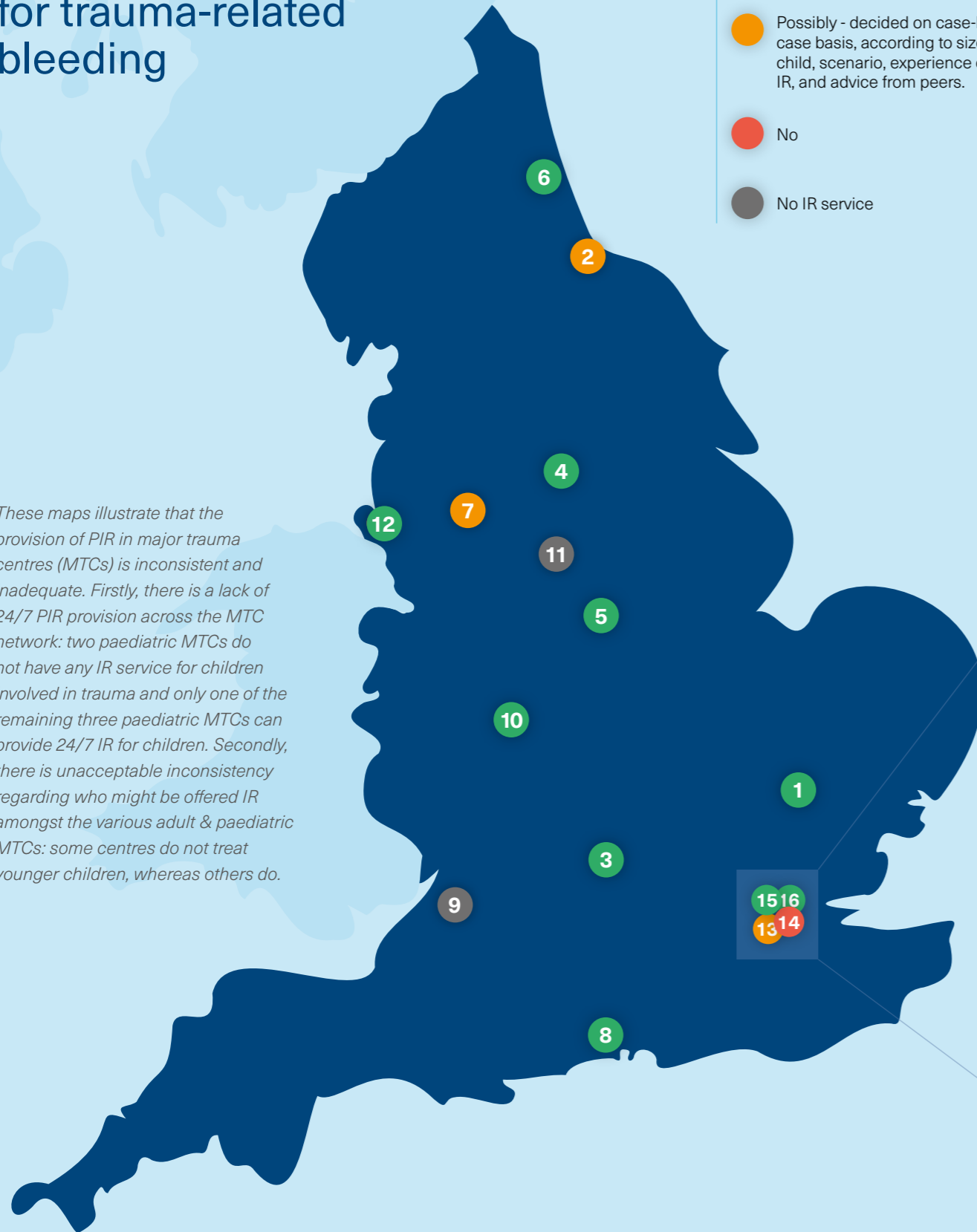
1. Addenbrooke's Hospital
2. The James Cook University Hospital
3. John Radcliffe Hospital
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5. The Queen's Medical Centre
6. Royal Victoria Infirmary
7. Manchester Royal Infirmary

8. Southampton General Hospital
9. Bristol Royal Hospital for Children
10. Birmingham Children's Hospital
11. Sheffield Children's NHS Foundation Trust
12. Alder Hey Children's Hospital - Liverpool

London

13. St George's Hospital, Tooting
14. King's College Hospital NHS Foundation Trust
15. St Mary's Hospital
16. Royal London Hospital

These maps illustrate that the provision of PIR in major trauma centres (MTCs) is inconsistent and inadequate. Firstly, there is a lack of 24/7 PIR provision across the MTC network: two paediatric MTCs do not have any IR service for children involved in trauma and only one of the remaining three paediatric MTCs can provide 24/7 IR for children. Secondly, there is unacceptable inconsistency regarding who might be offered IR amongst the various adult & paediatric MTCs: some centres do not treat younger children, whereas others do.



Clinician and commissioner awareness

IR exists in a symbiotic relationship with other specialist teams who often receive the initial referrals and who then reach out to IR for help in delivering care for their most complex patients. 50 years of adult IR practice means that IR is now accepted as invaluable to patient management and it forms a core part of adult treatment pathways. However, the majority of paediatric departmental leads, hospital organisations, health boards and commissioners remain largely unaware of this service need.

The British Society of Interventional Radiology (BSIR) and RCR are championing PIR. There has recently been increased interest around collaboration with paediatric surgery and trauma leads at NHS level are now more aware of the discrepancy in trauma provision for adults versus children. However, the UK has yet to catch up with the standards of care, level of recognition and equity of access to PIR that, for instance, the USA and parts of Canada have developed*.⁶

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The British Society
of Interventional
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and RCR are
championing PIR

Data collection

Part of the challenge in building PIR services is the lack of comprehensive data. Surgical procedures are coded in great detail, allowing procedure numbers, resources and costs to be accurately tracked and measured. Coding of diagnostic imaging such as CT scans, using the NHS Diagnostic Imaging Dataset (DID), works in a similar way. But IR has, from the start, suffered from a lack of effective procedure coding, falling between the two different coding systems of radiology and surgery. Interventional procedures are frequently not recognised by the DID system (for example, biopsy is not recognised as an IR procedure), many IR procedures are not identified because there is no procedure code and, crucially, there is no separate report for IR.

The NHSE Model Hospital improvement tool uses separate National Imaging Data Collection (NIDC) data, submitted by hospital organisations and used primarily to give an overview and comparison of services delivered. The NIDC data include some IR procedures but, as with DID data, several common IR procedures such as biopsy are not recognised.

This is compounded in PIR, where the procedure numbers are far smaller and local coding systems, not built by IR specialists, significantly under-record activity. As an example, the Model Hospital currently shows Alder Hey Children's Hospital to be performing no PIR procedures at all, while in reality it is one of the key PIR centres in the UK. In addition, the existing Model Hospital data cannot be interrogated for paediatric procedures only, so any PIR data from centres such as Birmingham and Leeds are lost amongst the adult IR data from those Trusts. This means that the huge disparities in PIR delivery across the UK remain unmapped and unrecognised. In turn, this lack of any meaningful data hampers any attempts at business case development or advocacy for the development of PIR services.^{18, 19, 20}

PIR facilities and equipment

In most centres, fledgling PIR services have had to develop through the use of workarounds and compromises, such as the re-purposing of spaces such as anaesthesia induction rooms or radiology fluoroscopy suites that were never built to be operating suites. These inadequate surroundings lead to compromises in infection control and patient safety (due to inadequate anaesthesia facilities and lack of physical space for staff or resuscitation equipment in the event of a major event such as cardiac arrest) and contravene specific guidance issued by the Royal College of Anaesthetists in their Guidelines for the Provision of Anaesthetic Services (GPAS).²¹ PIR operators often have to perform procedures without adequate nursing support, both in terms of numbers of staff and of skill sets, and have to monitor spending and stock of consumables themselves. The radiology facilities in such rooms are often woefully inadequate compared to the high specification angiography suites used in adult IR. This leads to inadequate imaging guidance for procedures, with the attendant risks of procedure failure, higher complication rates and increased radiation dose to the child. Finally, these spaces are often far from the main operating hub within the hospital, leaving operators and anaesthetists vulnerable and distanced from the support of their teams.²¹

“
PIR operators often have
to perform procedures
without adequate
nursing support, both
in terms of numbers of
staff and of skill sets

Interdependency with anaesthesia services

Most procedures in young children, be they surgical or IR, are performed under general anaesthesia. This is very different to adult IR, where a large proportion of procedures can be undertaken in awake patients and there is far less reliance on anaesthesia support. In centres where PIR services develop from an adult IR base, recognition of the vital role anaesthesia services play may be slower to grow and the necessary links with the anaesthetic department may take time to develop. Additionally, not all hospital organisations are able to provide anaesthesia services for children of all ages and all disease complexities to the required standards as set out in the Royal College of Anaesthetists' GPAS guidelines.²² This key interdependency needs to be factored in to service development; without significant investment in the hospital's anaesthesia services, a PIR service cannot exist. Far too often, paediatric radiologists or adult IRs are asked to deliver IR for young children without funding or staffing in place for the necessary paediatric anaesthesia support.

In almost all hospitals, anaesthesia is a heavily oversubscribed resource. This often necessitates valuable time personally negotiating for an anaesthetic team to support paediatric cases. Debates with anaesthetists, managers and surgeons regarding urgent case prioritisation across the organisation are frequent and often result in routine PIR procedures being performed out of hours or even at weekends.² In under-resourced departments, children awaiting a PIR procedure can wait many hours, starved in preparation for theatre, for a slot to become available on a busy surgical anaesthetic list and are often cancelled at late notice due to other emergencies, only to wait again the following day. Careful planning and proper resourcing of services can avoid this.

The current level of support for PIR means we are a far cry from the standard of care committed to by the 2019 NHS England and NHS Improvement (NHSEI) 'Paediatric critical care and surgery in children review' and the 2019 NHS Long Term Plan.^{4,3} Under the current resources, safe and efficient PIR service delivery is often frustrating and all too frequently impossible and carries the additional risk of creating conflict between specialities all vying for access to a very limited resource.

* There are several reasons for this, including differences in funding levels. It may, too, be in part because North America has far more stand-alone children's hospitals so if there is no PIR, there is no IR at all. In the UK, many paediatric centres share a site with an adult hospital and may rely on adult IRs to provide some PIR care.

Proposed solutions to improve paediatric IR services

- A** Improving service provision and capacity
- B** Improving training capacity and maintenance of competencies
- C** Out-of-hours and emergency service provision
- D** Increasing recognition of PIR within the wider healthcare system and improving clinician and commissioner awareness
- E** Establishing robust data collection
- F** PIR facilities and equipment
- G** Interdependency with anaesthesia services



A Improving service provision and capacity

The delivery of PIR services cannot be met by a 'one size fits all' solution, as acknowledged by the Department of Health in its National Imaging Board 'Interventional radiology: guidance for service delivery' 2010 document.²

However, the creation of a network model similar to existing networks for critical care, cancer, trauma and paediatric surgery is possible for PIR. The 2019 NHSE/I 'Paediatric critical care and surgery in children review' emphasises the benefits of operational delivery networks (ODNs).⁴ These include improved sustainability of services and workforce, reductions in variations in care quality, equity of access across the country, delivery of more joined-up services for children with different levels of need, and treatment offered closer to home wherever possible. Appendix 2 outlines a proposed model of PIR care.

While it is clear that a broad range of PIR procedures can be delivered by a mix of healthcare professionals with the right skills and competencies to deliver care, it is essential that the UK invests in a greater number of dedicated PIR consultant posts. This would create a pool of expertise in rarer procedures and enable care to be delivered in specialised centres that can support the complex package of care such patients require. Crucially, this expertise must reach beyond procedural proficiency and include in-depth knowledge of the often complex paediatric diseases requiring intervention, so that the clinical decision-making at the heart of specialist PIR practice is expert, up-to-date and authoritative. Using a hub and spoke model, this cohort of specialists can then be a source of advice and support for those teams establishing PIR services elsewhere in the region. This would make future consultant appointments in smaller centres wishing to develop some aspects of PIR a more attractive proposition, a critical factor in today's healthcare system where the risks of burn out and lack of support for young doctors are now well recognised.

Centres with these specialist posts would also provide higher level PIR training and promote much needed research and clinical development in the field of PIR, to ensure the UK keeps pace with practice in other comparable nations.

This PIR consultant expansion could be built into the existing centres already commissioned to deliver specialised care for children which, by the nature of the services they deliver, all require PIR both in and out of hours. There are 10 paediatric surgical ODNs in England, three major trauma centres in Scotland that include paediatric care, one children's hospital in Northern Ireland and one in Wales. Each of these 15 centres would require six consultants with PIR skills to deliver a robust 1 in 6 on call rota. Some of these consultants could be adult interventional radiologists or diagnostic paediatric radiologists, but the majority should be specialist PIR posts with job plans focused on PIR.

A doubling in the number of specialist PIR consultant posts every five years will achieve the required number of posts within 15 years (12 current posts doubled to 24 at five years, 48 at ten years and 96 at 15 years). As consultant PIR numbers increase, the necessary training capacity (in both the number of trainers and workload to support training) will also increase. An increase in recognised training posts must therefore follow. It must be noted, though, that as the number of consultants increase, so will the workload, as has been seen in a number of centres where a PIR service has been set up. Thus the consultant workforce numbers required may look different in 10-15 years and should be reviewed accordingly.

The investment, planning and commissioning required to establish a national PIR service that is fit for purpose requires tariffs for PIR procedures that reflect the additional complexities of procedures in young children and the scarcity of the resources available to deliver them. In 2021, NHSE agreed an uplift in tariffs for some of the most common PIR procedures. The Expert Working Groups (EWGs) continue to work with NHSE to re-evaluate tariffs applied to paediatric procedures and have recently proposed wider tariff uplifts on all paediatric procedures. This would immediately make PIR

provision a far more attractive option for organisations where PIR is currently undervalued or not considered a priority.

Appendix 3 outlines what is delivered in three UK children's hospitals which currently offer a comprehensive PIR service and provides an example of how demand for a PIR service can grow and how that demand can be met.

Once a service is well established and developed, certain aspects of that service can be self-sustaining. For instance, Great Ormond Street Hospital has a well-developed children's feeding tube service with routine feeding tube changes performed largely by specialist radiographers (non-doctor allied health professionals) on dedicated PIR lists several times a week. This service is relatively low maintenance but attracts a high tariff. As has become a well-established model of care in adult IR now, PIR can also deliver its own outpatient services, allowing the team to accept direct referrals, provide individualised outpatient care for patients, take the pressure off inpatient beds and generate much needed revenue for service development.²³

“Once a service is well established and developed, certain aspects of that service can be self-sustaining”

Recommendations

Quantifiable increases in PIR provision must be facilitated in the following ways:

- Creation of a nationally commissioned PIR network model similar to existing networks in critical care, cancer, trauma and paediatric surgery, led by regional Integrated Care Systems and paediatric surgical ODNs.
- Doubling of the number of specialist PIR consultant posts every five years to reach the required number of posts within 15 years: 12 current posts doubled to 24 at five years, 48 at ten years and 96 at 15 years.
- PIR consultant posts linked to paediatric surgical ODNs in England, paediatric MTCs in Scotland and specialist children's hospitals in Wales and Northern Ireland.
- Uplift in tariffs applied to PIR procedures to ensure PIR service development becomes a more attractive option for hospitals and commissioners.



B Improving training capacity and maintenance of competencies

PIR services cannot grow without a pipeline of trained doctors to deliver the work. Having, at best, only five radiology training posts in the UK that explicitly offer training in PIR is unacceptable. Creativity and drive are urgently required by Health Education England (HEE), by the postgraduate Schools of Radiology and by training program directors across the four nations to flex existing training pathways so that specialist PIR training can be achieved at scale.

The current radiology training structure in the UK means trainees are unable or strongly discouraged from taking up specialist training outwith their current training program, so the few existing PIR training posts are only open to a cohort of local candidates and may go unfilled if there is scarce local interest while trainees elsewhere in the UK with PIR ambition are unable to apply. It would be highly advantageous if trainees could move between training programs with their training number and/or if a number of final year (ST6) posts in PIR were centrally funded by Health Education England.

A more comprehensive inclusion of PIR in the next iteration of the IR curriculum would strengthen its recognition and enable training schemes to better understand which skills are most useful at various levels of PIR provision. Including a period of exposure to PIR for all trainees during their IR or paediatric diagnostic training would increase trainee awareness of these procedures, widen their career choices and normalise PIR as a core part of IR practice.

There are many adult IRs who use their expertise in adult IR to provide some PIR services, almost always without any formal PIR training, and who often practice as sole

operators or in small, low volume centres with very limited PIR infrastructure or institutional support. These practitioners require support from the BSIR, RCR and established PIR centres to develop the valuable services they offer and be supported in the work that they do. These institutions should provide cross-skill training opportunities for consultant IRs who wish to adapt their adult IR skills for children as well as to better understand paediatric diseases and outcomes, to be familiar with the specific indications for paediatric intervention and to maintain best practice.

Similar training opportunities should be considered for paediatric surgeons, anaesthetists and allied health professionals such as radiographers and nurses. The upskilling of existing practitioners, whatever their background, is likely to achieve the fastest improvement in service delivery for the greatest number of children and their families. As these centres of practice mature, they can pave the way for employing dedicated PIRs in the future, having started the hard work of developing the local PIR environment and influencing referral practices and institutional awareness.



Recommendations

- Statutory training bodies (e.g. HEE and devolved equivalents) must facilitate the creation of additional capacity to train new PIR practitioners. Training bodies need to introduce flexibility in access to training opportunities for small 'specialties' such as PIR so that trainees can flexibly train by utilising any spare training capacity across the country and/or fulfilling some of their competency deficiencies in another centre in the latter part of their training.
- Offer a number of final year (ST6) posts in PIR that are centrally funded by national training bodies such as Health Education England (HEE) and open to both IR and paediatric radiology trainees.
- Expedite an increase in the overall number of PIR practitioners through cross-skilling of health care professionals, such as adult IRs, paediatric surgeons, anaesthetists, radiographers and nurses. This cross-skilling of existing practitioners, whatever their background, is likely to achieve the fastest improvement in service delivery for the greatest number of children and their families.
- Consider how to better integrate PIR into existing training curricula to strengthen its recognition and enable training schemes to better understand which skills are most useful at various levels of PIR delivery. This will also generate greater levels of awareness of PIR among medical students and junior doctors so that they have the opportunity to explore PIR early in their training as a viable future career path.



c Out-of-hours and emergency service provision

As stipulated in the 2010 RCR and RCPCH “Improving paediatric interventional radiology services” report, all hospitals that offer care to children must have a clear policy for PIR.¹

This may mean local provision of IR by paediatric interventional radiologists, cross-skilled adult interventional radiologists or other clinical specialists, or robust onward referral pathways to regional centres who do offer PIR. Unambiguous arrangements must be in place for the early referral of children requiring PIR care that cannot be provided locally in a timely manner. As exists with adult IR, this must extend to out of hours care.

Robust policy change is required in UK paediatric trauma provision and policy. As outlined on page 14, the service specifications for the Major Trauma Service allow both mixed adult and paediatric MTCs and standalone paediatric MTCs to avoid the difficult issue of developing PIR provision by relying on paediatric surgical input. This assumes the two services are equal in all scenarios, a concept that is

not applied to adult care, where IR is acknowledged to be critical. Many MTCs report issues with provision of care for younger children in particular. Adult interventional radiologists have expert skills and wide experience in trauma management and are key to MTC services but in some scenarios the direct input of those with specialised PIR experience is required. Building PIR facilities, anaesthetic support and consultant posts into hospitals that include mixed and standalone paediatric MTCs, to complement existing adult IR input and negate the need for transfer out, would strengthen the care delivered in those centres and ensure children receive life-saving interventions faster.

Recommendations

- NHS delivery bodies must officially and clearly recognise PIR in service specifications and assessment standards for the Major Trauma Services. This will provide a solid foundation from which to call for financial and operational support to develop robust PIR input into MTCs that offer care for children.
- All hospitals that offer care to children must have a clear PIR policy. Unambiguous arrangements must be in place for the early referral of children requiring PIR care that cannot be provided locally in a timely manner.



D Increasing recognition and awareness of PIR

The current reconfiguration of paediatric surgical services puts further pressure on the NHS to develop PIR services. The 2019 NHS England and NHS Improvement (NHSEI) 'Paediatric critical care and surgery in children review' and the 2019 NHS Long Term Plan committed to the development of paediatric healthcare networks and emphasised the importance of getting pathways right for children and their families, ensuring that all patients can access the right care, in the right place, at the right time.^{3,4}

The resulting paediatric surgical ODNs were designed to support the development of services in each region, to resolve inconsistencies in children's care and to ensure that a child's whole pathway through critical care and/or surgery is appropriately managed. The 10 ODNs in England each include at least one specialised paediatric surgical centre to provide comprehensive care. There are likely to be some nationally commissioned services relating to the ODNs in the near future. These have not yet been finalised but plans for provision of appropriate PIR at these centres are neither clear nor consistent. These networks provide an ideal opportunity to build PIR provision into existing networked care.

The numerous advantages of co-working between paediatric surgery and PIR are easy to see. Firstly, a wide range of diseases are well suited to joint care (e.g. trauma, kidney stone management, gastrointestinal intervention such as feeding tube management, stoma creation and management of post-surgical complications). A large proportion of PIR referrals come from local paediatric surgery colleagues. Growing these direct relationships would lead to more efficient workflows, inter-departmental collaboration and pathways that benefit the patient. Secondly, PIR can share the burden of some of the routine workload for over stretched surgical teams by, for example, providing a vascular access service for their patients who can only be fed intravenously, as well as feeding tube insertions and maintenance. If PIR is developed to deliver a number of procedures currently performed by paediatric surgeons, it would free up both paediatric surgery consultant time and surgical theatre facilities for more specialist surgical

work. PIR can also help with the pre-operative management of children that require major and complex surgery, as well as manage some of the post-operative complications that can occur. Finally, paediatric surgeons understand what PIR can offer better than many other services and are therefore well placed to strongly advocate for the development of PIR services, leading to better outcomes for all involved.

The NHS Getting It Right First Time (GIRFT) programme is designed to improve the treatment and care of patients through in-depth review of services, benchmarking, and presenting a data-driven evidence base to support change. The programme undertakes clinically led reviews of specialties, combining wide-ranging data analysis with the input and professional knowledge of senior clinicians to examine how things are currently being done and how they could be improved. The GIRFT ambition should lend itself well to improvement of PIR services. The Radiology GIRFT Program National Specialty Report (2020) documented inconsistencies in IR delivery between Trusts but made no direct comments or recommendations regarding PIR.²⁴ The Paediatric General Surgical and Urology GIRFT report (2021) highlighted variation in the availability of critical co-dependencies for paediatric surgery such as interventional radiology but goes no further.²⁵ An interventional radiology GIRFT report would hold immense value with regard to national IR development and would necessarily include a much needed in-depth review of and recommendations for improvement in PIR provision that is beyond the scope of this document.



Recommendations

- NHSE must incorporate PIR specifications into the paediatric surgery Operational Delivery Network (ODN) workstreams and recommendations. This would allow for the following types of joint advocacy:
 - Push locally, regionally and nationally for more PIR consultant posts
 - Develop local service models and referral pathways
 - Include PIR in treatment algorithms
- Support local PIR teams to get access to theatres and anaesthetic lists
- Work to meet trauma service specifications
- Increase co-working with other specialties.
- Commitment by NHSE to an interventional radiology GIRFT report to provide a much-needed in-depth review of and recommendations for improvement in national PIR provision.



E Establishing robust data collection

There is huge complexity to the breadth and type of data collected about both radiology and interventions that, as the Radiology GIRFT report acknowledged, may be counterproductive. Nationally recorded activity data must be accurate and auditable, so that it can be used effectively to drive change. Through the advocacy of a small group of adult and paediatric interventional radiologists, NHS Digital and NHS England now acknowledge that the definition of IR, for the benefit of data collection, needs further clarification and that the data collected must accurately reflect the work being done. Significant refinements are required to the way both NIDC and DID data is collected and PIR specialists must be actively consulted on those changes so that the data become fit for purpose.

Recommendations

- NHS Digital and NHS England must acknowledge that the definition of IR, for the benefit of data collection, needs further clarification and that the data collected must accurately reflect the work being done.
- Significant refinements are required to the way both NIDC and DID data are collected. PIR specialists must be actively consulted on those changes so that the data become fit for purpose.



F PIR facilities and equipment

Once trained, paediatric interventional radiologists need dedicated operating space, support staff and equipment with which to do their job. As the need for PIR becomes clearer, some new consultant appointments are now being created that specify delivery of some level of PIR in the job description or job plan but without adequate infrastructure, funding or staffing to provide such a service.

Recommendations

- The RCR, RCoA and BSIR must work with all hospitals committed to developing a PIR service to stipulate the standards of infrastructure, funding and staffing required to deliver various tiers of PIR care.

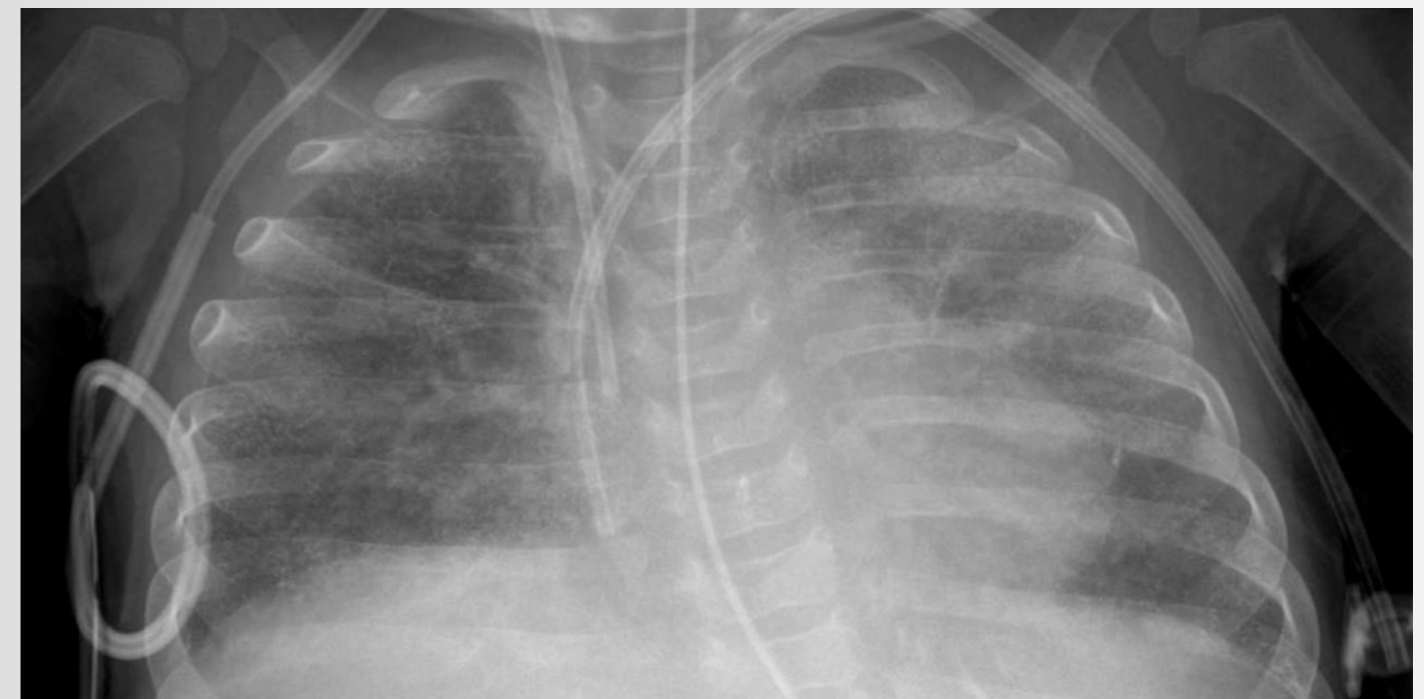


G Interdependency with anaesthesia services

Paediatric anaesthetists are well placed to work with IR colleagues to develop safe and consistent PIR spaces. Expert anaesthetic support is key and anaesthetists are valuable advocates in negotiations with surgical specialities and operating theatre managers to help prioritise the use of scarce resources. By engaging early and working closely with local anaesthesia teams, hospitals must include anaesthesia services in the development of 24-hour care pathways and referral strategies, recognising that, like IR, not all hospitals can offer anaesthesia to children of every age and at every level of care. When paediatric anaesthesia services are required, they must be developed under the GPAS guidance provided by the RCoA.^{21,22}

Recommendations

- Hospitals must include anaesthesia services in the development of PIR care pathways.
- When paediatric anaesthesia services are required, they must be developed under the GPAS guidance provided by the RCoA.



Conclusion

PIR has huge growth potential to provide lifesaving and life-altering care for our youngest patients. A well-resourced national PIR service with a wide base of trained specialists, networked tiers of care, dedicated infrastructure, appropriate funding and formal training programs would directly influence the healthcare offered to children in all four nations. The 2010 report recognised the value and importance of PIR to the NHS and made recommendations to grow and support PIR but has not driven change.¹

We welcome these recent advances:

- HEE-approved new IR training post at Birmingham Children's Hospital, the second national PIR training post in the UK, and the recent integration of PIR into the adult IR training program at Guy's & St Thomas' and the Evelina London Children's Hospitals.
- In addition to the two PIR consultants at Leeds Children's Hospital, a new consultant post has been approved and filled to support both the paediatric interventional and diagnostic service there.
- A second PIR consultant post planned at Alder Hey Children's Hospital.
- RCR collaboration with the BSIR's PIR special interest group on the development of a rolling PIR cross-skilling program, aimed at adult IRs, paediatric diagnostic radiologists, surgeons and anaesthetists.

While the above elements are positive steps, there needs to be a conversation at the highest level about dedicated specialist services and whether PIR becomes centrally funded so organisations do not view it as an unfeasible financial burden. Accordingly, our recommendations are summarised on the next page.

This document clearly illustrates that PIR is a crucial element of modern NHS care for the UK's youngest patients. These recommendations provide a clear roadmap for supporting and growing PIR across all four nations and bringing paediatric healthcare in the UK into the 21st century.

Summary of recommendations

- ★ Creation of a nationally commissioned PIR network model led by regional Integrated Care Systems and paediatric surgical ODNs.
- ★ Doubling of the number of specialist PIR consultant posts every five years to reach the required number of posts within 15 years: 12 current posts doubled to 24 at five years, 48 at ten years and 96 at 15 years.
- ★ PIR consultant posts to be linked to paediatric surgical ODNs in England, paediatric MTCs in Scotland and specialist children's hospitals in Wales and Northern Ireland.
- ★ Additional national capacity and flexibility for PIR training. The possibility of a number of final year (ST6) posts in PIR centrally funded by national training bodies such as Health Education England (HEE) and open to both IR and paediatric radiology trainees should be considered.
- ★ Increase in the number of overall PIR practitioners through cross-skilling of health care professionals, such as adult IRs, paediatric surgeons, anaesthetists, radiographers and nurses.
- ★ Consider how to better integrate PIR into existing training curricula.
- ★ Uplift in the tariffs applied to PIR procedures.
- ★ Inclusion of PIR in the service specifications and assessment standards for the Major Trauma Services.
- ★ A clear PIR service delivery policy in all hospitals that offer care to children. Unambiguous arrangements must be in place for the early referral of children requiring PIR care that cannot be provided locally in a timely manner.
- ★ Incorporation of PIR specifications into the paediatric surgery Operational Delivery Network (ODN) workstreams and recommendations.
- ★ Commitment by NHSE to an interventional radiology GIRFT report to provide a much-needed in-depth review of and recommendations for improvement in national PIR provision.
- ★ Acknowledgement by NHS Digital and NHS England that the definition of IR, for the benefit of data collection, needs further clarification and that the data collected must accurately reflect the work being done.
- ★ Significant refinements to the way both NIDC and DID data are collected. PIR specialists must be actively consulted on those changes so that the data become fit for purpose.
- ★ Commitment by the RCR, RCoA and BSIR to stipulate the standards of infrastructure, funding and staffing required to deliver various tiers of PIR care in all hospitals developing a PIR service.
- ★ Inclusion of anaesthesia services in the development of all PIR service provision pathways, in line with the GPAS guidance provided by the RCoA.

Appendices

Appendix 1

Case studies

Appendix 2

Models of paediatric
IR service provision

Appendix 3

Examples of current
service delivery and
growth in PIR demand

APPENDIX 1

Case studies

This section provides selected case studies highlighting the gaps currently limiting paediatric healthcare in the UK and how organisations could bridge these.

Case Study 1

Problem: Understaffing/workload

One of the UK's dedicated children's hospitals has had one consultant PIR running the organisation's PIR service single-handedly for the last 16 years. This PIR consultant has been unofficially on call for PIR every night of the year. The Trust has agreed to pay locum rates if the consultant gets called in for an emergency but they get no payment for their 24/7 out of hours availability. In one week in 2021, the consultant performed 38 operations singlehandedly, a workload which would normally be ambitious for a team of two consultants. This demonstrates the fragility of the service being offered in this tertiary centre. The consultant has been open about elements of burn out and mental ill-health that they are suffering, which they feel are directly attributable to the job. Until 2021, there was no formal succession plan in place. A locum consultant was appointed in 2022 to work alongside the PIR in post, with a plan to progress to a substantive appointment once relevant certifications are confirmed.

Potential solution:

Utilising training posts. There is a training post at the same Trust that could be used for a radiology trainee to train with the incumbent PIR and be well-placed to then join the service as a consultant but the training post is ring-fenced for local trainees only, so trainees who are interested in PIR from anywhere else in the UK cannot apply. A more flexible approach to the design of and changes to the funding of training posts would open up staffing opportunities for organisations such as this.

Case Study 2

Problem: Policy failure leading to patient harm

A story from an adult-only Major Trauma Centre (MTC) where a lack of PIR posed direct danger to a young patient: A 13yr old boy fell in the playground and came into A&E unstable and requiring active resuscitation. He had a CT scan which showed rapid bleeding from his right kidney with a large pool of blood in his abdomen. The radiologist who reported the CT recommended that the trauma team urgently discuss the child's case with the local adult IR team who were very experienced in treating such bleeds in adult patients and could consider applying their expertise to this teenager. This conversation did not occur. Instead, the child continued to require repeated blood transfusions while transfer was arranged to the nearest paediatric MTC. This centre was 98 miles away and had no adult or paediatric IR services. En route, the child became increasingly unstable, requiring the ambulance to be diverted to another hospital to collect more blood for him before completing the journey, further delaying any definitive treatment for the bleeding. On arrival at the paediatric MTC, a decision was made to simply monitor the child to see if the bleeding stopped. Fortunately, the child eventually stabilised and ultimately made a good recovery, but this lack of PIR service awareness, joined-up thinking and patchy service provision could have been fatal to a young person.

Potential solutions:

1. Recognition by individual organisations that adult IRs, with the right support from national PIR networks, have transferable skills that can be utilised in urgent situations to provide expert and often life-saving care.
2. Review of Major Trauma Centre structure to ensure paediatric IR care provision is mandated, robust and practical.

Case Study 3

Problem: Lack of PIR services lead to inadequate healthcare for children

The paediatric surgical team at a major UK children's hospital have highlighted local barriers to being able to access a comprehensive PIR service, the harm that can come to their patients as a result and their current local work-arounds.

Central venous access (to administer drugs, chemotherapy etc)

Without any IR service, these procedures are performed by paediatric surgeons and cardiologists, a significant workload that, in other centres with PIR services, is delivered or shared with IR. There is an 18 month waiting list here for elective surgery, made far longer by having to use specialist surgical operating time to do these procedures.

Management of appendicitis

There is one non-IR radiologist who is able to insert IR guided drains which are critical for the treatment of abdominal abscesses such as those often found in patients with appendicitis. A child's treatment is significantly delayed if this doctor is not available. When the doctor is away on leave, children instead have to have repeat abdominal surgery to try to drain these abscesses.

Kidney obstruction

Infected, obstructed kidneys are at high risk of damage which can lead to kidney failure and the need for dialysis or kidney transplantation. Children in this centre with obstructed kidneys have to be referred to the adult IR service in the adult hospital across town. It can take 2 days for an adult IR to be available to place a drainage tube to unblock the child's kidney. In adult care, this would be considered an emergency requiring intervention within hours.

Feeding tubes

The placement and maintenance of feeding tubes is a major service in any paediatric hospital and many families rely on rapid access to this crucial service, without which a child may not be able to be fed or receive their medications. Currently, none of the diagnostic paediatric radiologists here are comfortable with placing feeding tubes so the general surgeons have to go to the radiology department and use their facilities to do the procedure themselves. They are not trained in this procedure, which relies heavily on both IR skills and equipment. These procedures therefore take a far longer time compared to when an IR performs them, and there is an unacceptably high procedure failure rate. If the surgeons fail, the child has to then have this relatively simple IR procedure under a full general anaesthetic, meaning increased risk to the patient, longer inpatient stays and squandering of valuable theatre and operator time. Although the situation is rare, at least one child has ended up with a surgical stoma due to repeated difficulties in replacing their feeding tubes, a pragmatic decision made to avoid the need for multiple anaesthetics.

Potential solution:

Investment in a PIR service to deliver expert services the paediatric surgeons are currently doing in a less skilled way. This would dramatically improve children and families' experience and ensure safer care. Other parts of the workload could be shared, freeing up surgical resources to address current surgical waiting lists. The fledgling service would be supported by existing PIR experts at the nearest neighbouring children's hospital. In time, the PIR service would generate revenue which would allow it to thrive and expand.

APPENDIX 2

Models of paediatric IR service provision

It is clear that not all hospitals that treat children can, or should, provide a full 24/7 PIR service offering every possible type of procedure. The service offered will depend on the site and size of the hospital or organisation but, in many contexts, hub-and-spoke models work well. Looking broadly at three typical contexts, best practice could be delivered using the following model:

In a large district general hospital, one adult IR, with an interest in PIR and strong links to PIRs elsewhere for advice and guidance, could lead on advising on local cases. Within a formalised regional network agreement for the provision of out of hours and emergency care, they could also work with their colleagues to deliver intervention for rare life-threatening cases that cannot be transferred out (such as bleeding tumours).

In a tertiary centre without a dedicated PIR unit, two adult IRs with a subspecialty interest in PIR, who are cross-skilled in some PIR procedures, could offer a bespoke range of procedures including biopsies, insertion of long-term central venous lines for children with difficult vascular access, and emergency interventions (such as abscess drainage, unblocking kidneys, stemming acute bleeding in trauma), as well as one routine PIR list per week supported by a nurse and radiographer who are also skilled in PIR, creating a clinical team skilled to ensure safe paediatric-focussed care. A formalised regional network agreement for the provision of out of hours and emergency care would need to be in place. This service would necessarily be limited to more straightforward procedures but would fill part of the UK service shortfall. This level of service at tertiary centres is achievable and is the very least that the UK should aspire to.

A tertiary centre with a dedicated PIR service should offer a team of PIRs (including advanced practice nurses and radiographers where possible) delivering a comprehensive range of procedures, with access to regular paediatric anaesthetic lists using dedicated IR operating suites and an on-call service. In addition, such centres should aim to offer a formal PIR training programme. Ultimately, such a centre should be the aim of each Integrated Care System (ICS), though this is likely to require significant investment and workforce planning.

APPENDIX 3

Examples of current service delivery and growth in PIR demand

Comparative data collected for the RCR from three UK children's hospitals which currently offer a comprehensive PIR service shows the approximate annual PIR procedures at those three sites:

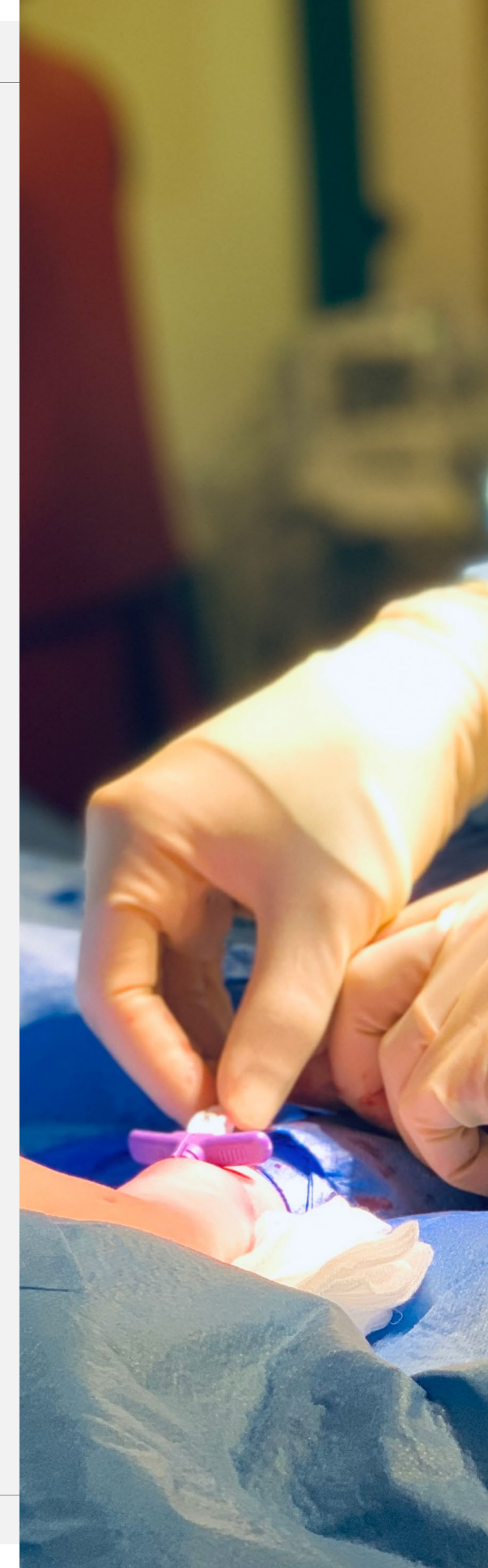
- **Great Ormond Street Hospital:** approximately 3100 procedures per year
- **Birmingham Children's Hospital:** approximately 750 procedures per year
- **Leeds Children's Hospital:** approximately 1100 procedures per year

Taking a closer look at the PIR service development at Leeds Children's Hospital (LCH) over the last 11 years demonstrates how demand for a PIR service can swiftly grow and how that demand can be met:

LCH is a 296-bed hospital which stands on a shared site with Leeds General Infirmary (LGI). In 2011 LCH appointed a paediatric diagnostic radiologist with 2.5 sessions of PIR per week included in his job plan. His practice was strongly supported by the adult IR consultants at LGI. In 2013, 222 PIR procedures were performed, increasing to 290 procedures in 2014. A second consultant was appointed in 2015 and by 2016, 626 procedures were performed. 2019 saw over 1000 procedures. The hospital currently has three PIR consultants with ongoing strong support from adult IR for more complex procedures. However, the service is still hampered by very limited access to anaesthetic services and operating space. Currently, 40% of PIR procedures are performed on the hospital's emergency list (competing with all other urgent surgical work in the hospital on a case by case basis) and approximately 30% of procedures are performed outside of the consultants' job plans (on days off, evenings, weekends). National funding has been approved for a new children's hospital in Leeds and in recognition of the value that PIR provides in this Trust, a commitment has been made to provide a dedicated PIR suite in the new hospital with a view to further service expansion as the workload increases further.

References


1. "Improving paediatric interventional radiology services" The Royal College of Radiologists and The Royal College of Paediatrics and Child Health, 2010 <https://www.rcr.ac.uk/publication/improving-paediatric-interventional-radiology-services>
2. Department of Health's National Imaging Board 'Interventional radiology: guidance for service delivery' 2010 document <https://www.gov.uk/government/publications/interventional-radiology-guidance-for-service-delivery-a-report-from-the-national-imaging-board>
3. The NHS Long Term plan (England), 2019 <https://www.longtermplan.nhs.uk/wp-content/uploads/2019/08/nhs-long-term-plan-version-1.2.pdf>
4. NHS England and NHS Improvement 'Paediatric critical care and surgery in children review' 2019 <https://www.england.nhs.uk/publication/paediatric-critical-care-and-surgery-in-children-review-summary-report/>
5. Roebuck DJ (2009) Paediatric interventional radiology. *Pediatr Radiol* 39 (Suppl):S491-5
6. Harned RK, Heran MKS, Patel M, Barnacle AM, Cahill AM et al (2018) Challenges and opportunities for continued success and growth of pediatric interventional radiology: a communique from the Society for Pediatric Interventional Radiology. *Am J Radiol* 211:740-3
7. Miglioretti DL, Johnson E, Williams A, et al (2013). The use of computed tomography in pediatrics and the associated radiation exposure and estimated cancer risk. *JAMA Pediatr* 167:700-7
8. Clinical Radiology census 2021 – The Royal College of Radiologists, 2021 <https://www.rcr.ac.uk/clinical-radiology/rcr-clinical-radiology-census-report-2021>
9. Population estimates for the UK, England and Wales, Scotland and Northern Ireland: mid-2019 [https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2019estimates#:~:text=the%20number%20of%20children%20\(those,by%2022.9%25%20to%2012.4%20million](https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2019estimates#:~:text=the%20number%20of%20children%20(those,by%2022.9%25%20to%2012.4%20million)
10. Society for Pediatric Interventional Radiology, registered members in the United States of America
11. The Royal College of Radiologists' 'Clinical Radiology speciality training curriculum' 2021 <https://www.rcr.ac.uk/clinical-radiology/specialty-training/radiology-curricula>
12. The Royal College of Radiologists' 'Interventional Radiology speciality training curriculum' 2021 <https://www.rcr.ac.uk/clinical-radiology/specialty-training/curriculum/interventional-radiology-curriculum>
13. Hassan SF, Mathur S, Magliaro et al (2012) Needle core versus open biopsy for diagnosis of intermediate- and high-risk neuroblastoma in children. *J Pediatr Surg* 47:1261-6
14. Mohamed H, Pastor MC, Langlois S, Cowan KN (2022) Comparing safety and adequacy between surgical biopsy versus core needle biopsy in diagnosing neuroblastoma. *J Pediatr Surg* 57:866-70
15. Devin CL, Teeple EA, Linden AF, Gresh RC, Berman L (2021) The morbidity of open tumour biopsy for intrabdominal neoplasms in paediatric patients. *Pediatr Surg Int* 37:1349-54
16. Lau CSM, Chamberlain RS (2016) Ultrasound-guided central venous catheter placement increases success rates in pediatric patients. *Pediatr Res* 80:178-84
17. NHS England Standard Contract For Major Trauma Service (All Ages), 2013 <https://www.england.nhs.uk/wp-content/uploads/2014/04/d15-major-trauma-0414.pdf>
18. Hancock-Howard R, Connolly BL, McMahon M et al (2010) Cost-effectiveness analysis of implantable venous access device insertion using interventional radiologic versus conventional operating room methods in paediatric patients with cancer. *J Vasc Interv Radiol* 21:677-684
19. Roudsari B, McWilliams J, Bresnahaan B, Padia SA (2016) Introduction to cost analysis in IR: challenges and opportunities. *J Vasc Interv Radiol* 27:539-545
20. Rubin GD (2017). Costing in radiology and health care: rationale, activity, rudiments and realities. *Radiology* 282:333-47
21. Guidelines for the Provision of Anaesthetic Services, Royal College of Anaesthetists Chapter 7, 2021 <https://rcoa.ac.uk/gpas/chapter-7>
22. Guidelines for the Provision of Anaesthetic Services, Royal College of Anaesthetists Chapter 10, 2022 <https://rcoa.ac.uk/gpas/chapter-10>
23. Wells RD (2022) Ambulatory care in interventional radiology: a framework for radiology day-case. *Clin Radiol* 77:489-495
24. Radiology Getting it Right First Time report NHS England, 2020 <https://www.gettingitrightfirsttime.co.uk/wp-content/uploads/2020/11/GIRFT-radiology-report.pdf>
25. Paediatric Surgery Getting it Right First Time report NHS England, 2021 <https://www.gettingitrightfirsttime.co.uk/wp-content/uploads/2021/09/PaediatricSurgeryReport-Sept21w.pdf>





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