GETTING IT RIGHT FIRST TIME

Paediatric Critical Care

GIRFT Programme National Specialty Report

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GIRFT is part of an aligned set of programmes within NHS England and NHS Improvement

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Foreword from Professor Tim Briggs

I am delighted to recommend this Getting It Right First Time review of paediatric critical care, led by Professor Kevin Morris.

This report comes at a time when the NHS has undergone profound changes in response to the COVID-19 pandemic. The unprecedented events of 2020-21 - and the extraordinary response from everyone working in the NHS – add greater significance to GIRFT's recommendations, giving many of them a new sense of urgency.

Actions in this report, such as increasing the number of level 2 beds and adopting approaches to flex the number of level 3 beds to adapt to flux in demand, can help the NHS as it faces the substantial challenge of recovering services, while remaining ready for any future surges, by operating more effectively and safely than ever before.

Kevin's report brings the GIRFT approach to paediatric critical care, a relatively new specialty which has seen major change over the past 20 years. Paediatric critical care looks after many of the sickest children seen in our hospitals. Around 8-10% of children admitted to hospital require high dependency care and 2% are admitted to paediatric intensive care units.

This report, based on national data and Kevin's insights from his deep-dive visits to 24 paediatric units in 21 trusts, and to ten operational delivery networks (ODNs), identifies areas of unwarranted variation in paediatric critical care and sets out recommendations that can deliver better outcomes and improvements to the care of children. The report focuses on paediatric critical care pathways at network and provider level. Key recommendations in the report include: delivering paediatric critical care beyond the intensive care unit and developing a suitably skilled workforce to support this; and increasing volumes of paediatric critical care outside of paediatric intensive care units in order to relieve some of the pressure on services and deliver care as close to the child and family home as possible.

Kevin has found many examples of excellent practice on his visits, some of which are highlighted in this report. It has been encouraging to hear about the engagement Kevin has had with colleagues on deep dive visits, including a commitment to using the data and improving services. There is a clear understanding that paediatric critical care is just one part of the pathway, and that partnership with general and specialist paediatrics is vital. This engagement is essential, as GIRFT cannot succeed without the backing of clinicians, managers, and all involved in improving care and outcomes for the most critically ill and injured children.

With the recommendations and actions set out in this report, and the urgency added by the COVID-19 pandemic, I hope that GIRFT will provide further support and impetus for all those involved in paediatric critical care to work together, shoulder to shoulder, to improve treatment, care and outcomes for our patients.

Professor Tim Briggs *CBE*

GIRFT programme Chair and National Director of Clinical Improvement for the NHS

Professor Tim Briggs is a consultant orthopaedic surgeon at the Royal National Orthopaedic Hospital NHS Trust, where he is also Director of Strategy and External Affairs. He led the first review of orthopaedic surgery that became the pilot for the GIRFT programme, which he now chairs. Professor Briggs is also National Director of Clinical Improvement for the NHS.

Introduction by Professor Kevin Morris

Paediatric critical care (PCC) is a relatively new specialty, with a number of current senior paediatric intensivists trained overseas before any training programme existed in the UK. Significant changes have occurred over the past 20 years, with centralisation of paediatric intensive care (PIC) services in fewer centres, establishment of specialist training for healthcare professionals working in PIC, and improved audit of activity and outcomes. Over that period clinical outcomes have improved but this has been at the expense of increasing pressure on limited PIC resources and the loss of important critical care experience and expertise, and confidence, beyond the PIC centres.

More recently there has been greater appreciation of the importance of delivering paediatric critical care beyond the intensive care unit, within high dependency and ward beds, and the need to develop a suitably skilled workforce to support this. Effective delivery of high dependency care for children is important both within hub (PICU) providers and within spoke (district general hospital) providers. A recent national review of PCC, along with surgery in children, recognised the need for improved, more formal, networks to optimise delivery of safe, effective, efficient PCC services across a hub and spoke model. A goal of the newly commissioned operational delivery networks is to deliver increased volumes of PCC outside of PICUs, thereby relieving some of the pressure on services, and at the same time delivering care as close to the child and family home as possible.

In this GIRFT report we provide a range of data to describe the current landscape of PCC services and how these services are used, at both individual provider and network level. It is our hope that shining this 'data spotlight' will facilitate critical review of services by local teams and, in turn, the development of improved services for critically ill children and their families.

Professor Kevin Morris

Professor Morris is a Consultant in Paediatric Intensive Care at Birmingham Children's Hospital. His clinical and research interests include management of traumatic brain injury, lung mechanics and mechanical ventilation, and the provision of critical care beyond the intensive care unit.

In recent years, his focus has been on how to adapt services to deliver safe, effective critical care to children outside of the ICU. He led the RCPCH/PICS project 'High Dependency Care: Time to move on' (2014), and the development of 'Quality Standards for the Care of Critically Ill Children' (2015).

Professor Morris has held a number of national roles including: president of the Paediatric Intensive Care Society (PICS) from 2010-13; and member of the NHSE Clinical Reference Group for PIC from 2011-15, and Chair of NHSD Casemix Programme HRG Expert Working Group (2009 to present).

Statements of support

Royal College of Paediatrics and Child Health

The Royal College of Paediatrics and Child Health (RCPCH) welcomes the publication of the GIRFT programme's Paediatric Critical Care report, and the excellent overview it provides of the current challenges, variation and examples of good practice in paediatric critical care. The report demonstrates one of RCPCH's key aims: to harness knowledge, data and intelligence to improve the quality of care for children and young people.

The detailed and comprehensive approach taken by the report has identified important recommendations for delivering better outcomes and improvements to the care of the sickest children in our hospitals. Many of the actions and recommendations are already informing practice as part of quality standards.

Children and their families should always be at the centre of care so we particularly welcome the recommendations around establishing clinical pathways and networks so that children and young people receive critical care support as near to home as safely as possible. We also support the establishment of a Children's Strategic Forum in each region to help facilitate greater alignment and integration of children's care.

Paediatric critical care is high pressure, highly skilled work and as demonstrated in the pandemic it is vulnerable to becoming over-stretched and under-resourced. Whilst we wholeheartedly support these recommendations we would like to highlight on a wider level that without sufficient workforce training and development across all relevant specialties and health professions, and provision of appropriate resources to support efforts to reduce variation across ODNs, there may be practical constraints on delivery of the report's recommendations.

RCPCH commends Professor Morris and the GIRFT team for this important report. Where excellent practice has been identified we hope this will be shared and celebrated. Where improvements in the care of children have been highlighted, we strongly encourage both hub and spoke providers to be supported to undertake the necessary service development.

RCPCH
Royal College of Paediatrics and Child Health
Leading the way in Children's Health

Dr Camilla Kingdon
President of the Royal College of Paediatrics and Child Health

Paediatric Critical Care Society

The Paediatric Critical Care Society (PCCS) welcomes this well-written report into paediatric critical care that correctly identifies many of the key challenges facing our speciality: the imbalance between capacity and demand ('unit strain'); a lack of clarity around commissioning responsibility; and the stress on the workforce and its wellbeing.

The report is data rich, and the reader is urged to go beyond the executive summary and recommendations to explore some of the detailed explanatory narrative within the body of the document. It is clear there exists significant variation between providers across an array of metrics and the GIRFT team's detailed analysis helpfully sheds lights on some of the reasons for this.

The authors make clear recommendations with nominated principal owners and timescales. Many of these are very sensible and include a focus on education, the introduction of a national validated early warning system, the development of models to better report risk adjusted outcomes, improved LTV pathways, responsibilities upon ODNs to develop clear pathways of care, and a just focus on real-time reporting of core quality metrics and PCC data flow generally.

Other recommendations such as regional Children's Strategic Forums, and a National Oversight Group to advise on ODN configurations, are more ambitious and will require co-operation between NHSE/I, the regional teams, and the Clinical Reference Group. The authors also correctly recognise that some key proposals may be impacted by future funding models and an evolving commissioning landscape based around Integrated Care Systems.

The authors are to be congratulated for producing such a stimulating and thoughtful document that will undoubtedly provide a platform for improvements in the years ahead. PCCS looks forward to working with other stakeholders to realise its potential.

Dr James Fraser
President of the Paediatric Critical Care Society

PCCS Paediatric Critical Care Society

Faculty of Intensive Care Medicine

The Faculty of Intensive Care Medicine (FICM) welcomes this report, which rightly places the patient at the centre of its recommendations. We fully support the recommendations and their integration into commissioning policy and future paediatric critical care transformation projects. We would like to see further investigation into standards for transition from paediatric to adult critical care, and the lack of access to paediatric ICM training for ICM CCT trainees in some regions. The inequity and access to paediatric critical care across the UK must be addressed so we can deliver better outcomes and improvements to the care of children. The Faculty endorses the collaborative approach to patient care highlighted by GIRFT and looks forward to improved networking and quality improvement initiatives.

Dr Alison Pittard *OBE*
Dean, Faculty of Intensive Care Medicine

The Faculty of Intensive Care Medicine™

Executive summary

The context

Paediatric critical care (PCC) services provide a care pathway for very sick children. Across England, 153 hospitals provide inpatient care for children, including elements of high dependency care (HDC). But only 23 hospitals deliver intensive care for children, via a networked 'hub and spoke' model, with the support of specialised 'transport' services to provide advice and assistance in the event of a child needing to be moved from a district general hospital (DGH) to a centre with a PICU.

Across England, 8-10% of children admitted to hospital require HDC and around 2% are admitted to PICU, with demand on PCC services increasing year on year by around 5%. Regional prevalence of PICU admission varies from less than 100 to greater than 400 per 100,000 population, and seasonal variation results in a winter surge in PCC demand due to winter respiratory illness.

A recent NHS England national review of PCC recommended the establishment of PCC operational delivery networks across England, with the goal of reducing demand on PICU (level 3) beds by delivering HDC (levels 1 and 2 care) beyond PICU, within both hub and spoke sites, and as close to the family home as clinically appropriate.

The principal focus of our report is on PCC pathways, both at network and PICU provider level. The Getting It Right First Time (GIRFT) approach is data focused and whilst we had access to high quality data pertaining to care delivery within PICUs there is currently a paucity of relevant data relating to care within HDC beds. We recognise that PCC represents only a small component of the patient pathway, and that general and specialist paediatricians are vital partners in delivering good outcomes for critically ill and injured children. We hope that future GIRFT reviews of other paediatric services will shed additional light on our findings and expand our understanding of how PCC fits into wider paediatric patient pathways.

The structure of our report

The sections in this report cannot cover every area of specialised PCC and there are many other aspects of PCC services that we could have included, but the summary below describes the background and findings in some of the areas that we consider most likely to have an impact.

Networks and configuration of services

Ten PCC operational delivery networks (ODNs) were commissioned by NHS England and NHS Improvement in 2019/20 to provide oversight of all PCC services at a regional level.

What we found

Establishment of PCC ODNs has been slow, with some regions still without established ODN arrangements in March 2020, and many others awaiting approval for staff appointments. Funding to support network core functions is highly variable between ODNs and there is insufficient resource to establish a network PCC education workforce, through which necessary PCC training for staff working in spoke hospitals can be delivered.

There are too few level 2 beds across England to deliver the goal of reducing demand on level 3 (PICU) beds and deliver PCC closer to the family home. In some regions of England there are no commissioned level 2 (HDC) beds.

Paediatric specialist care and hub to spoke flow

A significant proportion of children who require PICU admission have existing conditions (comorbidities) that require specialist care. Some children have multiple comorbidities and are under the care of a number of specialists.

What we found

Across some networks paediatric specialist pathways are poorly aligned, with inconsistent co-location of specialist services in each hub centre. This can result in children with complex medical conditions being admitted to a number of hubs, and PICUs, over time.

Across a number of networks large numbers of children are not being admitted to the PICU closest to the family home, and there is inconsistent flow of patients to hub PICUs from individual spoke hospitals in the network which are not explained by specialist pathways.

PICU capacity versus demand

A PICU service should have sufficient commissioned beds to be able to admit all children requiring PICU care, recognising the unpredictable nature of that demand and increased requirement over winter.

What we found

The balance of demand against capacity is highly variable across PICUs, with some that cannot meet demand and others that have more commissioned beds than needed to meet demand. Current metrics and reporting do not provide a representative picture and there is no national oversight of how many PCC beds are commissioned in each network or region and whether this is appropriate to demand.

Patient and family experience

Patient and family experience should be at the centre in any consideration of the quality of paediatric services.

What we found

We captured a range of metrics pertaining to quality of care and patient/family experience. This experience is at times sub-optimal, particularly in the setting of a service under capacity strain, with the child and family experiencing cancellation of elective surgery on the day of surgery as a result on a lack of a PCC bed, discharge from PICU to the ward in the middle of the night, and an unnecessarily prolonged PICU stay, with delayed discharge as a result of insufficient step-down beds. Within the group of children on a long-term (home) ventilation pathway care is often delivered within a PICU environment when a less intense, and less frightening, setting would be more appropriate.

Judicious use of PICU (level 3) beds

PICU is a low volume, high intensity, high cost service. It is imperative that this resource is used wisely and that those elements of the PCC pathway that do not require a PICU bed are delivered in HDC and ward beds, as appropriate, through the development of robust clinical pathways.

What we found

There is wide variation in how PICU beds are being used, with very little use of PICU beds in some centres for 'lower level' PCC, through well-developed step-up and step-down pathways, but poorly developed pathways in other providers resulting in inappropriate use of PICU beds.

Performance and metrics

A clinical service, and those with responsibility for that service, should have access to up to date data with which to monitor performance. Within PCC there is an NHS England specialist services quality dashboard that contains a number of metrics relating to PICU, and the Paediatric Intensive Care Audit Network (PICANet) national audit publishes an annual report containing valuable comparative data.

What we found

Existing metrics and benchmarking are at times 'comparing apples and oranges', for example when trying to compare a unit with 30 PICU beds, including a cohort of cardiac surgical patients, with another unit with four PICU beds and four HDU beds, and no cardiac surgical programme. There is a need for improved risk-adjusted outcome measures and analysis to be developed that will allow more meaningful benchmarking of unit performance in the future.

Data capture and coding

PCC is described by capture of a dataset called the paediatric critical care minimum dataset (PCCMDS) which is captured daily when a child is receiving one or more PCC interventions. As well as flowing to the national audit (PICANet), this data should be linked to the patient's hospital record and flow to the NHS data repository (Secondary Uses Service, SUS). Until now the scope of PICANet has been largely restricted to activity occurring in PICUs.

What we found

PCCMDS data is well captured in PICUs, with good quality data flowing to PICANet but the quality of data flowing to SUS on the same patients is often of poor quality. Very little data is captured in SUS, or PICANet, relating to the delivery of HDC to children across England, in either hub or spoke hospitals, creating a challenge to networks as they plan future PCC configuration and establish additional level 2 beds.

Commissioning and funding

Level 2 and level 3 PCC, and the newly established ODNs, are commissioned through NHS England and NHS Improvement regional specialised commissioning teams, informed by a series of service specifications.

What we found

The number of NHS England and NHS Improvement commissioned level 2 beds in each network is highly variable (4 to 40) and some PICU providers do not have any funded level 2 beds, placing additional pressure on level 3 beds. No new level 2 beds have been commissioned since the publication of the NHS England PCC national review.

There is no consistency in how PICU beds (level 3) are commissioned or funded, and in the majority of cases commissioning does not take into account the complexity of the care being delivered, or the staffing requirement to deliver that care.

What happens next?

The report makes 22 recommendations and identifies owners and timelines for each one. The GIRFT team will work with NHS England and NHS Improvement regional teams to support trusts in implementing the recommendations. These national actions and recommendations are in addition to more local actions, based on provider-level data analysis, that have already been shared after each PICU provider and PCC ODN deep dive visit. It is anticipated that the combination of an overarching national strategy and locally relevant feedback will provide PCC services, and those who manage and commission them, with a real opportunity to improve care, address variation and inequality, and improve efficiency.

Recommendations

For each recommendation and action we have listed who we see as the principal owners, those who will hold the key to bringing about change, and a proposed timescale for implementation of the recommendation. The list of owners of each action is not exhaustive and we recognise that there may be additional stakeholders who can, and will, play an important role in delivering change.

With respect to commissioning of services we recognise that the landscape is likely to change significantly over the coming months and years as the NHS moves towards commissioning the health and care needs of a local population, through integrated care systems (ICS). At the present time specialised PCC services remain the responsibility of NHS England and NHS Improvement regional specialised commissioning teams. We have assigned ownership based on current arrangements. Should commissioning arrangements change in the future, for example responsibility for PCC commissioning move from NHS England and NHS Improvement regional teams to ICS', it is imperative that there is an effective and full handover and those who acquire responsibility are clear about their responsibility to action and progress the relevant recommendations.

Configuration of paediatric critical care services

Recommendation	Actions	Owners	Timescale from date of publication
1. Develop and introduce a single early warning system for children across all hospitals in England.	**a** NHS England and NHS Improvement (NHSE/I) and RCPCH to complete development and piloting of a new national paediatric early warning system and introduce it across all hospitals, once validated.	NHSE/I, RCPCH.	Within 24 months
2. Ensure that specialist paediatric pathways are more closely aligned, so that a child with multiple comorbidities receives co-ordinated care in one tertiary hub whenever possible.	**a** Establish a Children's Strategic Forum (CSF) in each region, with NHS England and NHS Improvement commissioning team oversight. The CSF should include clinical representation from each paediatric ODN and other non-ODN specialist pathways, as well as representation from spoke and hub hospitals.	NHSE/I regional team, ODN.	Within 12 months
	b Identify a 'principal hub' link for each spoke hospital to foster development of closer collaborative working, and to ensure that a child requiring multiple PICU admissions is admitted to the same PICU and hospital wherever this is clinically appropriate.	ODN, CSF.	Within 12 months
3. Ensure that paediatric critical care provision across England is equitable and appropriate to local demand, so that every child requiring PCC can receive care as close to the family home as possible.	**a** Develop clear written criteria, to be used across all ODNs and transport services, to determine the appropriate destination PICU when a child requires urgent transfer from a spoke hospital into a hub PICU.	CRG, PCCS, ODN.	For immediate action
	b ODNs should monitor spoke to hub PICU transfers (both within ODN and out of ODN) to ensure that transfers comply with the principles of: i) admission to the 'principal hub' for that that spoke hospital and/or ii) admission to the closest PICU, whenever it is clinically appropriate.	ODN	For immediate action
	c Establish a group with national oversight (NOG) of PCC services across England. This group should be responsible for providing recommendations to NHS England and NHS Improvement regional teams and ODNs regarding: i) ODN configuration and potential reconfiguration – to ensure that spoke hospitals sit within the most appropriate ODN, ii) L3 bed distribution – to ensure capacity in each hub is appropriate to demand, including unmet demand, iii) L2 bed distribution across ODNs, within both hub and spoke hospitals. The group should bring together national and local stakeholder knowledge and include, as a minimum, representatives from Royal College of Paediatrics and Child Health (RCPCH), Paediatric Critical Care Society, PCC Clinical Reference Group, PICANet, NHS England and NHS Improvement Women's and Children's Programme of Care board, and the PCC ODNs.	NHSE/I, CRG, PCCS.	Within 12 months

Recommendation	Actions	Owners	Timescale from date of publication
3. (Continued)	**d** ODNs should notify their NHS England and NHS Improvement regional team, and the National Oversight Group (NOG), when lack of L3 capacity within a provider is considered to be a factor in reducing compliance with the principles of i) admission to the 'principal hub' linked to a spoke hospital and/or ii) admission to the closest PICU, where clinically appropriate.	ODN	Within 12 months
4. Increase the number of L2 beds across both hub and spoke hospitals, to reduce strain on L3 beds, improve efficiency, and improve value for money	**a** Every L3 provider should have a commissioning contract with their NHS England and NHS Improvement regional team that captures commissioning of both L2 and L3 beds.	NHSE/I regional teams, L3 provider.	Within 12 months
	b As a minimum one L2 bed should be commissioned in each hub for every two L3 beds. This should be considered a minimum and will need to be higher where data supports the need for additional L2 beds.	NHSE/I central and regional teams.	Within 12 months
	c Each ODN should have a number of spoke hospitals that are designated as L2 providers, with this service commissioned by NHS England and NHS Improvement regional teams. It is not possible to be specific with how many spoke hospitals in each ODN should be designated as L2 providers, but an indicative number of 3-4 hospitals is proposed based on evidence from successful networks (though this could be fewer in smaller ODNs). Each designated L2 provider should be commissioned for a minimum number of 4 beds (to deliver efficient staffing given nurse:patient ratio of 1:2 for L2 beds).	ODN, NHSE/I central and regional teams.	Within 24 months
	d Each ODN, through their PCC Network Board, should establish a clear plan and strategy for delivery of PCC across the ODN, at both hub and spoke level, including how this will be commissioned and funded.	NHSE/I regional teams, ODN.	Within 12 months
	e This plan should consider how to integrate existing CCG commissioning relating to HDU beds, and the future role of ICS' in commissioning acute paediatric services (including L1 PCC).	ODN, CCG/ICS, NHSE/I regional teams.	Within 12 months
5. Ensure that there is equitable distribution of 'core' resources across the ten PCC ODNs, which is sufficient for them to achieve the key performance indicators set out by NHS England and NHS Improvement in the PCC national review recommendations, and sufficient for them to deliver the recommendations contained in this review.	**a** NHS England and NHS Improvement to undertake a central review of what resources have been distributed in 2020/21, and what core network functions are being delivered with this resource in each ODN. Note should be taken of relative population size in each ODN, and the number of providers.	NHSE/I	For immediate action
	b NHS England and NHS Improvement to consider the paucity of resource available for PCC educators across the ODNs, which presents a significant barrier to improving delivery of PCC across spoke hospitals, and consider allocation of additional resource for this function.	NHSE/I	For immediate action
	c NHS England and NHS Improvement to review the additional recommendations contained in this review and consider allocation of additional resource to ODNs to ensure delivery of these recommendations.	NHSE/I	Within 12 months

Access, capacity and strain

Recommendation	Actions	Owners	Timescale from date of publication
6. Adopt approaches to flex the number of L3 beds that can be opened, to better align staffing with predictable flux in demand, and improve winter surge capability	**a** NHS England and NHS Improvement regional teams to encourage/drive a flexible approach to managing bed capacity over the year, by incorporating differential activity targets (beds or bed days) to match anticipated seasonal demands within contracts.	NHSE/I regional teams	Within 12 months
	b L3 providers to implement a system that targets the opening of fewer L3 (and L2) beds over summer months and increased beds over winter months, through innovative staffing solutions.	L3 provider	For immediate action
	c ODNs to ensure that this approach is introduced by their L3 providers, and is able to deliver additional L3 beds over winter months across the ODN	ODN, L3 provider.	Within 12 months
7. Ensure that monitoring is in place to identify a L3 unit that is under strain, so that a plan of remediation can be developed.	**a** ODNs and NHS England and NHS Improvement regional team should review regularly (at least quarterly) the demand versus capacity balance of each L3 provider in the ODN. The following should be included in this review process: i) Occupancy of the unit – average occupancy target <85% ii) Adverse consequences of unit strain: • Out of hours discharge (20.00 to 08.00) – target <10% • Cancelled elective surgery on the day due to a lack of a L3 bed – target <4% iii) Number, and proportion, of urgent referrals of children from ODN spoke hospitals, that cannot be accepted by the L3 ODN hub provider that is closest to the child and family home – target <5% of referrals (where L3 provider is clinically appropriate) iv) The unmet demand described in iii) should be incorporated into the review process, and any capacity modelling that is done.	ODN, NHSE/I regional teams.	For immediate action
	b Where these targets are not being met ODN and NHS England and NHS Improvement regional teams should work with the L3 provider to develop solutions. This may require commissioning of additional L3 activity if evidence suggests that existing L3 capacity is being used efficiently.	ODN, NHSE/I regional teams, L3 provider.	For immediate action
	c The ODN should notify the NOG where compliance with the above targets is not met.	ODN	Within 12 months
8. Make revisions to improve the reporting of 'refused' admissions	**a** Encourage the use of alternative terms (and the avoidance of 'refusal') for a situation in which a L3 provider is unable to accept a PICU referral as a result of a lack of L3 capacity at that time, to provide a more detailed understanding and audit of this patient group.	CRG, PCCS, and provider transport services.	For immediate action
	b Adaptation of the existing PICANet 'referral' dataset would provide the appropriate forum through which to capture and report this data.	PICANet	Within 12 months
	c Refusal (using current terminology) should not be confined to occurrences when a child is transferred out of ODN ('out of catchment'), but to the recording of every instance in which a child is not able to be transferred to the closest, clinically appropriate, L3 ODN hub.	CRG, PCCS, PICANet, and provider transport services.	Within 12 months
	d ODNs should ensure that every PCC transport service is capturing this data and is reporting the revised dataset to PICANet, and to other relevant PCC dashboards.	ODN, Transport service.	Within 24 months

Recommendation	Actions	Owners	Timescale from date of publication
9. Ensure clear, consistent reporting of bed occupancy metrics	**a** All bed occupancy metrics should be reported separately for L3 beds and L2 beds, in order to aid interpretation and benchmarking	NHSE/I, CRG, PCCS, PICANet.	For immediate action
	b Occupancy should be defined as: i) The number of occupied beds at midnight (occupied bed days) *divided* by the number of funded beds. ii) The number of funded beds should consider all funding sources and not be confined to NHS England and NHS Improvement regional team funding only.	NHSE/I, CRG, PCCS, PICANet.	For immediate action
	c Explore development of a national, real-time, electronic PCC critical care bed occupancy dashboard populated directly by hospital PAS/EPR systems	NHSE/I, NHSX.	Within 24 months

Pathways, flow and efficiency

Recommendation	Actions	Owners	Timescale from date of publication
10. Undertake research to develop a comorbidity index for children (research recommendation)	**a** National Institute for Health Research (NIHR) to consider commissioning research to develop a tool to identify children with important comorbidities, that can be used to improve coding, audit, and to improve mortality risk prediction in hospitalised children.	NIHR , PCCS SG, PICANet .	Within 24 months
11. Develop network clinical pathways, which clearly describe aspects of care that are to be delivered within each spoke hospital, and implement regular monitoring of spoke activity and spoke to hub PICU transfers.	**a** Develop written network pathways of care for at least the following, identifying aspects of care that should be delivered in spoke hospitals (L1, 2), and criteria for referral to L3: i) Care of a child with a tracheostomy ii) Care of a child on home non-invasive ventilation requiring admission to hospital iii) Care of a child on home invasive (tracheostomy) ventilation requiring admission to hospital iv) Care of an infant with bronchiolitis requiring acute continuous positive airway pressure (CPAP) v) Care of an older child requiring acute CPAP	ODN	For immediate action
	b ODNs should ensure that positive aspects of current delivery are maintained as much as possible, as long as evidence supports safe, quality care and outcomes.	ODN	For immediate action
	c Where necessary the ODN should approve local deviation, or derogation, from current L2 guidance and standards where L1 spokes are approved to deliver elements of care that are above current definitions of L1 care.	ODN	Within 12 months
	d ODN to monitor the frequency with which PCC elements of these and other pathways are being delivered within each spoke hospital, through regular collection and review of Paediatric Critical Care Minimum Dataset (PCCMDS) data.	ODN	Within 24 months
	e ODN to monitor the rate of spoke to PICU transfer across their providers, and aim to drive down the rate through implementation of improved pathways and enhanced PCC education to spoke hospitals.	ODN	Within 24 months

Recommendation	Actions	Owners	Timescale from date of publication
12. Ensure that L3 beds are used efficiently, with alternative pathways in place to minimise the use of L3 beds by patients who do not require L3 care.	**a** Level 3 providers should develop a PCC system that enhances step-up and step-down pathways beyond PICU, thereby reducing the proportion of L0/1/2 activity delivered in designated L3 beds.	L3 provider	For immediate action
	b Monitor bed day utilisation to ensure that use of L3 beds to deliver L0/1 care is kept to a minimum. Target: <10% of bed days in L3 beds should be L0/1.	L3 provider	For immediate action
	c Hospitals providing paediatric services should have a single 'hospital wide group' responsible for the co-ordination and development of care for critically ill children (Paediatric Critical Care Society (PCCS) Quality Standard).	L3 provider	For immediate action
	d Within L3 providers this group should be actively involved in ensuring that effective step-up and step-down pathways are in place to avoid L3 admission as much as possible.	L3 provider	For immediate action
	e L3 providers should monitor and report delays in critical care discharge of greater than 24 hours from the time when the patient is deemed fit for critical care discharge. Target: <5% of discharges.	L3 provider	For immediate action
	f Consideration should be given to adding this metric to the NHS England and NHS Improvement Speciality Services Quality Dashboard (SSQD), and to PICANet and other relevant dashboards.	NHSE/I, CRG, PICANet .	Within 12 months
13. Develop improved long-term ventilation (LTV) pathways, to deliver hospital care, when it is necessary, as close to the child and family home as possible.	**a** ODNs should develop a clear pathway for children on home ventilation who require hospital admission, aiming to deliver that care within an ODN spoke hospital close to the family home wherever possible.	ODN, L3 provider, and provider respiratory teams.	Within 12 months
	b Level 3 providers and ODNs should develop an improved pathway for children dependent on long-term ventilation that delivers care in a non-critical care environment unless the child is clinically unstable.	ODN, L3 provider, and provider respiratory teams.	Within 12 months
	c HRG data should be used to monitor whether care is being delivered in the right place. Indicative targets for patients recorded as receiving tracheostomy ventilation: L3 beds: <25% of related bed day activity should be L2 (XB06Z), <10% L1 (XB07Z). L2 beds: <20% L1. These targets are indicative and should be informed and modified by future data from the paediatric intensive care audit network (PICANet) using a best practice approach (target top quartile).	L3 provider, PICANet. PICANet	Within 12 months Within 12 months
	d PICANet should consider adding coding terms with which to identify this cohort of patients within PCC national audit, ensuring that tracheostomy ventilated and non-invasively ventilated patients can be identified separately.	PICANet	Within 12 months

Pathways, flow and efficiency

Recommendation	Actions	Owners	Timescale from date of publication
14. Implement strategies to improve early detection of patient deterioration and ensure timely paediatric critical care intervention	**a** All paediatric providers to implement the national paediatric early warning system when this becomes available.	All providers	Within 12 months
	b Every L3 provider should put in place a system of 24/7 critical care outreach.	L3 provider	Within 24 months
	c L3 providers should monitor rates of ward cardiac arrest, via data collated by the National Cardiac Arrest Audit (NCAA), and drive down the rate over time through improvements across the PCC pathway.	L3 provider	Within 24 months
15. Undertake work to enhance the reporting of PCC outcomes, and deliver improved metrics of unit performance	**a** Undertake work to explore further improvements in mortality risk prediction, recognising additional risk factors beyond existing paediatric index of mortality (PIM) variables.	PICANet, PCCS SG, NIHR.	Within 24 months
	b Develop models to allow presentation of risk adjusted outcome metrics, including length of ventilation and length of stay.	PICANet , PCCS SG.	Within 24 months
	c Deliver reporting that differentiates activity delivered through L3 beds and other (non-L3) beds, to improve the validity of L3 benchmarking comparisons.	PICANet, PCCS SG.	Within 12 months
16. Deliver near real-time reporting of a set of core quality metrics relevant to critical care	**a** Develop a unified, single dashboard and portal through which data can be viewed, bringing together the expertise of relevant partners including GIRFT, Model Hospital, PICANet, NHS England and NHS Improvement (SSQD), and NHSX. The dashboard should contain up to date data, integrate relevant and existing data sources without requiring duplicate data entry, export data from EPR systems wherever possible, and be interactive and flexible. The dashboard must be easily accessible to all clinical staff working in PCC.	GIRFT, NHSE/I, CRG, Model Hospital, PICANET, NHSX .	Within 24 months (Develop strategy within 12 months)
	b Ensure that key adverse events are captured in the dashboard, including: i) Rate of unplanned extubation, and requirement for reintubation after unplanned extubation. ii) Rate of central line associated bloodstream infection (CLABSI).		
	c Ensure that key outcome measures are captured including: i) Risk adjusted mortality. ii) Risk adjusted length of invasive ventilation (via endotracheal tube). iii) Risk adjusted PICU length of stay.		
	d Ensure that key performance and efficiency measures are captured including: i) Average L3 bed occupancy. ii) Rate of same day cancellation of elective surgery due to lack of a critical care bed. iii) Rate of delayed discharge >24hrs. iv) Rate of out of hours discharge (20.00 to 08.00). v) Use of L3 beds to deliver L0/1 care. vi) Use of L3 beds to deliver care to children requiring ventilation via a tracheostomy, including how often this care is L1, L2 and L3.		

Workforce

Recommendation	Actions	Owners	Timescale from date of publication
17. Ensure that clinical staff are available, in appropriate numbers and with relevant critical care expertise, and working to acceptable roster patterns.	**a** Ensure that reporting of PCC staffing levels is adjusted to take into account the complexity of care being delivered, and reported according to staffing guidance and standards. (Separate reporting of whole-time equivalent staffing pertaining to L3 beds is recommended.)	PCCS, L3 provider, PICANet.	For immediate action
	b Every L2 and L3 provider should have 24/7 access to a physiotherapist with paediatric respiratory competencies who is available to attend the bedside if required, and access to 24/7 advice from a pharmacist with knowledge of paediatric prescribing.	L3 provider, L2 provider, ODN.	Within 24 months
	c Consultants working in PICU should not be on duty for more than 25 consecutive hours.	L3 provider, PCCS.	Within 12 months
	d No consultant should be providing clinical cover to a critical care unit and to the transport service at the same time.	L3 provider	For immediate action
18. Ensure that clinical staff working with critically ill children have access to appropriate PCC education and training.	**a** Individual organisations and ODNs should have up to date knowledge of the number, and proportion, of their registered nursing staff that have completed an accredited high dependency course and are competent in delivery of L1 and L2 care.	All providers, ODN.	Within 12 months
	b It is recommended that >80% of registered nursing staff working in an HDU area should have completed a relevant HDU course.	ODN	Within 24 months
	c All paediatric trainees should complete a period of at least six months' training in PCC prior to becoming a consultant in acute paediatrics.	RCPCH, HEE.	Within 48 months
	d ODNs should develop a clear, written strategy for delivering L1/2 education across their ODN. i) They should evaluate the staff resource required to deliver the strategy, working closely with PCC educators within L3 hubs to review areas of potential overlap and potential for collaborative working. ii) There should be clarity regarding the elements of L1/2 education delivery that will be the responsibility of the ODN, and those for which responsibility will lie with individual providers within the ODN. iii) They should ensure that HDC education across the ODN is delivered via PCCS-Education (PCCS-E) group approved courses and providers and follows the PCCS-E standards for education in paediatric critical care level 1 and 2 specialist nursing.	ODN	Within 12 months
	e NHS England and NHS Improvement should consider the paucity of resource available for PCC educators across the ODNs, which present a significant barrier to improving delivery of PCC across spoke hospitals, and consider allocation of additional resource for this function.	NHSE/I	Within 12 months

Data capture and reporting

Recommendation	Actions	Owners	Timescale from date of publication
19. Improve the accuracy and completeness of PCC data capture and flow	**a** All providers should implement a full electronic patient report (EPR). This should include automated data capture from ventilators, monitoring and infusion devices, and electronic prescribing. Ensure digital connectivity standards are specified to allow capture and automated upload of PCC activity.	All providers	Within 36 months
	b Ensure that every paediatric provider has access to a digital solution, and necessary hardware, to support the routine capture of PCC activity (PCCMDS). Consideration should be given to whether PICANet can provide this solution.	NHSE/I, PICANet, HQIP.	Within 12 months
	c Ensure that PCCMDS is collected in all PCC areas of each organisation. (As a minimum data should be captured in all L2 and L3 beds.)	All providers	Within 12 months
	d Improve the accuracy of PCC activity data being submitted to the secondary users service (SUS), and to the national cost collection (NCC). i) Ensure that PCC activity data that leaves the organisation is sense checked by clinical, information and finance teams before submission. ii) Use PICANet data as the gold standard comparator for XB01Z to XB05Z healthcare resource group (HRG) data.	All providers	For immediate action
	e Expand the scope of PICANet to capture activity occurring in all L2 beds, in both hub and spoke hospitals. This will require additional funding. (In the longer-term consider further expansion to capture all PCC activity)	PICANet, HQIP.	Within 24 months
	f NHS E/I to consider using PICANet, rather than SUS, as the preferred data source for PCC activity. (Alternatively develop a solution that automates the flow of PICANet data into SUS.)	NHS E/I, PICANet.	Within 12 months
	g Consider a future model in which a single high quality data source is used for multiple purposes, including audit, commissioning, pricing and payment. (Consider PICANet as a potential source.)	NHSE/I, NHS Digital, PICANet.	Within 24 months

Commissioning and funding

Recommendation	Actions	Owners	Timescale from date of publication
20. Ensure that there is a consistent approach to commissioning of PCC services across ODNs.	**a** Establish a group with national oversight (PCC NOG) of PCC services across England. This group will be responsible for providing recommendations to NHS England and NHS Improvement regional teams and ODNs regarding: i) ODN configuration and potential reconfiguration – to ensure that spoke hospitals sit within the most appropriate ODN, ii) L3 bed distribution – to ensure capacity in each hub is appropriate to demand, including unmet demand, iii) L2 bed distribution across ODNs, within both hub and spoke hospitals.	NHSE/I, CRG, PCCS.	Within 12 months
	b Establish a clear and consistent approach to commissioning of PCC delivery across each ODN, with clarity over which aspects of PCC are the responsibility of CCGs, ICSs and NHS England and NHS Improvement regional teams.	NHSE/I	Within 12 months
	c Each ODN should have a limited number of spoke hospitals that are designated as L2 providers, with this service commissioned by NHS England and NHS Improvement regional teams.	ODN, NHSE/I central and regional teams.	Within 12 months
	d Each ODN should review the pathway for children on long-term ventilation and consider whether or not to designate additional spoke hospitals, over and above L2 and L3 designated providers, to support this pathway. Consideration should be given to using a model of L1+ beds in this situation.	ODN, provider respiratory teams, NHSE/I regional teams.	Within 24 months
21. Ensure that there is up to date guidance to support a consistent approach to commissioning of PCC services	**a** Review, and update accordingly, the existing PCC relevant service specifications. Ensure that recent guidance and recommendations from the PCC national review and updated PCCS Standards are appropriately captured, in particular the key roles of the PCC ODNs.	CRG, NHSE/I.	For immediate action
	b Adopt a standardised approach to commissioning of L2 and L3 beds, which incorporates the following principals: i) Always use the HRG definition of a bed day when describing activity (not occupied bed day [midnight occupancy]) ii) Establish a separate contract for L3 beds, to that for L2 beds iii) State the target number of bed days being commissioned iv) State explicitly the corresponding number of beds being commissioned to deliver this target • 2.9 L3 beds are commissioned for every 1,000 bed days of contracted activity • 2.6 L2 beds are commissioned for every 1,000 bed days of contracted activity v) Take patient complexity into account in contracting and when calculating funding	NHSE/I central and regional teams.	For immediate action
	c Introduce a standardised approach to payment for PCC services. i) Ensure that payment is adjusted for patient complexity (using PCC HRGs). ii) Take note of national PCC benchmark prices in agreeing local prices. iii) Consider whether a blended payment approach could be developed for future commissioning and payment, with a fixed and variable, HRG based, component to funding.	NHSE/I central and regional teams, NHS pricing team.	Within 24 months

Recommendation	Actions	Owners	Timescale from date of publication
21. (Continued)	**d** Change the label that is used for HRG XB09Z from 'enhanced care' to reduce potential confusion with L1 adult critical care. Consider using the term 'general care' as an alternative.	NHS Digital, Casemix HRG EWG.	Within 12 months
	i) Make recommendations about how XB09Z activity should be funded in future.	CRG, NHS pricing team, Casemix HRG EWG, NHSE/I.	Within 12 months

Litigation

Recommendation	Actions	Timescale from date of publication
22. Reduce litigation costs through application of the GIRFT programme's five-point plan.	**a** Clinicians and trust management to assess their benchmarked position compared with the national average when reviewing the estimated litigation cost per activity. Trusts should have received this information in the GIRFT 'Litigation data pack.'	For continual action
	b Clinicians and trust management to discuss with the legal department or claims handler the claims submitted to NHS Resolution included in the data set to confirm correct coding to that department. Inform NHS Resolution of any claims that are not coded correctly to the appropriate specialty via CNST.Helpline@resolution.nhs.uk	For continual action
	c Once claims have been verified clinicians and trust management to further review claims in detail including expert witness statements, panel firm reports and counsel advice as well as medical records to determine where patient care or documentation could be improved. If the legal department or claims handler needs additional assistance with this, each trusts panel firm should be able to provide support.	For continual action
	d Claims should be triangulated with learning themes from complaints, inquests and serious incidents (SI)/ patient safety incidents (PSI) and where a claim has not already been reviewed as SI/PSI we would recommend that this is carried out to ensure no opportunity for learning is missed. The findings from this learning should be shared with all front-line clinical staff in a structured format at departmental/directorate meetings (including multi-disciplinary team (MDT) meetings, morbidity and mortality meetings, and regional service meetings where appropriate).	For continual action
	e Where trusts are outside the top quartile of trusts for litigation costs per activity, GIRFT will be asking national clinical leads and regional hubs to follow up and support trusts in the steps taken to learn from claims. They will also be able to share examples of good practice where it would be of benefit to trusts.	For continual action

About paediatric critical care

General introduction

Paediatric critical care (PCC) services provide a care pathway for very sick children. This ranges from recognition and stabilisation of a sick or injured child on a general ward, to delivery of enhanced observation and monitoring in a high dependency unit (HDU), through to providing highly specialist care within a paediatric intensive care unit (PICU).

There are 153 hospitals across England that provide inpatient care for children, including elements of high dependency care (HDC), but only 23 hospitals can deliver intensive care for children. A networked approach to care of critically ill children is therefore essential, with additional specialised 'transport' or 'retrieval' services required to provide advice and assistance in the event of a child needing to be moved from a district general hospital (DGH) to a centre with a PICU. Colleagues in anaesthesia and critical care within the DGH play a vital role in assisting the paediatric team with the initial stabilisation of a critically ill child pending the arrival of the retrieval team.

Historical developments in paediatric critical care

The specialty of paediatric intensive care medicine did not exist prior to the 1990s. Reviews undertaken in the mid-1990s identified that care of critically ill children was fragmented, often being delivered in adult ICUs or paediatric wards, that paediatric units were understaffed, and these staff did not have sufficient specialist training, and that knowledge of numbers of children receiving care, and their outcomes, was poor. A study comparing the outcomes of children requiring PICU care in Australia and the UK in 1994-5 found that children were twice as likely to die in the UK, with around 450 excess deaths a year[1].

Paediatric intensive care – "a framework for the future"[2]

A review, commissioned by the NHS Executive, produced a policy framework[2] in 1997, key recommendations of which included:

- centralisation of PICU care into fewer centres;
- a hub and spoke model of PCC delivery with 'lead' centres and other hubs;
- establishment of transport services to move critically ill children from spokes to hubs;
- development of a set of minimum standards for PICU;
- formalisation of staffing and training requirements for PICU;
- development of a national audit of PICU;
- future work to develop high dependency care (HDC) for children.

In the years that followed, the care of critically ill children was radically improved. For the first time doctors were trained in Paediatric Intensive Care Medicine (PICM) in the UK, across a limited number of training approved units, with a training programme that was Royal College and General Medical Council approved. Specialist nurse training programmes evolved, a specialist society was born (Paediatric Intensive Care Society [PICS]) and a set of standards developed, hub PICUs were designated, regional transport services commissioned, and a national audit of PICU activity began in 2003 (Paediatric Intensive Care Audit Network [PICANet]).

A consequence of these changes was that the care of sick children became more centralised, and both activity and experience were lost from DGH centres. Paediatricians, anaesthetists, surgeons and paediatric nurses working in spoke sites reported concerns of clinical deskilling and vulnerability, and workload on tertiary centres increased.

This was compounded by slow progress in the development of high dependency care for children. A national review and recommendations regarding HDC[3], published in 2001, recommended clear criteria for how HDC could safely be delivered in both hub and spoke sites, but few of these recommendations were progressed over the next 15 years as the focus remained largely on PICU and transport services.

[1] *Pearson G., Shann F., Barry P. et al, 1997. Should paediatric intensive care be centralised? Trent versus Victoria. The Lancet Vol 349, Issue 9060; pp1213-1217.*

[2] *Paediatric Intensive Care – "A Framework for the Future" (NHS Executive, 1997)*

[3] *Department of Health, 2001. High dependency care for children, Department of Health, 2001.*

High dependency care – time to move on[4]

In 2014 the Royal College of Paediatrics and Child Health (RCPCH) published a document called 'High dependency care – time to move on', reflecting the need to improve HDC for children. The description of HDC services was remarkably similar to the description, almost 20 years earlier, of PICU services, with HDC delivered across multiple settings, poor knowledge of the number of children receiving HDC, or their outcomes, and poor specialist PCC relevant knowledge and skills across medical and nursing staff delivering HDC to children. Key recommendations included:

- establishment of formal PCC networks;
- a move towards describing a pathway of PCC from basic 'Level 1' (L1), intermediate 'Level 2' (L2) to advanced 'Level 3' (L3) critical care;
- identification of DGH 'Level 2' sites who can deliver L2 PCC, but with higher competency requirements for clinical staff;
- a broadening of transport arrangements to include L2 patients as well as L3 patients;
- data capture and audit of all PCC activity and outcomes.

National review of PCC (NHS England, 2016 – 2019)

Many of these recommendations were adopted by an NHS England and NHS Improvement sponsored national review of PCC[5], undertaken alongside a national review of surgery in children, which recommended a new 'model of care', with establishment of 10 Operational Delivery Networks (ODNs) across England. Each network is responsible for implementing systems of governance, education and training, and data capture, as well as rationalisation of clinical pathways to deliver safe, effective critical care, and surgery, as close to the child's family home as possible. The new model of care is expected to improve patient/family experience and to reduce demand on services within the tertiary L3 provider, specifically freeing up PICU capacity, through an increased number of L2 beds across designated L2 spokes within each ODN, as well as an increase in the number of L2 beds within L3 hubs.

Terminology and levels of care

PCC services can be divided into three levels according to the complexity of care they can provide, with L3 being the most complex (see **Table 1**).

L1 and L2 PCC refer to care that has historically been called high dependency care (HDC).

L1 PCC (also known as *basic critical care*) must be available in every hospital that admits children[6]. L1 PCC is the commissioning responsibility of local Clinical Commissioning Groups, who are responsible for the commissioning of non-specialised paediatric services.

L2 PCC (also known as *intermediate critical care*) represents a higher level of HDC that should be available within all hospitals with a PICU, and within a number of designated DGHs as part of networked delivery of PCC. Regional NHS England and NHS Improvement Specialised Commissioning teams are responsible for commissioning L2 PCC services.

L3 PCC (also known as paediatric intensive care or *advanced critical care*) is the most complex and can only be delivered in a PICU, which is staffed by doctors, nurses and allied health professionals with specialist PCC training. Regional NHS England and NHS Improvement Specialised Commissioning teams are responsible for commissioning L3 PCC services, and their associated transport services.

[4] *Royal College of Paediatrics and Child Health, 2014. High dependency care – time to move on.*

[5] *NHS England and Improvement November 2019. Paediatric critical care and surgery in children review. https://www.england.nhs.uk/wp-content/uploads/2019/11/paediatric-critical-care-and-surgery-in-children-review-summary-report-nov-2019.pdf*

[6] *Paediatric Intensive Care Society, 2015. Quality standards for the care of critically ill children.*

Table 1: Current classification and levels of paediatric critical care

Level	Classification	HRG	Terminology	Examples of care given
Level 3	Advanced critical care	XB01Z	PIC	Extracorporeal membrane oxygenation (ECMO)
	Advanced critical care	XB02Z	PIC	ICU care to a child with severe burns (>80% BSA)
	Advanced critical care	XB03Z	PIC	Mechanical ventilation **and** renal replacement therapy
	Advanced critical care	XB04Z	PIC	Mechanical ventilation **and** inotropic support, High frequency oscillatory ventilation
	Advanced critical care	XB05Z	PIC	Invasive mechanical ventilation
Level 2	Intermediate critical care	XB06Z	HDC (advanced)	Non-invasive mechanical ventilation, inotropic support
Level 1	Basic critical care	XB07Z	HDC (basic)	High flow oxygen therapy, severe acute asthma, diabetic ketoacidosis
Level 0		XB09Z	Ward care	Low flow oxygen therapy

HRG: healthcare resource group, PIC: paediatric intensive care, HDC: high dependency care, BSA: body surface area.

Over the coming years it is likely that the commissioning landscape of the NHS will change as greater emphasis is placed on commissioning to meet the health and care needs of a local population, through an Integrated Care System (ICS) approach, and CCGs cease to exist. The commissioning responsibilities for PCC services may alter as a result, so that, for example, some of the recommendations contained in this report which cite the NHS England and NHS Improvement regional specialised commissioning team as the owner may become the responsibility of ICS' in the future.

Paediatric critical care minimum dataset and healthcare resource groups

A dataset called the paediatric critical care minimum dataset (PCCMDS) and a system of healthcare resource groups (HRGs) is used to identify the complexity of care being delivered to a patient. PCCMDS consists of 36 intervention and diagnostic activity codes that are captured each calendar day. An algorithm or 'grouper' takes the PCCMDS information and maps the daily activity codes to one of seven PCC HRGs, ranging from XB01Z (the highest complexity) to XB07Z (the lowest complexity) (see APPENDIX 1).

PCCMDS and the seven PCC HRGs were initially developed as a currency to inform a future payment system for PCC services, with a detailed time in motion study across 10 PICUs establishing that the cost of delivering a day at XB01Z complexity is approximately five times the cost of delivering a day at XB07Z complexity.

Relationship between HRGs and levels of care

XB01Z to XB05Z are HRGs that describe L3 activity, XB06Z describes L 2 activity, and XB07Z describes L1 activity (see **Table 1**).

After the introduction of PCCMDS and HRGs it became apparent that some activity occurring within PICUs was not mapping to any of the HRGs as, in some patients, none of the 36 PCCMDS activity codes were being met. To identify and quantify these patients a new HRG, 'XB09Z', was added capturing 'ward level' care which is described as 'Level 0' (L0) care.

Potential confusion– level of care versus level of bed (or unit)

It is important to appreciate the difference between the level of care being delivered (activity) and the level, or designation, of the PCC bed or unit in which that activity is delivered. A L3 unit is able to deliver care at L 0, 1, 2 or 3, whilst a L2 unit is able to deliver care at L 0, 1 or 2. It is entirely appropriate that a proportion of *activity* delivered in a L3 *unit* will be below L3, given that children stepping down from L3 care will require a period of observation before they are considered fit for PICU discharge, and others may be admitted to PICU for close monitoring in case of further deterioration.

What is L2 care?

Every hospital admitting children must be able to deliver basic critical care (L1) to a child who needs it. This requirement can place a significant burden on paediatric staff, many of whom have had little or no specific PCC training. Paediatricians going through the RCPCH training programme all undertake training in neonatal intensive care but training in paediatric intensive care is not seen as essential. As a result, we found that only 50% of consultant paediatricians working in spoke hospitals have had any specific PCC training.

Interventions that map to L2 PCC are more complex than those that map to L1 care. Consequently, standards for delivery of L2 care place a higher training and competence requirement for staff, which, along with other requirements, mean that it is not feasible to deliver L2 care across all paediatric providers. PICS standards and the NHS England and NHS Improvement national review[7] recommendations support delivery of L2 care across a limited number of network providers, making it feasible to develop and maintain a critical mass of clinical expertise. Hospitals with higher volumes of inpatient activity are the most logical candidates for L2 designation.

Original thinking was that L2 spokes might be able to receive transfers from other spoke hospitals, thereby providing step-up care that would otherwise have required transfer to the L3 provider. This concept is no longer felt to be realistic as these children may deteriorate further, requiring a second transfer from L2 to L3 provider in up to 50% of cases.

The emphasis is now, therefore, that a L2 spoke hospital is able to keep a greater proportion of their own patients locally, reducing transfers into L3 hubs, and be able to accept step-down patients from the L3 hub in larger numbers and at an earlier stage than would be possible for other spoke hospitals.

The scope of L2 care is different in hubs and spokes

A number of PCCMDS interventions that map to L2 care are included to capture elements of specialist care that will only ever be undertaken in hub centres. Examples include acute renal replacement therapy, temporary cardiac pacing and intracranial pressure monitoring. Others are more generic and will potentially be relevant to both hub and spoke delivery of L2 care. Examples include delivery of acute CPAP, care of a child on home ventilation, fluid volume resuscitation and infusion of vasoactive drugs.

It is important to stress that the scope of L2 should be seen as flexible, with adaptation for a local situation, and that the scope can change over time. For example, an ODN may prefer a L2 spoke to stage their learning and development, building and consolidating competencies in one area before moving on to another. It is important that ODNs, working closely with NHS England and NHS Improvement commissioners, agree the scope of care with each L2 provider.

In addition, consideration should be given to the potential impact of L2 designation on other services, notably anaesthesia and 'adult' ICU colleagues who may have understandable anxieties about what will be expected of them. They may identify additional training needs beyond the paediatric components covered by their respective training curricula.

National audit – PICANet

PICANet was established in 2002 as a partnership between the universities of Leeds, Leicester and Sheffield, and the PCC clinical community. It is now funded by the Healthcare Quality Improvement Partnership (HQIP), and the devolved nations and Republic of Ireland, and captures detailed, high quality information from every PICU across the UK, as well as from some non-NHS providers and from PICUs in Dublin. An annual report summarises activity and outcomes for every PICU. Up until now the scope of PICANet has been restricted to L3 (PICU) provider hospitals, which limits our understanding of PCC activity in other hospitals.

[7] *https://www.england.nhs.uk/publication/paediatric-critical-care-and-surgery-in-children-review-summary-report/*

Across England, all L3 (PICU) activity is captured and reported but L2 activity is not universally reported. Currently, 12 PICUs submit a dataset to PICANet that combines data relating to both L2 and L3 bed activity i.e. combining HDU level data and PICU level data. The 12 remaining PICUs submit only L3 (PICU) activity even though they may have L2 beds commissioned within their hospital. This makes benchmarking of services challenging, and results in an incomplete picture of all PCC activity occurring within L3 provider hospitals.

What does national audit data tell us?

In 2018, 16,572 admissions were reported to PICANet by 21 L3 provider trusts (encompassing 24 PICUs and 23 hospital sites) across England, with 5,104 of these (30.8%) transferred in from another hospital. PCC admissions utilised 116,872 PCC bed days.

One third of admissions are planned admissions to PICU following surgery, whilst 55% of admissions are unplanned 'medical' cases.

Age profile

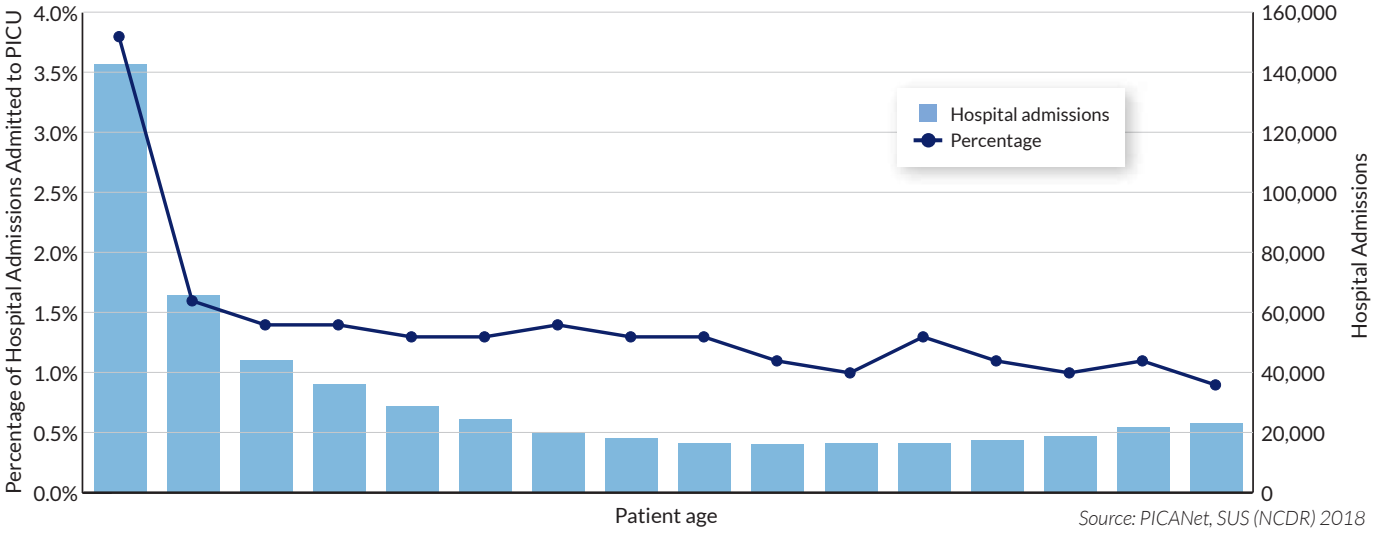
Infants in the first year of life are at highest risk of requiring hospital admission and at highest relative risk of requiring admission to a PICU (see **Figure 1**). Across the paediatric age range (0-16 years), 2.0% of hospital admissions have an associated PICU stay. In the first year of life this value is 3.8% and nearly half of all PICU admissions are under 1 year of age (43.5%).

Although alternative definitions of childhood are at times used within the NHS (0-18 years, or even 0-25 years if they include 'young people'), operationally most PICUs do not admit children once they have reached their 16th birthday. Only 2.8% of admissions to PICU are aged 16 or over and primary responsibility for the delivery of critical care to the16-18 year age group is reported to lie with the adult critical care network in 8/10 PCC ODNs, with only 2/10 reporting a shared responsibility between adult and paediatric critical care networks, and no network reporting sole responsibility for the PCC ODN. Transition of complex paediatric patients to adult services can, however, be challenging, in particular, the population of long-term ventilated children and other children with life-limiting conditions, as expectations of families and adult teams may not align.

COVID-19

During wave 1 and wave 2 of the pandemic a number of PICU beds, along with PICU clinical teams, were utilised to provide care for adults, to provide additional 'adult' ICU beds. This was possible as demand on PICU beds fell. Children rarely becoming severely ill with Covid, there was a marked reduction in elective paediatric surgery, and the guidance to stay at home, social distance and wear masks resulted in a marked fall in typical winter respiratory infections in children. The outcomes of adults looked after in PICUs have been comparable to those looked after within AICUs, a testament to close collaborative working between AICU and PICU teams and the ability of PICU clinical teams to adapt and to learn new skills.

Figure 1: PICU Admissions as a Proportion of Hospital Admissions by Age

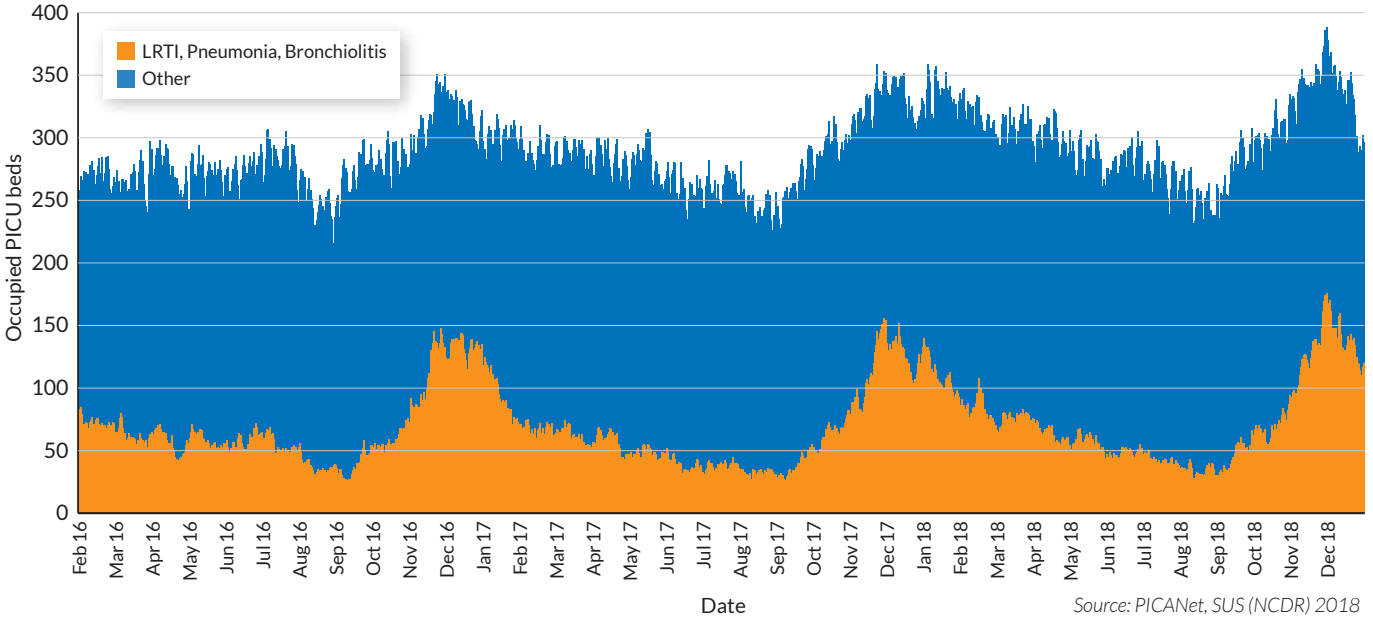


Source: PICANet, SUS (NCDR) 2018

Seasonal flux in demand

Demand and PICU utilisation increases every winter, and conversely decreases over summer months (see **Figure 2**). The cause of the winter 'surge' is largely respiratory infections in infants, with Respiratory Syncytial Virus (RSV), and other respiratory viruses, responsible for an annual surge in bronchiolitis admissions.

Figure 2: National PICU daily bed census (March 2016-December 2018), showing the proportion of beds occupied by children with an acute respiratory infection

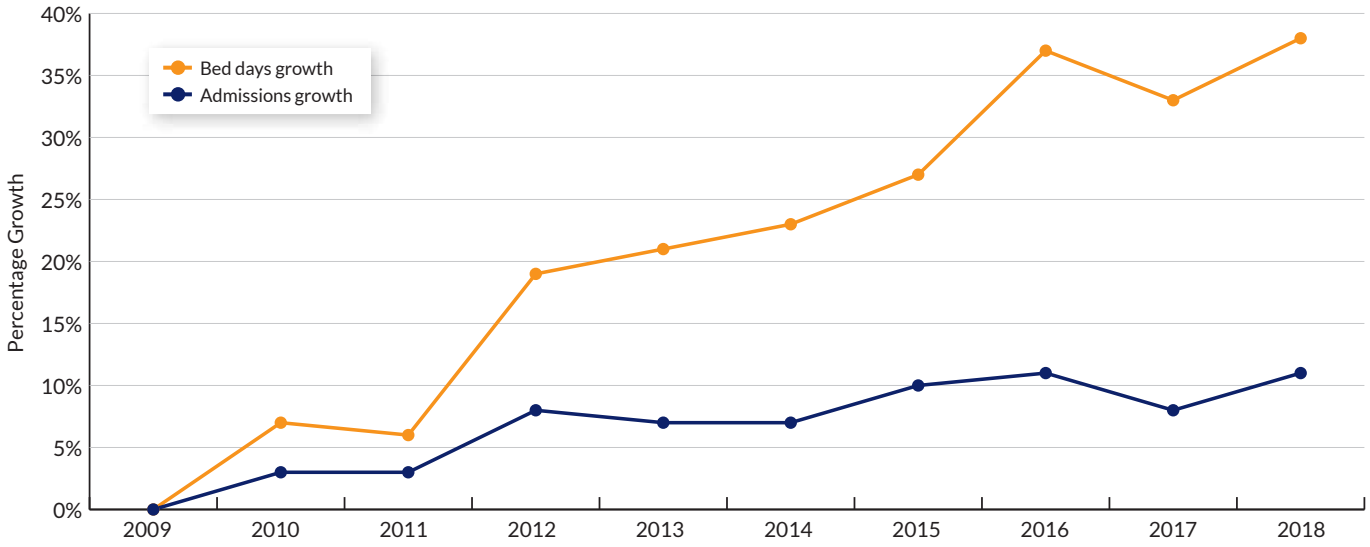


Source: PICANet, SUS (NCDR) 2018

Time trends

Over the past ten years there has been a significant increase in national PICU activity. It is notable that there has only been a slow increase in the numbers of children admitted to PICU, averaging a rate of ~1.5% a year, but a much greater increase in the number of PICU bed days utilised, by those patients, at closer to 5% a year (see **Figure 3**).

Figure 3: Growth in Bed Days and Admissions since 2009



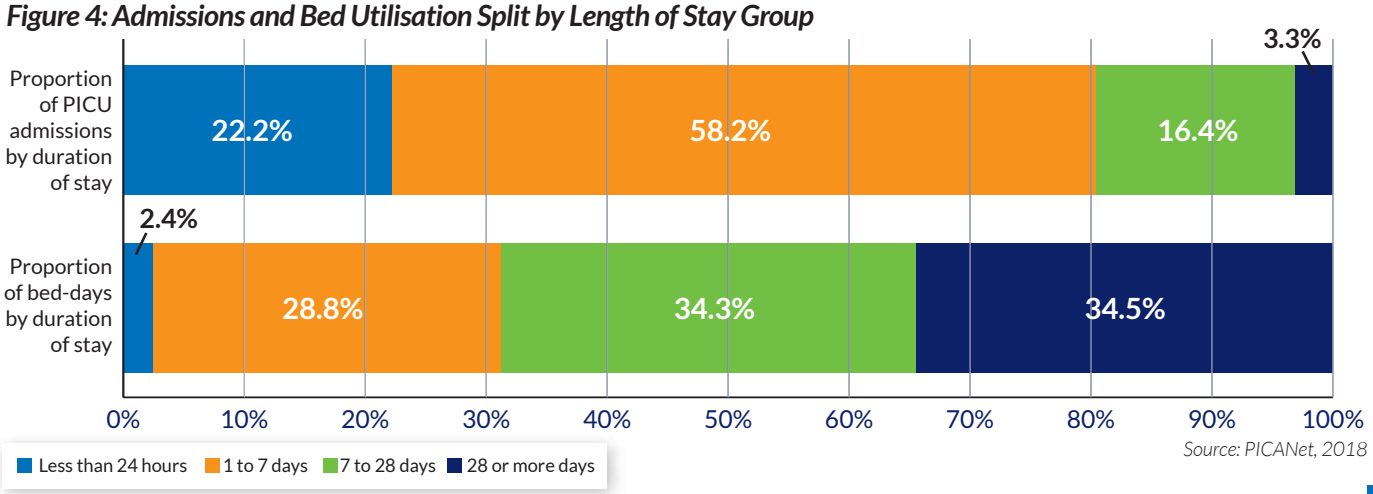
Source: PICANet Annual Reports 2009-2018

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Admissions	14366	14760	14827	15567	15377	15306	15862	15959	15474	16011
Bed Days	82596	88414	87286	98696	99803	101448	105302	113450	110026	113756

The discrepancy is explained by a progressive increase in the average length of stay in PICU from 5.7 days in 2009 to 7.1 days in 2018, which reflects an increasing population of children with complex needs who often have more prolonged stays in PICU.

Figure 4 shows that only 3.3% of admissions across England stay longer than 28 days in PICU but collectively 'consume' 34.5% of all bed days across England. Conversely 22.2% of admissions stay less than 24 hours but collectively consume only 2.4% of bed days.

Figure 4: Admissions and Bed Utilisation Split by Length of Stay Group



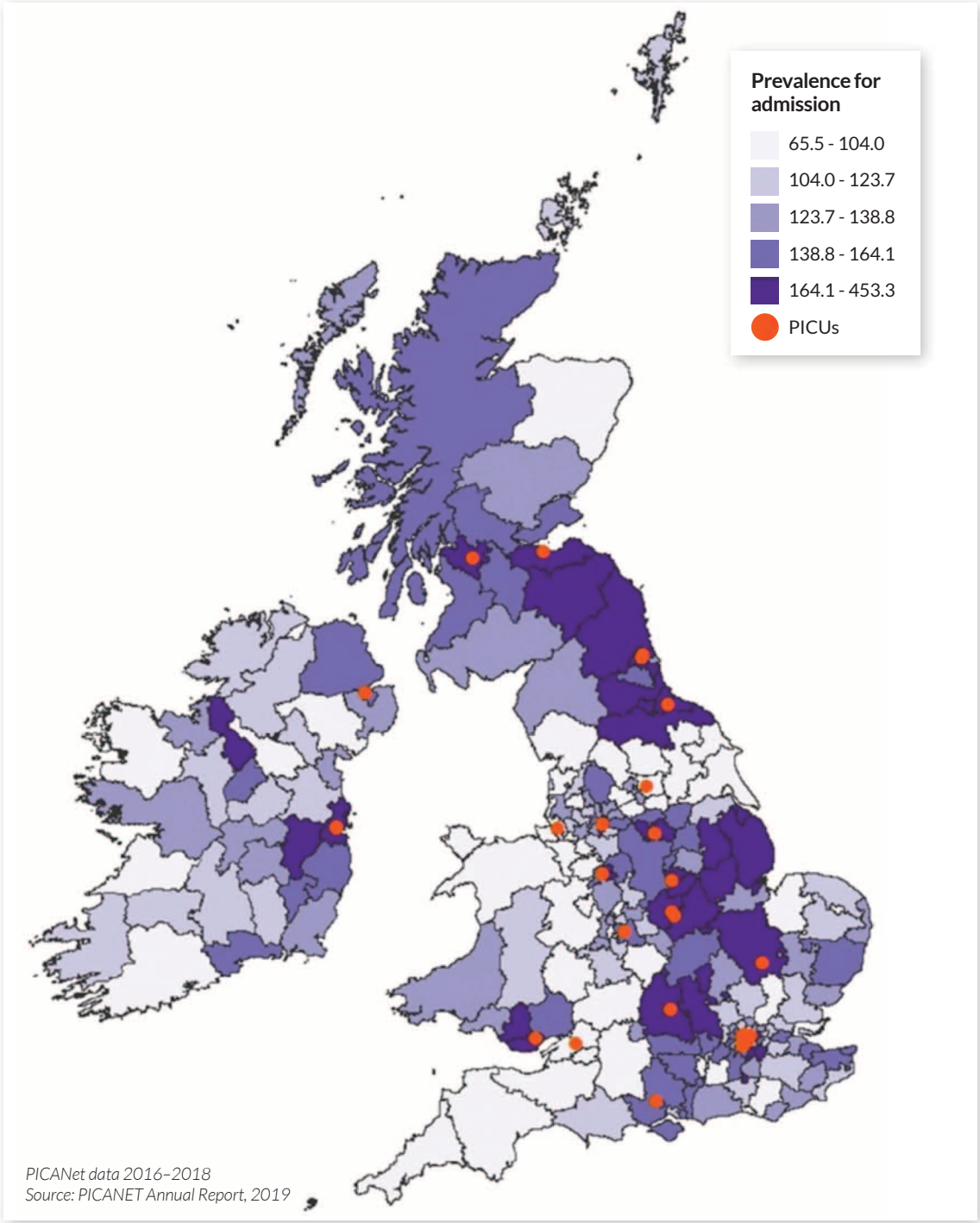
Source: PICANet, 2018

Geographical variation in prevalence of PICU admission

Across England approximately 150 children per 100,000 population are admitted to PICU each year but this rate varies widely from less than 100 to greater than 400 per 100,000 across different regions of England (PICANet; see **Figure 5**).

A number of factors will influence the frequency with which children in a local population are admitted to PICU, including deprivation, ethnicity, rate of significant comorbidities, and the quality of primary, secondary and tertiary care. However, the rate will also be influenced by other 'process' factors, such as whether admissions to HDU beds are captured in PICANet in one region but not another, and differences in the threshold for PCC admission that exist between different L3 providers.

Figure 5: Rate of PICU admission per 100,000 childhood population by healthcare area



PICANet data 2016–2018
Source: PICANET Annual Report, 2019

Deprivation

Children living in areas of greater deprivation are more likely to be admitted to hospital, including to PICU, and are at increased risk of dying in PICU[8]. Across England 46% of admissions to PICU come from the most deprived 30% of the population, but this proportion varies widely between different PICUs from 12% to 67%.

Children with complex medical needs and life limiting conditions

An inevitable consequence of advances in medical care and changing societal attitudes to the appropriate threshold for active intervention, is that greater numbers of children are surviving with increasingly complex medical needs. These children represent an increasing proportion of PICU admissions, and often have a longer length of stay in PICU. One study estimated that over half (57.6%) of children admitted to PICUs across the UK have a life limiting condition, with these children 75% more likely to die in PICU[9].

Increasingly there is divergence of opinion between the clinical team and the parents and family with respect to placing limits on what care should be delivered and for how long. This can create significant tension and potential conflict, which sometimes cannot be resolved without seeking legal opinion[10].

Patients with tracheostomy ventilation

An example of a complex patient group is children with a tracheostomy who are admitted to PICU and require mechanical ventilation. Some of these will be children who do not usually require ventilation, whilst others will be on a home long-term ventilation (LTV) pathway. As the recent National Confidential Enquiry into Patient Outcome and Death (NCEPOD) review highlighted[11] reliable identification of these patients using current coding options is problematic, but we are able to identify patients coded as ventilated through a tracheostomy using PCCMDS. This group represented 3.8% of all PICU admissions in 2018 (n=630 admissions) and consumed 9.6% of all bed days (n=11,220 bed days), equivalent to occupying 30.7 PICU beds each day across England.

[8] *Parslow RC, Tasker RC, Draper ES, et al.. Epidemiology of critically ill children in England and Wales: incidence, mortality, deprivation and ethnicity. Arch Dis Child 2009: 94: 210-215*

[9] *Fraser LK, Parslow R Children with life-limiting conditions in paediatric intensive care units: a national cohort, data linkage study.Arch Dis Child 2018: 103: 540-547. https://pubmed.ncbi.nlm.nih.gov/28705790/*

[10] *Linney M, Hain R, Wilkinson D. et al: Achieving consensus advice for paediatricians and other health professionals: on prevention, recognition and management of conflict in paediatric practice. Arch Dis Child 2019: 104: 413-416. https://adc.bmj.com/content/104/5/413*

[11] *NCEPOD, 2020. Balancing the Pressures, www.ncepod.org.uk/2020ltv/LTV_Full_Report.pdf*

What does a unit look like?

Paediatric critical care is an expensive service, with a high requirement for staff which represents approximately 80% of the total costs of delivering a service. Associated requirements for space attract capital charges, and drugs, equipment and disposables add to this.

There is no typical unit, even among similar hospitals. What has emerged is a series of local solutions to local needs. Just as all hospitals are different depending on the population they serve, the surgeries they provide and the specialties they cover, so every critical care unit will vary to some extent. Ten PICUs across England provide support to children undergoing cardiac surgery, and can also offer 'extra-corporeal life support' (ECLS - in which a heart and lung machine supports the body giving time for a patient's own organs to recover),15 are located within a major trauma centre for children, and a more limited number support services that are highly specialised and only undertaken in a few centres. Examples include liver services, with liver transplantation, airway surgery, and ventricular device support and heart transplantation.

Historical factors such as the amount of space already allocated to the critical care unit within a hospital (given the extremely high cost of building new units), and the extent to which HDC is provided will affect critical care provision.

While every unit is configured and works across its hospital in a slightly different way, the aim and ideal always is for critical care to enjoy and promote mutually supportive relationships across all the hospital specialties.

Workforce recruitment can be challenging, which has encouraged novel solutions such as the introduction of advanced critical care practitioners (ACCPs), who are being recruited and trained in part to help alleviate a shortage of medical trainees, and development of non-registered practitioner programmes for Health Care Assistants to provide bedside care working alongside PICU nurses. ACCPs working in PICU are predominantly from a PICU nursing background, and often known as advanced nurse practitioners (ANPs), though the role can also be undertaken, particularly in adult critical care, by those from physiotherapy and operating department assistant backgrounds.

There is a significant workforce shortage in nursing across England. Critical care nursing is stressful, which leads to high turnover and recruitment issues. Those working in critical care do not receive any salary uplift or other benefits to incentivise them to work in this high-stress environment. Therefore, ensuring nurses, and other members of the critical care team, feel valued and supported is crucial, and an increased emphasis is being placed on staff wellbeing programmes to tackle stress and burnout across all PICU staff groups. This must occur alongside robust, realistic workforce planning to ensure sufficient numbers of staff with the right level of skills, knowledge and experience. Education and career development opportunities are critical, but nurse educator posts are often lost when money is tight, paradoxically leading to higher costs later when bank and agency nurses must be employed.

Patient flow

Patient flow refers to the movement of patients in and out of the unit. At its simplest, it means that sufficient capacity should be available to ensure that patients can be admitted in a timely manner and they must be discharged from the critical care unit promptly when they are deemed ready for discharge, in order to make room for new patients.

Good patient flow is central to the provision of an efficient critical care service, but a critical care unit may have little control over this aspect of care, since the availability of ward beds is dependent on the efficient use of these beds by other clinical teams, and with bed managers who have to balance the competing demands of emergency admissions and elective surgery, and other elective admissions, across the hospital.

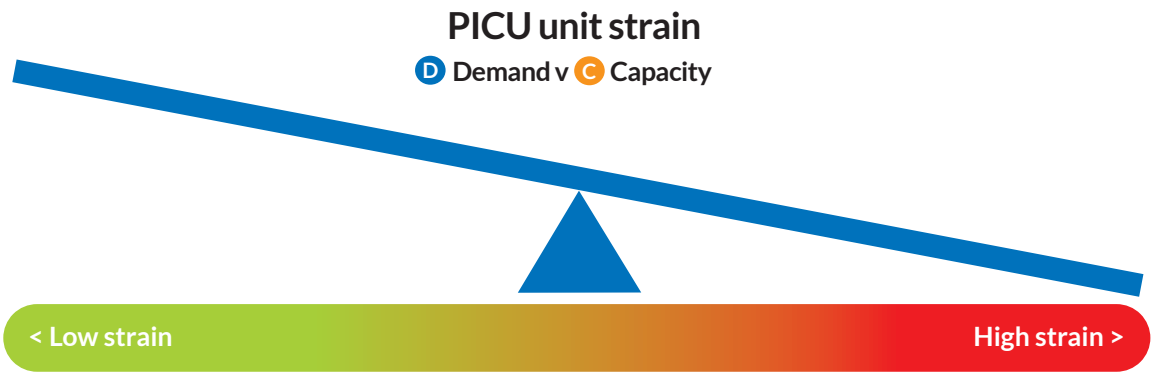
When flow is problematic it will increase PICU bed occupancy and can lead to cancelled surgery and refused emergency admissions. Additional metrics that can point to ineffective flow include delayed discharge, overnight discharge, and discharge direct from PICU to home. Poor patient flow can also affect decision-making around admissions, which involves balancing competing patient needs, often against a background of 'unit strain'.

Unit strain

Unit strain is a term that is increasingly being used to describe the tension or balance that exists between demand for admission to a critical care bed and the supply or availability of a staffed critical care bed. The latter is often referred to as capacity.

Figure 6 provides an overview of the many factors that will affect this balance, both 'demand' factors and 'capacity' factors.

Figure 6: Schematic to describe the concept of strain on PCC services, and contributory factors that affect demand on the service or the capacity of the service



Contributory factors to increased strain

D increased demand
C reduced capacity

D	More complex patients in hospital wards with a higher likelihood of requiring PICU admission
D	'Routine' use of PIC beds for low risk pathways (eg sleep studies, post-tonsillectomy, idiopathic scoliosis surgery)
D	Above average rate of transfer from spoke hospitals to hub PICU
D	Poor outreach support to hospital wards and teams
D	Poorly developed step-up HDU pathways beyond PICU
D	Limited hospital pathways for long-term ventilation patients
C	Insufficient commissioned Level 3 PICU beds
C	Staff factors (sickness, vacancies, turnover, staff seniority/competence)
D	Increased adverse events in PICU, prolonging length of stay
D	Insufficient commissioned Level 2 beds to facilitate step-down from PIC
C	Delayed discharge from PICU to wards or HDU

A UK study of adult critical care has demonstrated that unit strain is associated with increased mortality on acute wards[12].

The capacity of a unit can be described in terms of the number of funded beds, through NHS England and NHS Improvement and other sources, or in terms of available staffed beds. At times of high staff sickness, maternity leave, turnover and vacancies there may be a significant gap between the funded capacity and the available staffed capacity.

Calculated occupancy is widely used to provide a signal of unit strain however reporting and interpretation is often problematic, as different values will be reported if the number of available staffed beds is used as the denominator rather than the number of funded beds.

Reporting of staffed beds must take into account the complexity of patients in the unit at that time, as well as the nursing skill-mix on duty. The recommended nurse:patient nursing ratio for a L3 patient is 1:1, with an uplift if the patient is of high complexity or nursed in a cubicle, but it is 1:2, or potentially lower, for a L2 or L1 patient. Failure to account for this lower nursing requirement for HDC level patients will impact on accurate reporting of numbers of staffed beds.

Occupancy is typically reported at a point in time each day, with the unit bed census of patients occupying a bed at that time used. This is referred to as an occupied bed day (OBD) and a midnight census is often used as the time point of interest. This approach is used in NHS England and NHS Improvement paediatric critical care Directory of Services reporting and monthly critical care NHS England and NHS Improvement Sitrep reporting. This definition has the disadvantage that the work and resources associated with caring for a patient who was discharged shortly before the census time point is not captured.

Given that the majority of PICU admissions are unplanned /emergency it is difficult to accurately predict the number of PICU beds needed. A unit needs to be able to admit an unstable patient immediately and so a reserve needs to be built into bed numbers to allow this, creating unavoidable inefficiency which will be greater in relative terms for smaller units rather than larger units. Studies have shown that detrimental effects of high strain begin to emerge as average occupancy of a unit exceeds 85%.

What do PICUs see as their greatest challenges?

PICUs were invited to identify their top three challenges prior to their GIRFT deep-dive visits. A number of themes are identified in **Figure 7** below:

[12] *M. E. Wilcox, D. A. Harrison, A. Patel et al. (2020), Higher ICU capacity strain is associated with increased acute mortality in closed ICUs, Crit Care Med, May 48 (5): 709–716, https://pubmed.ncbi.nlm.nih.gov/32141924/*

Figure 7: Challenges identified by PICU providers through GIRFT questionnaires:

Workforce

Workforce concerns was the most frequently stated challenge, with specific discussion of recruitment and retention of intensive care nurses and doctors (middle-grade and consultant) in addition to advanced care practitioners, and HDU trained general paediatric consultants. The impact of workforce concerns was not only on delivery of patient care, but also on education and training of staff, staff well-being, and the ability to develop, lead, and sustain research and quality improvement.

Responses:

"We are in a constant battle of recruitment and retention of nursing and medical staff"

"Difficulty in recruiting PICU nurses with post-course qualifications therefore heavily reliant on internal educational programmes to meet Band 6 requirements"

"Rotas are very demanding and work life balance is compromised particularly for consultants who have to cover middle grade gaps"

"We worry that having no nursing or allied health professionals with extended roles working clinically within PICU or HDU reflects badly on our service on a national level"

"There are middle grade shortages throughout paediatrics"

Medically complex patients

A heterogeneous but distinct cohort of patients, with complex medical needs and/or technology dependence, was highlighted as an important but challenging group to care for within the PCC setting.

Responses:

"We are seeing an increased length of stay and challenges with transfer out of PICU to an appropriate care area either internally… or a centre closer to home."

"There are increased time demands across the multidisciplinary team to attend complex care meetings / discharge planning meetings which takes us away from the acute setting or occur in our own time."

"These long term patients are exposing a need for increased input from allied health professionals such as occupational therapy, play therapy and school teachers, in excess of our funded allocation."

"Chronic patient/LTV population are occupying more and more bed days, we need pathways for these patients to facilitate early PICU discharge and improve PICU bed access for acute patients."

Bed capacity

Bed capacity was stated as a challenge in relation to balancing competing demands, and the impact of seasonal variation.

Responses:

"Balancing bed capacity demands – the competing needs of highly specialised and emergency work against an elective work load."

"Higher acuity and patient volumes in winter"

"Capacity, especially in the winter months, and with reduced capacity secondary to COVID requirements"

Patient Flow

Various aspects of patient flow were described, in particular the challenge of step-down from PICU to HDU, wards and local hospitals. Some units expressed the additional challenges of COVID-19.

Responses:

"Patient throughput is compromised most commonly by inability to discharge to the wards. This was a problem pre-COVID, but is now compounded by the need for blue/green pathways across the hospital."

"Hindrance to "flow" out of PICU (e.g. delayed discharges due to lack of capacity "downstream" from PICU on general and specialist wards)"

"Step down from PICU, within and outside the hospital, including bed availability at DGHs and issues relating to delays in patient transport out of region. Lack of HDU within the hospital presents challenges with regards to step down"

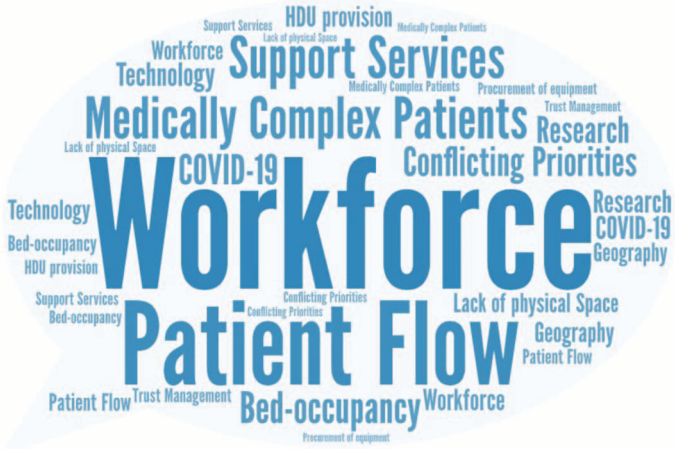
Co-located and support services

Responses highlighted difficulties in providing comprehensive care for complex patients due to paediatric specialist pathways and services often being provided in different hub sites, and limited commissioning of paediatric palliative care services.

Responses:

"Lack of comprehensive tertiary services on a single site…thus many complex children have care delivered across >1 tertiary site…"

"We have no access to in-house paediatric palliative care and rely on external charity funded paediatric palliative care support. The lack of palliative care impacts on our service"



About our analysis

The scope of the review

The scope of this review of paediatric critical care services in England was established by NHS England and NHS Improvement. Of note, paediatric critical care transport and ECMO services were not within scope as these had recently been reviewed as part of the NHS England and NHS Improvement PCC national review. The focus of our review is on PIC and HDC services for children, with an important emphasis placed on the new PCC ODNs and L2 PCC services for children.

Separate GIRFT workstreams have reviewed neonatal and adult critical care services.

The approach

Characteristics of a 'good' PIC (L3) service were used to develop a set of metrics to explore variation in practice and performance. A similar process was followed to define metrics for review of ODNs (Appendix 2).

We analysed clinical and non-clinical data from multiple sources concerning activity, quality, performance, efficiency, workforce, education and finance. We supplemented existing data with questionnaire data from each L3 provider, ODN team and spoke hospital.

A virtual deep-dive visit was undertaken to each L3 provider and each ODN, with a GIRFT datapack circulated ahead of the visit. Deep-dive ODN visits were open to all spoke hospitals across the network. After the visit each L3 provider and each ODN was provided with a summary presentation, findings and recommended actions.

Identifying paediatric critical care service providers

Providers of PIC (L3) care were identified through PICANet, a UK wide audit that captures all PIC (L3) providers and activity. 21 trusts were identified, with 24 distinct PICUs across 23 hospital sites. One of these providers, South Tees Hospitals NHS Foundation Trust (The James Cook University Hospital), commissioned as a L3 unit in 2018/19 and submitting data to PICANet in 2018, has since been designated as a L2 unit. For consistency it has been treated as a L3 provider, and hub hospital, throughout this report.

Ten PCC ODNs were identified through NHS England and NHS Improvement and a full list of spoke hospitals providing general paediatric in-patient care was populated with the help of the ODNs. Hospitals that only provide day case or clinical assessment unit functions, and those providing only specialist care, were not classified as spoke hospitals. A total of 128 hospitals were identified as paediatric spoke hospitals and were sent a questionnaire to gather information about local delivery of PCC. There were 108 spoke hospital questionnaires completed (84% response rate). Through the process of ODN deep-dive visits we became aware of a further two hospitals providing paediatric services, bringing the total number of spoke hospitals providing general paediatric in-patient care to 130.

Over the course of the GIRFT review set-up phase it became apparent that limited progress had been made since the PCC national review in the formal designation of spoke hospitals as providers of L2 care. For the purposes of the review L2 beds were considered to be those HDC beds commissioned by NHS England. CCG commissioned HDC beds were considered to be commissioned L1 beds, and any additional HDC beds declared by spoke hospitals were considered to be L1 beds without explicit commissioning.

Data Sources

The primary sources of data presented in this report are:

- PICANet
- Secondary User Services (SUS), taken from the National Commissioning Data Repository (NCDR)
- National Cardiac Arrest Database (NCAA)
- Infection in Critical Care Quality Improvement Programme (ICCQIP)
- NHS England and NHS Improvement quality metrics including PCC Quality Dashboard
- NHSI Single Oversight Framework, Final Accounts and Reference Costs
- NHSI Resolutions Litigation Data

Caveats of the analysis of L3 providers

Twelve of the 24 PICUs return activity to PICANet relating to both PIC (L3) and HDC (L2) beds (in a single data stream) whilst the remaining 12 return activity that relates only to PIC (L3) beds. For certain metrics this will have a potential impact on the findings.

Similarly casemix may impact on findings. The paediatric subspecialties represented within the hospital, the proportion of admissions that are transferred into PICU from another hospital, and whether the hospital has a paediatric emergency department, will have potential impact. In developing the GIRFT metrics we opted not to attempt to sub-group providers but rather to consider these factors when discussing metrics at deep-dive visits.

In many trusts paediatric critical care services exist alongside adult critical care services, preventing us from presenting unique PCC findings for a limited number of metrics, for example CQC inspection ratings for critical care which are currently based solely on adult services, if these exist within an organisation.

During the pilot phase of the project it became apparent that consistent, robust data regarding levels of allied health professional (AHP) staffing was challenging for providers to provide as models of staffing vary considerably and many providers were unable to separate out PICU provision from more general staffing across paediatrics. PICANet undertake a detailed annual PICU staffing survey, which includes AHP staffing, and is a valuable resource for more detailed staffing data.

How the data has been used to set targets

In this report the GIRFT data has been used to propose a number of future targets. These are based on the performance achieved by the top performing 25% of units/providers for each metric.

Configuration of paediatric critical care services

Paediatric pathways

The majority of hospital paediatric care is delivered by general paediatricians working across 153 hospitals with inpatient beds, as well as a further 15 hospitals that deliver daytime paediatric care through children's assessment units (CAUs) and day surgery units. However, a number or children will require additional care from a paediatrician trained in a sub-specialty of paediatrics.

The model is generally a hub and spoke model, with specialist input delivered through a tertiary paediatric 'hub' centre alongside ongoing care and support delivered more locally in a spoke hospital. Historically, development of a specialist pathway has often occurred without sufficient consideration of other specialist pathways, resulting in a lack of alignment. In addition, some specialist paediatric services are delivered in stand-alone hospitals. Examples of stand-alone paediatric services exist across England for cardiac surgery, orthopaedic surgery and oncology/bone marrow transplantation.

The end result has been poorly co-ordinated, misaligned pathways of care in some parts of England. We heard examples of fragmented paediatric care where one child with a number of complex comorbidities could be under the care of four different tertiary hospitals. This was most likely in and around London, including the South East and East of England, where specialist paediatric pathways appear to be particularly poorly aligned.

The PCC national review team highlighted the need to establish an overarching Children's Strategic Forum in each region to ensure that recommendations and developments across different paediatric ODNs and other specialist paediatric pathways result in joined-up, closely aligned services. Achieving this would enable systems to foster more consistent hub and spoke relationships, improve collaborative clinical care, and improve the patient and family experience. This need is amplified by the fact that ODN configuration and boundaries are not always aligned between different paediatric specialist ODNs.

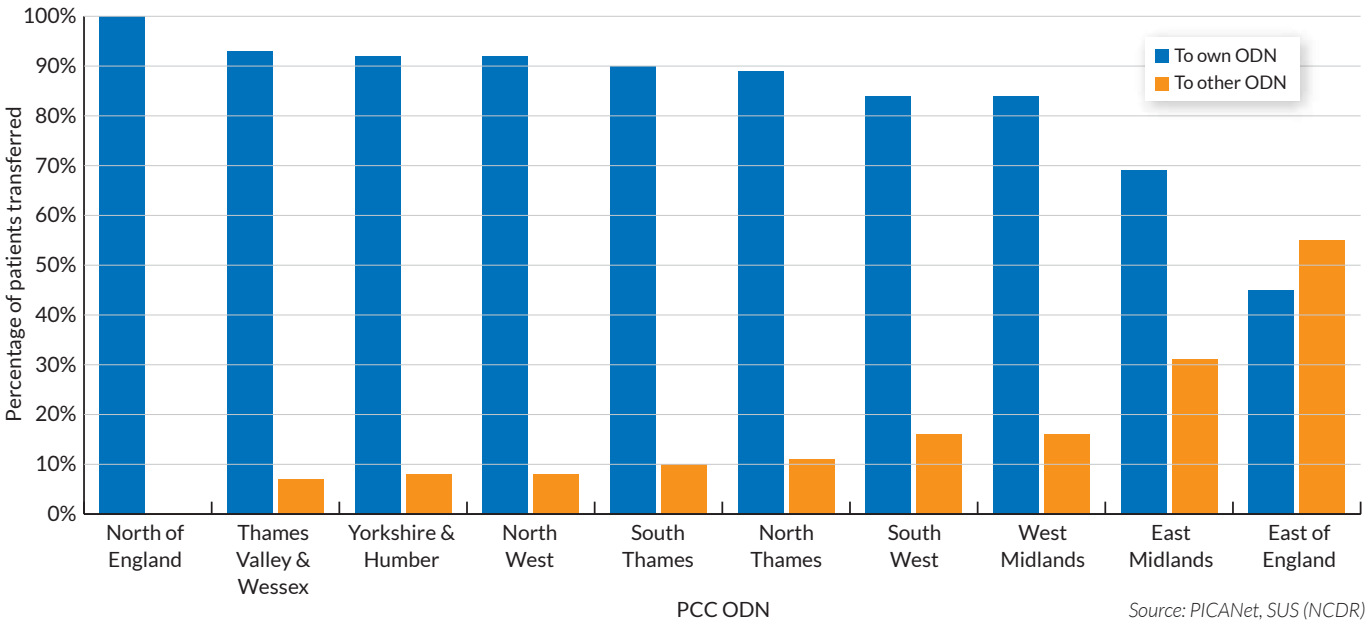
Only 20% of regional teams across England have implemented this recommendation to date.

Paediatric critical care pathways

'Out of ODN' flows

Across England the majority of children who require emergency transfer to PICU from a spoke hospital are transferred into a hub PICU within the same ODN. In 8 of 10 ODNs this is the case for greater than 80% of transfers (see **Figure 8**).

Figure 8: Proportion of spoke to hub PICU transfers that stay within ODN and those that are transferred to a PICU outside the ODN



Source: PICANet, SUS (NCDR)

East of England (EofE) ODN is an exception, with more than 50% of children being transferred out of the ODN, most commonly into a PICU within the North Thames ODN. This is not explained by a lack of available capacity in the EofE hub PICU in Cambridge, but contributory factors include geographical considerations, a lack of a PCC transport service within EofE ODN, and a requirement for cardiac patients to be transferred out of ODN to a cardiac provider.

The footprint of the EofE ODN extends from the north Norfolk coast in the north to Southend-on-Sea in the south. There are spoke hospitals in the south part of the ODN that are geographically much closer to hubs within North Thames than they are to Cambridge. In addition, retrieval of a critically ill child admitted to a spoke hospital within EofE is undertaken by the North Thames transport service. Logistically it is a more efficient use of a limited resource to move a child from Watford or Southend-on-Sea into a PICU within North Thames than to ask the transport team to take the child to Cambridge before returning to London. The end result is that children admitted to hospitals within the south part of EofE ODN are much more likely to be admitted to a PICU outside of their designated ODN.

A risk of out of ODN flow is that it can threaten the viability of a hub PICU, which is particularly problematic where this is the only PICU within an ODN which covers a wide geographical area. Work is ongoing to establish a PCC transport service for EofE and to ensure that, where feasible and clinically appropriate, patients from spoke hospitals in EofE are admitted to Cambridge PICU.

A limited number of spoke hospitals belong to more than one ODN, though officially they are designated to only one ODN. This usually reflects the location of a spoke hospital towards the border of one ODN but equidistant, or sometimes closer, to a hub in a neighbouring ODN. Longstanding specialist pathway links to a tertiary hub within another ODN may also contribute. From a governance perspective it is recommended that each spoke hospital belong to only one ODN, so that lines of accountability are clear. This will also assist in improving alignment of clinical paediatric pathways over the coming years.

Delivery of this objective may require a review of current ODN boundaries and configuration, with some spoke hospitals 'moved' into another PCC ODN. Current configuration of the PCC ODNs should not be seen as set in stone and should be adapted as required. To avoid potential conflict and territorial behaviour it is suggested that decision-making of this nature be overseen by a PCC 'national oversight group', with responsibility for configuration of PCC services across England. Throughout this process the governing principles should be to keep the child and family at the centre of proposals, and to deliver improved alignment across paediatric specialist pathways.

'Within ODN' flows

Within ODNs with more than one hub PICU there is inconsistency in PCC hub-spoke pathways which is not explained by clinical factors. Children from one spoke hospital can be transferred to up to four different hub PICUs. This does not help to foster a close collaborative working relationship between a spoke hospital and any particular hub, and it is not a positive experience for the family of a child with complex medical needs who may experience multiple admissions to different PICUs and hospitals.

It is not conceivable that children from one spoke hospital will always be admitted to the same hub PICU, as specialist clinical pathways will always take priority and capacity constraints may intervene, but identification of a 'principal PICU' link for each spoke hospital is recommended as a means of keeping the child and family as close to home as possible, and developing closer collaborative working between hub and spoke hospital.

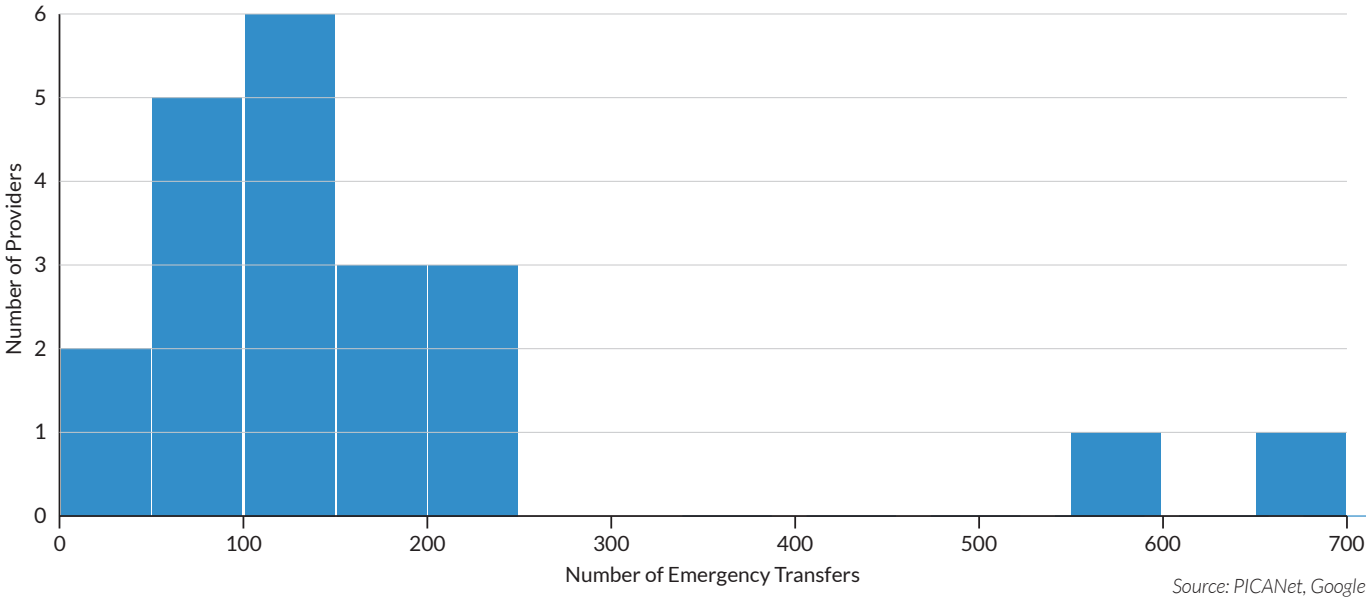
Appropriate destination PICU –geographical considerations

Within the GIRFT review an analysis was undertaken using the home post code of each child to establish the closest PICU to the family home, using Google drive time to establish the shortest drive time.

We recognise that this analysis has limitations as many children will be transferred to PICU from a spoke hospital, which may have different travel time implications. The analysis does not factor in the child's primary condition, or comorbidities, specialist pathways, or specialist services available in each hub site. In addition, the analysis does not take into account existing ODN boundaries and pathways. In some cases the difference in travel times may be quite small, particularly in areas with a number of closely located PICUs, for example around London. Nonetheless, we anticipate that the data will be useful to PCC ODNs and contribute as they try to better understand patient flows within their networks.

Across England only 63% of children are admitted to their closest PICU. PICUs vary in the proportion of their total emergency PICU admissions that live closest to their PICU, from 15 to 97%. The number of children admitted to each PICU that actually live closer to a different PICU varied from 10 to 693 in 2018. Two hospitals exceeded 500 such cases in 2018, and notably, both of these host the transport service for their respective ODN (see **Figure 9**).

Figure 9: Number of emergency transfers to each provider where the admitting hospital is not the closest L3 hospital to the family home (Google drive time)



Source: PICANet, Google

Conversely the number of children who live closest to each PICU but were admitted to another PICU ranged from 11 to 880 in 2018. It was clear from the data that a number of the cases bypassing a closer PICU were not explained by clinical or network pathways, or by capacity constraints within the closer provider. This situation was more evident from data relating to PICUs within London than to other parts of England and was raised as a significant concern by a number of PICUs around London.

There is a need for ODNs and transport services, which have a central role in identification of the appropriate destination unit for each child being retrieved, to produce consistent, equitable policies that define the criteria to be used in determining destination PICU. Clearly, priority should always be given to specialist clinical pathways relevant to the child's acute clinical problem(s), to any pre-existing relationship between a child and a hub hospital, and to the co-located specialist services available at each hub. Beyond these clinical factors, the 'principal PICU' for that spoke hospital, and geographical proximity for the family should be included in the decision-making.

A set of principles should be developed that can be applied across all ODNs and transport services to ensure that children are admitted to the closest, clinically appropriate PICU.

Impact of limited capacity on destination PICU

Capacity constraints can also contribute to children being transferred to a PICU that is not closest to the family home. For example, in 2018, 242 children were admitted to another PICU for non-clinical reasons when Birmingham PICU was closest to the family home. In many instances children from Birmingham, Coventry and surrounding areas were admitted to Stoke, more than 50 miles away. The Birmingham PICU runs at very high occupancy, and has the highest rate of on-the-day cancellation of elective surgery due to lack of availability of a PICU bed across England. This has led to a planned 'redirection policy' so that a child not requiring specialist input is transferred to Stoke PICU without an approach being made to admit the child to Birmingham PICU.

Whilst these transfers are to a hub PICU within the West Midlands ODN, and would therefore not be classified as out of ODN transfers, they do not comply with the recommendation of the PCC national review to deliver PCC as close to the family home as possible, and constitute a patient and family experience that is far from optimal.

ODNs, working closely with their regional transport services, should monitor internal ODN spoke to hub PICU transfers, as well as out of ODN transfers, to ensure that appropriate destination rules are in operation and being followed. Where PICU capacity constraints prevent children and families from being admitted to the closest clinically appropriate PICU, the network should work with the NHS England and NHS Improvement specialised commissioning team to develop a solution that delivers sufficient PCC capacity to meet this demand.

Paediatric critical care networks

The hub and spoke model of PCC delivery established in the late 1990s following 'Framework for the Future' led to the setting up of informal clinical networks in some regions of England. However, without explicit funding and governance requirements their development was ad hoc. In one or two regions highly effective clinical networks were developed, most notably the South West, whilst in other regions networks were not developed at all.

The 2019 NHS England and NHS Improvement national review of PCC mandated the establishment of formal PCC Operational Delivery Networks across England, along with ODNs for surgery in children, to work closely with the existing neonatal ODNs and other paediatric networks (cardiac, neurosciences, oncology, trauma). Funding responsibility for the PCC ODNs lies with NHS England and NHS Improvement specialised commissioning regional teams.

Two ODNs were identified as pilot ODN sites and were established in 2018/19. All PCC ODNs were expected to be established by the end of 2019/20 but delays in agreeing funding and signing off contracts resulted in only 5 of 10 ODNs being designated, with their core team employed, by March 2020.

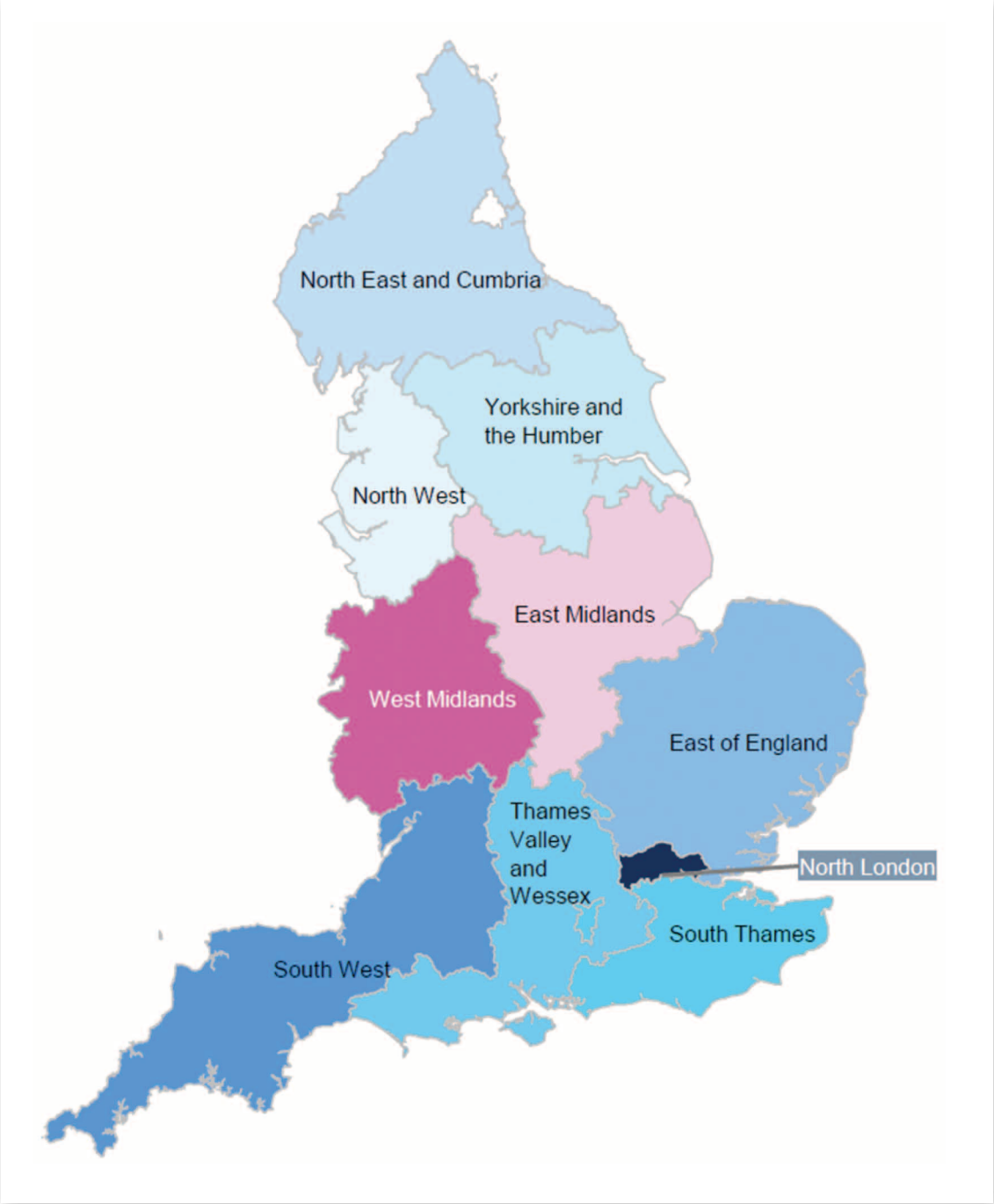
Usual GIRFT methodology would involve benchmarking of units, in this case ODNs, against each other. However, given the fact that the ODNs were at very different stages of development, with some not yet fully established, it was felt that this approach would not be appropriate or helpful. It was clear from discussions with ODN teams that a review process that enhanced their knowledge and understanding of PCC capability and activity across their spoke hospitals through transparent sharing of data would be of great value, and help to accelerate their development over the following 12 months.

In addition, we were able to aggregate responses from spoke hospital GIRFT questionnaires to provide a network level view of the data, allowing ODNs to compare their current position against other ODNs and signposting more advanced networks which may be able to share information and examples of best practice.

Overview of ODN configuration

Ten PCC ODNs have now been established across England (see **Figure 10**). These ten networks map to seven English NHS regions and regional teams (see **Table 2**), though in some cases one ODN may have spoke hospitals in more than one NHS England and NHS Improvement region. One of the ODNs, North West and North Wales, includes some hospitals in North Wales and another ODN, South West, delivers a PCC transport service in partnership with Cardiff PICU and shares some specialist activity with South Wales hospitals.

Figure 10: Map of the ten PCC ODNs across England (taken from National review document)[13]



Note that North East and North Cumbria ODN should include the area around Newcastle upon Tyne (shown in white on the map)

[13] *NHS England and NHS Improvement, 2019 Paediatric critical care and surgery in children review. Summary report. https://www.england.nhs.uk/publication/paediatric-critical-care-and-surgery-in-children-review-summary-report/*

As well as variation in geographical coverage, the ODNs vary in the number of PICU providers and spoke hospitals within each ODN, and the associated inpatient paediatric activity in spoke hospitals (see **Table 2**).

Table 2: ODNs, host NHS England and NHS Improvement regions and the number of hub and spoke providers in each ODN

Name of ODN	Host NHS England and NHS Improvement region	Number of PICU providers	Number of spoke hospitals	Annual paediatric admissions to spoke hospitals
East of England	East of England	1	16	33,300
East Midlands	Midlands	2	6	16,400
North of England	North East and Yorkshire	2	7	15,600
North Thames	London	4	14	34,600
North West	North West	2	19	53,500
South Thames	London	3	17	41,200
South West	South West	1	10	26,200
Thames Valley & Wessex	South East	2	15	35,600
Yorkshire & Humber	North East and Yorkshire	2	15	33,600
West Midlands	Midlands	2	11	32,400

Note: North East and North Cumbria PCC ODN is referred to as 'North of England' and North West and North Wales PCC ODN is referred to as 'North West' in this and subsequent figures and tables.

ODN development

Through questionnaires completed by spoke hospitals the GIRFT review identified that communication from the ODNs has been very good, and that good progress has been made over the past 12 months.

A summary was presented to each ODN of the key challenges described by spoke hospitals relating to delivery of PCC. Dominant themes from the responses were:

- collection and flow of PCCMDS (HDU) activity (data);
- need for more PCC education and training;
- workforce – insufficient to open HDU beds, vacancies, maintenance of competencies;
- commissioning and funding of HDU beds.

A summary was also presented of priority areas for the ODN over the next 1 year and next 5 years, as described by their spoke hospitals. Dominant themes for ODN priorities were to:

- establish a clear configuration of PCC services across the ODN;
- ensure there is sufficient L3 capacity to cope with winter surge in demand;
- designate L2 providers within the ODN;
- work with NHS England and NHS Improvement to align commissioning with PCC beds across the ODN;
- deliver more L2 care and care for LTV patients within spoke hospitals;
- deliver an education programme and resources for both L1 and L2 PCC;
- expand the scope of transport service to include HDU level patients;
- provide a single system for PCCMDS (HDU) data capture and flow;
- develop guidelines and policies to improve consistency of care across the ODN.

ODN challenges

Network core teams were invited to identify their top three challenges prior to their deep-dive visits. The responses have been analysed and emerging themes are shown below:

Figure 11: Theme areas of 'challenge' identified through network questionnaires

Data

The most cited challenge was that of data, both in terms of collection and quality. Collection of activity data and staffing data were cited, with lack of standardisation across the network.

Responses:

"We have no system to gather data on activity delivered in our units"

"It is challenging to get an accurate picture of the exact specialist skill mix of PICU staff which impacts on staffed bed ratio and service delivery."

"Trusts often use different systems and responsibility for collating or inputting data varies"

Education and Training

Networks face challenges in delivering education and training, in reaching frontline staff, where it can be difficult to be released from clinical duties. COVID-19 brought further challenges with limited face to face training, such as simulation. Limited provision of PCC Level 1 and 2 nursing education and educators was also highlighted.

Responses:

""Delivering education and training equitably to all, the new challenges of COVID-19 meaning face to face training such as simulation days have been reduced."

"Practice educators - able to access voluntary support from existing services but have been unable to develop consistent education throughout the region."

Funding/ commissioning, transformational change, and ODNs

Networks highlighted the challenge of funding and commissioning, the need for regular and consistent investment to develop networks, and for transparency about what funding has been allocated and should therefore be made available by host trusts. Engagement and collaboration across different specialty ODNs and commissioning footprints were stated as a challenge in planning and implementing transformational change.

Responses:

"The need for regular consistent funding to ensure longevity and development of the network."

"Transparency of funding being released from NHSE to host trusts"

"Linking effectively across different footprints (e.g CCG, STP, local trust, commissioning) to engage in transformational change"

"There is a real lack of understanding across the network about what levels 1, 2 and 3 constitute, and what activity is commissioned by NHS E / CCGs."

Network processes

As well as slow establishment of a core team in some networks, overall progress was found to be relatively slow in establishing core structures and processes, governance and education. Similarly, ODS had only begun to develop a knowledge and understanding of current PCC provision and capabilities across spoke hospitals in each network.

Only six of ten ODNs had a PCC Network Board in operation, with only three of these having an independent Chair. Representation on many of the boards was quite narrow, with, for example, only two having both NHS England and NHS Improvement and CCG/STP/ICS representation. Only half of ODNs reported having a written policy for handling governance issues across the ODN.

Funding of ODNs

The level of funding allocated to PCC ODNs has been very variable from less than £100k to greater than £500k. Less than £2m in total has been allocated to PCC ODNs to this point. This has limited what core functions ODNs have been able to staff and deliver, even if resources are shared with other paediatric or neonatal ODNs. It has almost certainly also contributed to the slower than anticipated progress.

The PCC national review team identified certain core staffing requirements for the new ODNs, including a network manager, clinical lead, lead nurse or AHP, along with dedicated data analysis and administrative support. Failure to identify PCC education within the core staffing requirement, along with the relatively low levels of funding that have been distributed to date, has resulted in too little network resource being allocated for HDU education and training of spoke hospital staff. An average of only 0.3 WTE educator has been appointed to each ODN, range 0 to 1.5 WTE. Five ODNs do not have any educator role. Additional resource will undoubtedly be needed to deliver this essential component of ODN development if greater volumes of safe, effective PCC are to be delivered in spoke hospitals.

PCC delivery across spoke hospitals

Paediatric early warning system (PEWS)

Early identification of a deteriorating child, with appropriate intervention, can result in an improved outcome for that child. A number of different paediatric early warning tools have been developed and implemented across hospitals in England over the past 10-15 years. Unfortunately, these are not consistent with each other, often having different scoring thresholds for intervention. This creates an unhelpful barrier, for example when a clinician from one provider is trying to describe a clinical scenario to a colleague at a different provider, who is unfamiliar with that scoring system.

A clear and accurate shared understanding of the patient's condition is particularly important in the context of a referral from a spoke hospital to the regional transport service for advice and decision-making. A transport service may be dealing with over 15 different spoke hospitals.

The Paediatric Intensive Care Society Standards (2015) - now the Paediatric Critical Care Society (PCCS) - stated that PCC networks should implement the same PEWS across all hospitals in their network. This has not happened and we found that no ODN has the same early warning system in place across all of its hospitals.

Understandably, individual hospitals who have invested considerable time and resources embedding PEWS into their daily practice, and into their observation charting, may be reluctant to move across to a different 'ODN preferred' system. Similar challenges in adult practice led to the development and implementation of a national early warning system (NEWS).

A national PEWS is currently being piloted and should be implemented across all paediatric hospitals in England when it becomes available.

PCC interventions

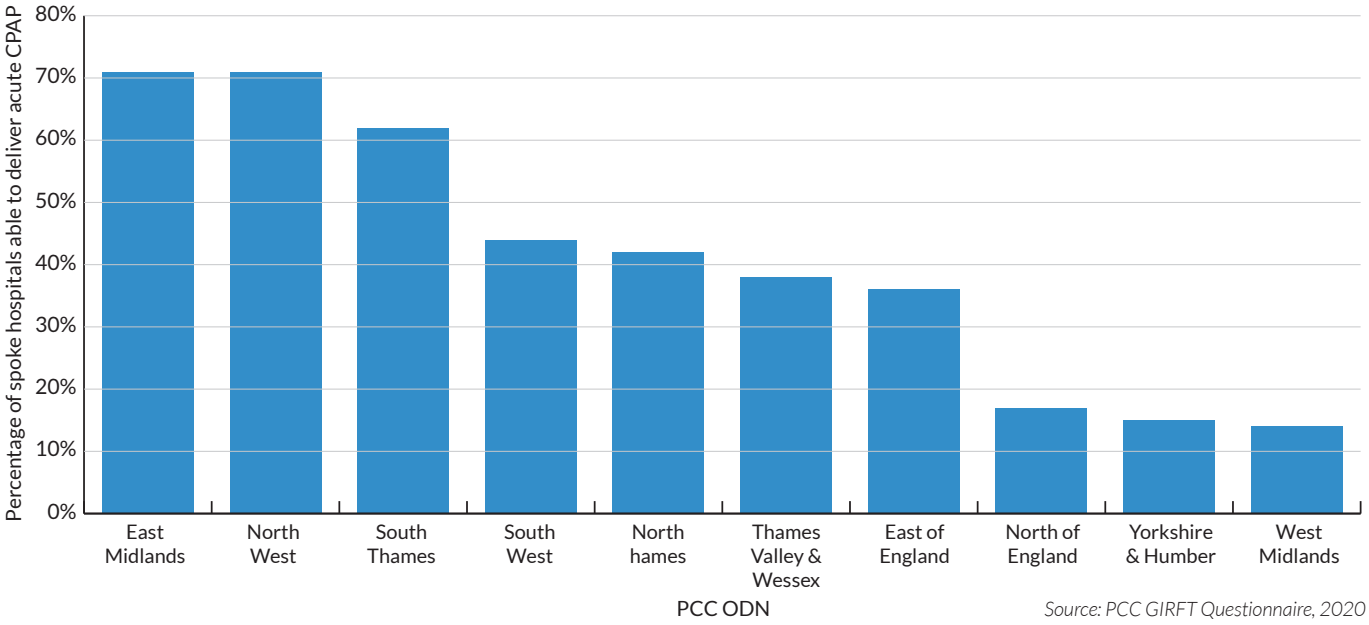
By aggregating data returned by individual DGHs it was possible to build up a picture of what interventions are able to be delivered across ODNs. Overall, it is apparent that considerable PCC expertise exists across many ODNs. As ODNs evolve and some spoke hospitals become designated as L2 centres it will be important to preserve the positive aspects of current delivery as much as possible, provided it can be delivered in a safe manner by staff with appropriate training and competence.

However, capability was found to vary considerably between ODNs, and across different interventions.

High flow nasal cannulae (HFNC) therapy is a simple form of non-invasive respiratory support that has been introduced over the past 10 years as a step-up therapy when simple 'low flow' oxygen proves insufficient. HFNC can be delivered by spoke hospitals in all ODNs (median 96%, range 92-100% of hospitals in each ODN), whereas few hospitals are able to look after a child with a chest drain (median 30%, range 14-78%) and the picture for care of a child with a tracheostomy is mixed (median 79%, range 43-100%).

Acute continuous positive airway pressure (CPAP) support for babies with bronchiolitis is possible in many spoke hospitals (median 84%, range 50-100%), whereas fewer hospitals reported being able to deliver acute CPAP for an older child (median 40%, range 14-71%) (see **Figure 12**).

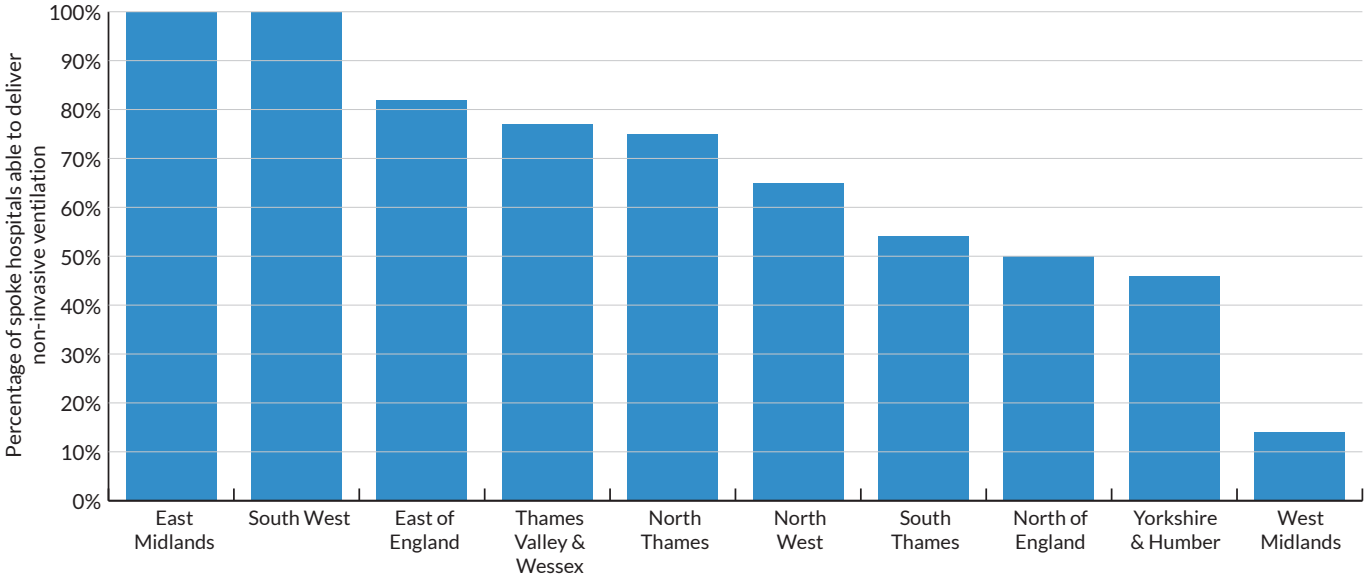
Figure 12: Percentage of spoke hospitals in each ODN that can deliver acute CPAP to an older child



Source: PCC GIRFT Questionnaire, 2020

With respect to being able to care for a child requiring admission who is dependent on home non-invasive ventilation there was wide variation between different ODNs, with 100% of spoke hospitals in the South West and East Midlands able to deliver this care compared with only 14% of spoke hospitals in the West Midlands ODN (overall median 70%, range 14-100%) (see **Figure 13**).

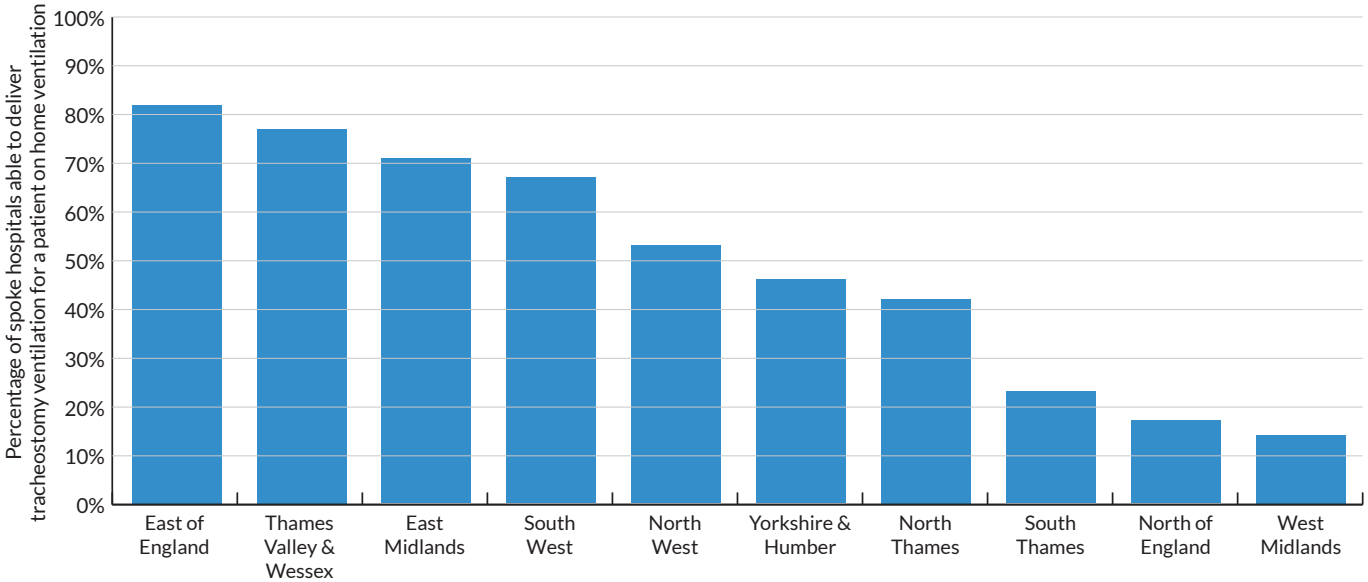
Figure 13: Percentage of spoke hospitals in each ODN that can deliver non-invasive ventilation (bi-level) for a patient on home ventilation



Source: PCC GIRFT Questionnaire, 2020

Similar variation was seen in those able to deliver care to a child dependent on home tracheostomy ventilation (median 50%, range 14-77%) (see **Figure 14**).

Figure 14: Percentage of spoke hospitals in each ODN that can deliver tracheostomy ventilation for a patient on home ventilation



Source: PCC GIRFT Questionnaire, 2020

It is apparent from the data that some ODNs have access to greater PCC capability across their spoke hospitals than others, where there is a much greater challenge. It is no surprise that the South West, which has had a clinical PCC network in place for 20 years, has spoke hospitals with high levels of capability.

Provision of L3 (PICU) beds

In England, 21 trusts deliver PICU care, in 24 units across 23 hospital sites. One hospital site has two PICUs, and two trusts have a PICU in each of the two hospital sites.

Across the 24 PICUs submitting data to PICANet there are a total of 380 beds, with the number within each unit ranging from 6 to 31 beds. 359 of the 380 beds (94%) are commissioned by NHS England and NHS Improvement, with the remainder funded through a variety of income streams including contracts with Wales, Scotland, Northern Ireland and Isle of Man.

Twelve of the PICANet submitting PICUs are commissioned as 'PICU (L3) only' units with the remaining 12 commissioned as 'combined PICU (L3) and HDU (L2) units'. Of the 359 beds across these units that are commissioned by NHS England and NHS Improvement, 284 are commissioned as PICU (L3) beds and 75 are commissioned as L2 beds.

In summary there are 284 NHS England and NHS Improvement commissioned L3 beds across England.

How many L3 bed should there be within a paediatric tertiary centre?

The number of L3 beds that are needed within a paediatric tertiary centre will depend on a range of factors including:

- the health needs, and deprivation, of the local population;
- the range of specialist services available within the centre;
- the complexity of care being delivered across its paediatric specialty services;
- volumes of planned surgical activity that require a L3 bed in the post-operative period;
- how much PICU capacity is needed to cope with emergency admissions to PICU from other hospitals (these make up 31% of all PICU admissions, although this varies from 5% to 58%).

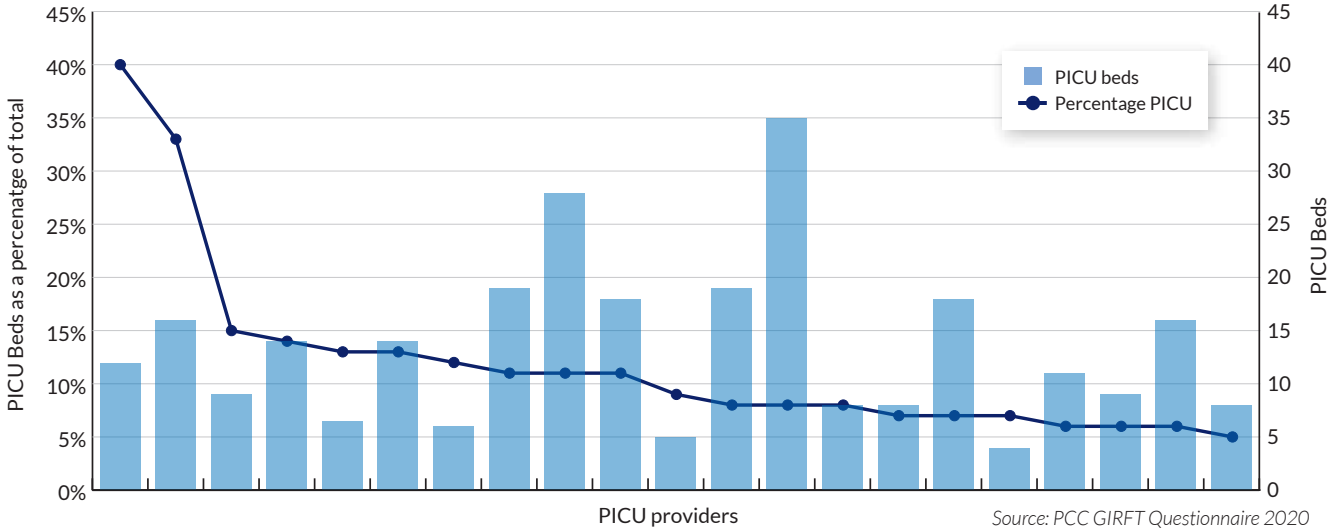
Service planning must also take into account unmet need, including, for example, local children who are admitted to other PICUs, and graduates of NICU who at times are remaining in NICUs beyond 44 weeks post-menstrual age (GIRFT Neonatology national report). Planning will also need to take into account future changes to provision of paediatric specialist services, for example the recommendation to deliver highly specialist paediatric surgery in fewer centres (GIRFT Paediatric Surgery national report).

Overall, 4.5% of all admissions to tertiary paediatric hospitals in England result in a PICU stay but this varies from 1.2% to 7.9%.

It is therefore not appropriate to recommend a fixed proportion of total hospital beds that should be L3 beds.

Figure 15 shows the proportion of total hospital beds that are L3 beds for every L3 provider. There are 3,038 paediatric inpatient beds in total within L3 hubs across England and 284 of these are commissioned L3 beds, 9.3% of the total. The two units with the highest percentage of L3 beds in **Figure 15** are both standalone cardiac centres – if these are excluded 8.6% of paediatric beds across general centres are L3 beds.

Figure 15: Proportion of hospital beds that are L3 (PICU) beds (NHS England and NHS Improvement commissioned) across all L3 providers



Source: PCC GIRFT Questionnaire 2020

Co-location of specialised paediatric services

A reflection of the heterogeneity of L3 services, and the poor alignment of specialised paediatric services, is seen when looking at some of the specialised services that are co-located on the same hospital site as the PICU (see **Table 3**).

Table 3: Specialised paediatric services that are available on-site across L3 hospitals

	Co-located services				
Hospitals	**General**	**Cardiac surgery**	**Specialised paediatric surgery**	**Trauma / Neurosurgery**	**Bone marrow transplantation**
Alder Hey Birmingham Bristol GOSH (2 units) Leeds	✔	✔	✔	✔	✔
Southampton	✔	✔	✔	✔	
Nottingham Newcastle GNCH Manchester St Mary's Sheffield	✔		✔	✔	✔
Leicester RI Evelina	✔	✔	✔		
Barts Cambridge Kings Oxford St George's	✔		✔	✔	
Stoke	✔				
Brompton Leicester Glenfield Newcastle Freeman		✔			

Hospitals that do not currently meet co-location of specialised services recommendations are highlighted in red

Of note there are four L3 hospitals, identified in Table 3, that do not have specialised paediatric surgery on-site and one additional hospital that does not have ENT (airway) on site, both of which should be co-located on the same site as a PICU and immediately available (Paediatric Intensive Care Society Quality Standards, PICS QS)[14,15]

[14] *Department of Health, 2008, Commissioning safe and sustainable specialised paediatric services.*

[15] *Paediatric Intensive Care Society, 2015. Quality standards for the care of critically ill children.*

Provision of L2 (HDU) beds

An expansion in the number of designated, commissioned L2 beds will be essential if the networked model of care proposed by the NHS England and NHS Improvement national review is to be fully realised. This expansion will need to be underpinned by appropriate workforce planning to ensure that sufficient numbers of staff are available with the right PCC skills, knowledge and experience to ensure delivery of safe and effective care.

No additional L2 beds have been commissioned across England since publication of the national review recommendations or establishment of the PCC ODNs, despite this being a key recommendation. It is clear that there are currently too few L2 beds commissioned within L3 provider hospitals, as well as too few L2 beds commissioned across spoke hospitals in the majority of networks (see section '*Pathways, flow and efficiency*' on page 62). **Table 4** summarises the current L2 provision within each ODN.

Table 4: Provision of NHS England and NHS Improvement commissioned HDU (L2) beds across England, summarising data for both hub and spoke sites

	HUBS			SPOKES	
Network	Number of NHS England and NHS Improvement commissioned PICU (L3) beds	Number of NHS England and NHS Improvement commissioned HDU (L2) beds	Number of L2 beds relative to number of L3 beds (%)	Number of spoke hospitals in ODN with NHS England and NHS Improvement commissioned HDU (L2) beds	Total number of NHS England and NHS Improvement commissioned HDU (L2) beds in ODN
East of England	9	4	44%	1	4
East Midlands	22	13	59%	2	6
North of England	23	14	61%	0	0
North Thames	60	15	25%	1	8
North West	37	40	108%	0	0
South Thames	33	36	109%	0	0
South West	18	17	94%	4	16
Thames Valley & Wessex	22	23	105%	0	0
Yorkshire & Humber	25	20	80%	1	4
West Midlands	35	4*	11%	0	0
Total	**284**	**186**	**Average 70%**	**9**	**38**

*4 beds in West Midlands relate to funding of HDU+ programme rather than physical beds

L2 provision within hubs

Within hub PICU providers there are a total of 186 L2 beds commissioned by NHS England and NHS Improvement across England, along with 284 L3 beds.

Of the L2 beds, 75 are co-located with L3 beds (with data flowing to PICANet) and the remaining 111 are commissioned beyond PICUs (and data relating to activity in these beds is not currently captured in PICANet).

Provision of L2 beds within hubs is highly variable between networks, ranging from 11% of the number of L3 beds to 109% (average 70%). Five ODNs have L2 bed numbers equating to greater than 80% of the number of L3 beds.

Based on GIRFT review data showing that the most efficient use of L3 beds is achieved where effective L2 step-up and step-down care is available, it is recommended that every L3 provider should have L2 beds commissioned by NHS England and NHS Improvement. It is recommended that a minimum of one L2 bed be commissioned for every two L3 beds in the first instance, with additional L2 beds where data supports the case for more beds to optimise use of L3 beds. For reference, the GIRFT Adult Critical Care report recommends that this is one L2 bed for every L3 bed.

L2 provision within spokes

Provision of L2 beds across spoke providers is sparse with only 9 of the 130 spoke hospitals in England having HDU beds commissioned by NHS England and NHS Improvement England (totalling just 38 NHS England and NHS Improvement commissioned beds). There is significant variation between ODNs and the number of spoke hospitals with NHS England and NHS Improvement commissioned HDU beds ranges from 0 to 4 hospitals per ODN, and the number of beds from 0 to 16 per ODN. The South West ODN has the highest provision with 16 commissioned beds, whilst 4 ODNs currently have no commissioned beds.

With respect to L2 provision across spoke hospitals it is more difficult to make a clear recommendation regarding the number of spoke hospitals, and beds, that should be commissioned. This will be influenced by many factors, including the number of hospitals within the ODN, their geographical position, the volumes of paediatric and PCC activity going in each spoke hospital, and potentially co-location considerations with respect to paediatric surgery, oncology and other paediatric services.

The South West network is the most mature across England and has had many years to consider how best to organise PCC services across their geographically dispersed region. They currently have four spoke hospitals, each with 4 HDU beds, commissioned by NHS England and NHS Improvement.

Increased L2 provision within a spoke hospital will require an expansion in the paediatric workforce, who will have additional training needs, and careful consideration of the role of colleagues in anaesthesia and 'adult' critical care who are likely to play an important role in providing outreach support and advice.

Identification of suitable L2 spoke providers

The Royal College of Paediatrics and Child Health (RCPCH) 'High dependency care - time to move on' document[4] proposed that L2 spokes might be able to receive transfers from other (L1) spoke hospitals, thereby providing step-up care that would otherwise have required transfer to a L3 provider. This concept is now generally felt not to be realistic as these children can deteriorate and require a secondary transfer to a L3 hub. A pilot of this approach has suggested that up to 50% of cases may go on to require a second transfer.

The emphasis is therefore now on L2 spoke hospitals being able to keep a greater proportion of their own patients locally, reducing transfers into L3 hubs, and being able to accept step-down patients from the L3 hub in larger numbers and at an earlier stage than would be possible for other spoke hospitals. Spoke hospitals with a higher critical mass of paediatric activity, resources and capability should be the principal focus for L2 designation.

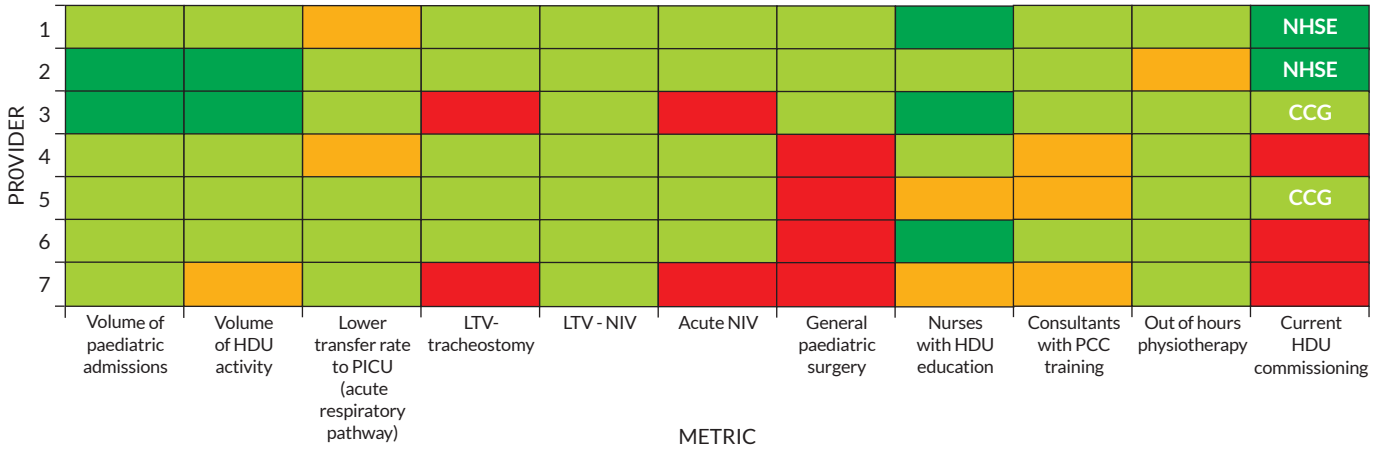
Each ODN will have unique considerations which will help to inform decision-making, and local understanding of relevant factors will play an important role. However, it is possible to use a data-driven approach to identify potential L2 providers, an approach that has been incorporated into GIRFT ODN reviews.

Data was provided across key variables, seen as relevant to decision-making:

- volume of in-patient paediatric activity (higher=better)
- volume of PCC activity currently delivered (higher=better) (data is very poor 'Data capture and reporting')
- % of acute respiratory pathway patients requiring transfer to PICU (lower=better)
- current ability to deliver PCC interventions – CPAP, LTV (higher=better)
- proportion of consultant staff with PCC training (higher=better)
- proportion of nursing staff who have undergone HDU training (higher=better)
- availability of out of hours access to physiotherapy (yes=better)
- volume of general paediatric surgery being undertaken (higher=better)

An example of how criteria can be applied at ODN level across a series of providers is shown in **Figure 16**. Providers 1 and 2 appear to be best placed as L2 spokes, whilst other providers would require additional support to become eligible. Relative weights placed on these criteria may differ across ODNs, reflecting local priorities.

Figure 16: Potential matrix for identification of L2 provider spokes



L1 beds across spoke hospitals

Provision of basic critical care (L1) is seen as integral to delivery of general paediatric care, with every hospital admitting children expected to put in place a system to deliver it. Responsibility for commissioning of general paediatric services lies with CCGs, who are also therefore responsible for L1 care delivery. Many CCGs consider that any additional costs related to L1 delivery are effectively captured and paid for within the core HRG payment for that admission.

However, this is not always the situation as some spoke hospitals have historically received additional funding from CCGs for delivering HDU services to children. In total 92 L1 beds are commissioned by CCGs across 130 spoke hospitals in England, ranging from 0 to 21 beds per ODN. We found no clear rationale or logic for which hospitals are receiving CCG funding, with examples of funded HDU beds in one small spoke hospital whilst another much larger, busier hospital in the same ODN was not CCG funded.

ODNs will need to engage with CCGs, STPs, and increasingly with integrated care systems (ICSs), as well as with NHS England and NHS Improvement regional teams to map out an accurate picture of HDU commissioning across their network. They will need to work together to formulate a commissioning plan for PCC services across the ODN, including how to make equitable use of existing CCG funding.

Recommendations

Recommendation	Actions	Owners	Timescale from date of publication
1. Develop and introduce a single early warning system for children across all hospitals in England.	**a** NHS England and NHS Improvement (NHSE/I) and RCPCH to complete development and piloting of a new national paediatric early warning system and introduce it across all hospitals, once validated.	NHSE/I, RCPCH.	Within 24 months
2. Ensure that specialist paediatric pathways are more closely aligned, so that a child with multiple comorbidities receives co-ordinated care in one tertiary hub whenever possible.	**a** Establish a Children's Strategic Forum (CSF) in each region, with NHS England and NHS Improvement commissioning team oversight. The CSF should include clinical representation from each paediatric ODN and other non-ODN specialist pathways, as well as representation from spoke and hub hospitals.	NHSE/I regional team, ODN.	Within 12 months
	b Identify a 'principal hub' link for each spoke hospital to foster development of closer collaborative working, and to ensure that a child requiring multiple PICU admissions is admitted to the same PICU and hospital wherever this is clinically appropriate.	ODN, CSF.	Within 12 months
3. Ensure that paediatric critical care provision across England is equitable and appropriate to local demand, so that every child requiring PCC can receive care as close to the family home as possible.	**a** Develop clear written criteria, to be used across all ODNs and transport services, to determine the appropriate destination PICU when a child requires urgent transfer from a spoke hospital into a hub PICU.	CRG, PCCS, ODN.	For immediate action
	b ODNs should monitor spoke to hub PICU transfers (both within ODN and out of ODN) to ensure that transfers comply with the principles of: i) admission to the 'principal hub' for that that spoke hospital and/or ii) admission to the closest PICU, whenever it is clinically appropriate.	ODN	For immediate action
	c Establish a group with national oversight (NOG) of PCC services across England. This group should be responsible for providing recommendations to NHS England and NHS Improvement regional teams and ODNs regarding: i) ODN configuration and potential reconfiguration – to ensure that spoke hospitals sit within the most appropriate ODN, ii) L3 bed distribution – to ensure capacity in each hub is appropriate to demand, including unmet demand, iii) L2 bed distribution across ODNs, within both hub and spoke hospitals. The group should bring together national and local stakeholder knowledge and include, as a minimum, representatives from Royal College of Paediatrics and Child Health (RCPCH), Paediatric Critical Care Society, PCC Clinical Reference Group, PICANet, NHS England and NHS Improvement Women's and Children's Programme of Care board, and the PCC ODNs.	NHSE/I, CRG, PCCS.	Within 12 months
	d ODNs should notify their NHS England and NHS Improvement regional team, and the National Oversight Group (NOG), when lack of L3 capacity within a provider is considered to be a factor in reducing compliance with the principles of i) admission to the 'principal hub' linked to a spoke hospital and/or ii) admission to the closest PICU, where clinically appropriate.	ODN	Within 12 months

Recommendation	Actions	Owners	Timescale from date of publication
4. Increase the number of L2 beds across both hub and spoke hospitals, to reduce strain on L3 beds, improve efficiency, and improve value for money	**a** Every L3 provider should have a commissioning contract with their NHS England and NHS Improvement regional team that captures commissioning of both L2 and L3 beds.	NHSE/I regional teams, L3 provider.	Within 12 months
	b As a minimum one L2 bed should be commissioned in each hub for every two L3 beds. This should be considered a minimum and will need to be higher where data supports the need for additional L2 beds.	NHSE/I central and regional teams.	Within 12 months
	c Each ODN should have a number of spoke hospitals that are designated as L2 providers, with this service commissioned by NHS England and NHS Improvement regional teams. It is not possible to be specific with how many spoke hospitals in each ODN should be designated as L2 providers, but an indicative number of 3-4 hospitals is proposed based on evidence from successful networks (though this could be fewer in smaller ODNs). Each designated L2 provider should be commissioned for a minimum number of 4 beds (to deliver efficient staffing given nurse:patient ratio of 1:2 for L2 beds).	ODN, NHSE/I central and regional teams.	Within 24 months
	d Each ODN, through their PCC Network Board, should establish a clear plan and strategy for delivery of PCC across the ODN, at both hub and spoke level, including how this will be commissioned and funded.	NHSE/I regional teams, ODN.	Within 12 months
	e This plan should consider how to integrate existing CCG commissioning relating to HDU beds, and the future role of ICS' in commissioning acute paediatric services (including L1 PCC).	ODN, CCG/ICS, NHSE/I regional teams.	Within 12 months
5. Ensure that there is equitable distribution of 'core' resources across the ten PCC ODNs, which is sufficient for them to achieve the key performance indicators set out by NHS England and NHS Improvement in the PCC national review recommendations, and sufficient for them to deliver the recommendations contained in this review.	**a** NHS England and NHS Improvement to undertake a central review of what resources have been distributed in 2020/21, and what core network functions are being delivered with this resource in each ODN. Note should be taken of relative population size in each ODN, and the number of providers.	NHSE/I	For immediate action
	b NHS England and NHS Improvement to consider the paucity of resource available for PCC educators across the ODNs, which presents a significant barrier to improving delivery of PCC across spoke hospitals, and consider allocation of additional resource for this function.	NHSE/I	For immediate action
	c NHS England and NHS Improvement to review the additional recommendations contained in this review and consider allocation of additional resource to ODNs to ensure delivery of these recommendations.	NHSE/I	Within 12 months

Access, capacity and strain

The concept of unit strain has already been described in 'About paediatric critical care' above.

Several factors, summarised in **Figure 6** on page 29, can affect the demand versus capacity balance and result in higher or lower degrees of strain. Many of these are modifiable. A number relate to how judiciously L3 beds are being used, which will be influenced by availability of alternative step-up and step-down pathways within the organisation. L3 bed availability (capacity) will also be compromised if patients are not able to be discharged to a ward or HDU bed when they are deemed fit for L3 discharge.

Consequences of high unit strain

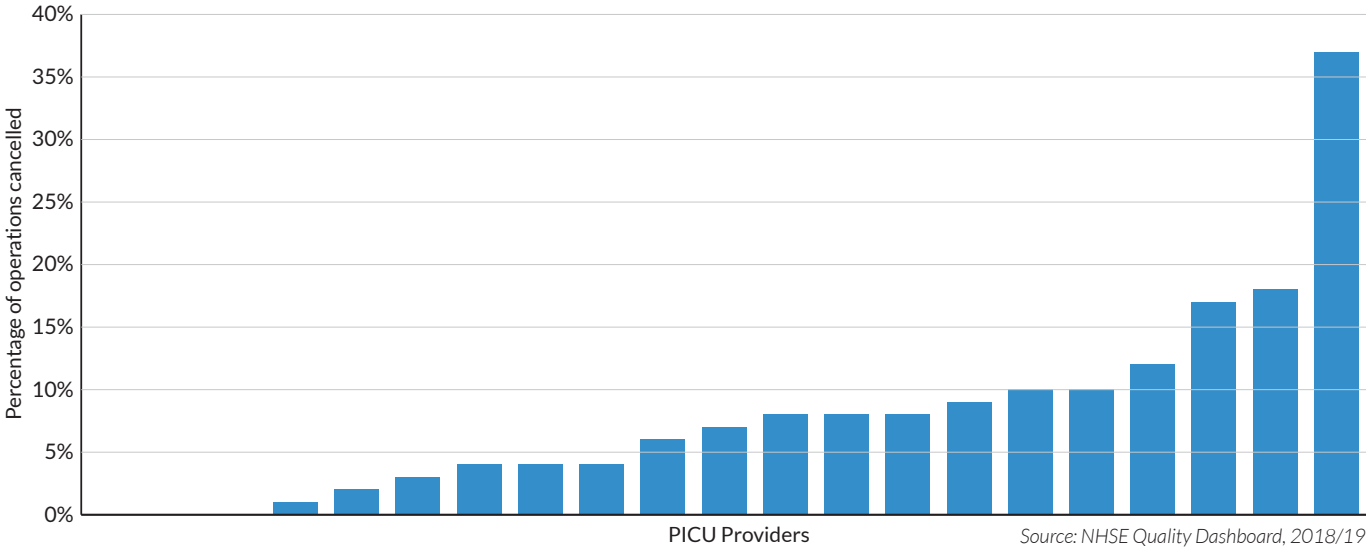
There are diverse consequences when there is insufficient capacity to manage demand. An acutely ill child will be unable to access a L3 bed when they need one, which will delay admission to PICU and can worsen the outcome for that child and family.

Cancelled surgery

Pathways of elective care that rely on access to a PICU bed are compromised, with same day surgical cancellations.

An average of 8.2% of elective operations are cancelled at least once because of lack of a PICU bed (range 0% to 36.8% across 21 L3 providers, see **Figure 17**), with this data reported through the NHS England and Improvement Specialised Services Quality Dashboard (SSQD). In some instances, children are having their operation cancelled on more than three occasions. This represents a very poor patient and family experience, particularly as children will often have required a period of preparation and psychological counselling in the build up to an operation. It is also an inefficient use of resources as the surgical team are not able to operate and an operating theatre lies empty.

Figure 17: Percentage of elective surgical cases cancelled on the day of surgery due to lack of availability of a PICU bed



Source: NHSE Quality Dashboard, 2018/19

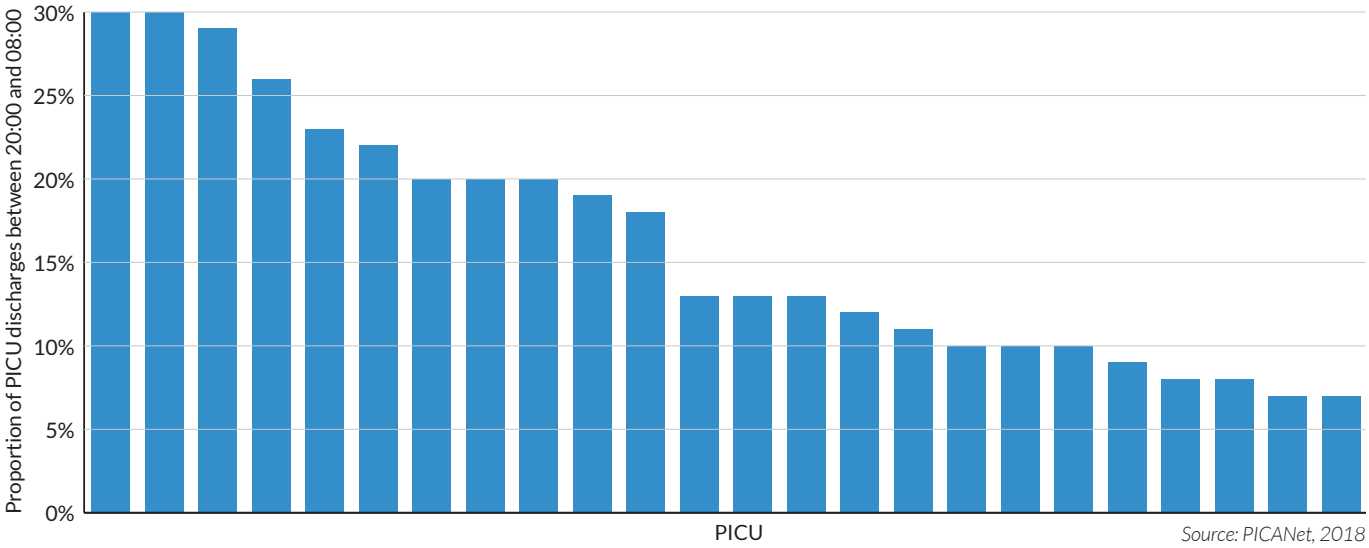
Out of hours discharge

Another consequence of increased pressure on PICU beds is for children to be discharged to the ward during the evening or night when there is reduced medical and nursing cover, and senior staff less likely to be available to review the patient. Out of hours discharge is associated with a higher rate of readmission to ICU[16]. Families are also less likely to be present to accompany the child if the discharge occurs overnight. The practice of discharging a patient out of hours is suboptimal and should be avoided as much as possible.

[16] *S. Vollman, S. Dutton, S. Lamb et al., Out-of-hours discharge from intensive care, in-hospital mortality and intensive care readmission rates: a systematic review and metaanalysis, Intensive Care Med (2018) 44: 1115–1129, https://cdoi.org/10.1007/s00134-018-5245-2*

The GIRFT review of ACC found that an average of 2% of adult ICU discharges occur between 22.00 and 07.00. The PCC review found an average rate of 8.6% (range 2.3% to 19.6%). Discharge after 22.00 is probably too conservative a start time for defining out of hours discharge and discharge between 20.00 and 08.00 is much more representative of the time interval during which staff availability on the wards will be reduced. An average of 15.5% of PICU discharges occur between 20.00 and 08.00 (range 6.7% to 29.7%), see **Figure 18**.

Figure 18: Proportion of PICU discharges in each unit that occur between 20.00 and 08.00



Source: PICANet, 2018

It is recommended that all units monitor and report rates of out-of-hours discharge. This could be achieved by adding this metric to the NHS England and NHS Improvement SSQD.

Impact on staff

Working in a unit that is constantly running at high strain is demanding, both physically and emotionally, and may result in increased levels of staff sickness, turnover and burnout, exacerbating the national shortage of PCC trained staff, and reducing capacity further. (see section '*Workforce*' on page 85).

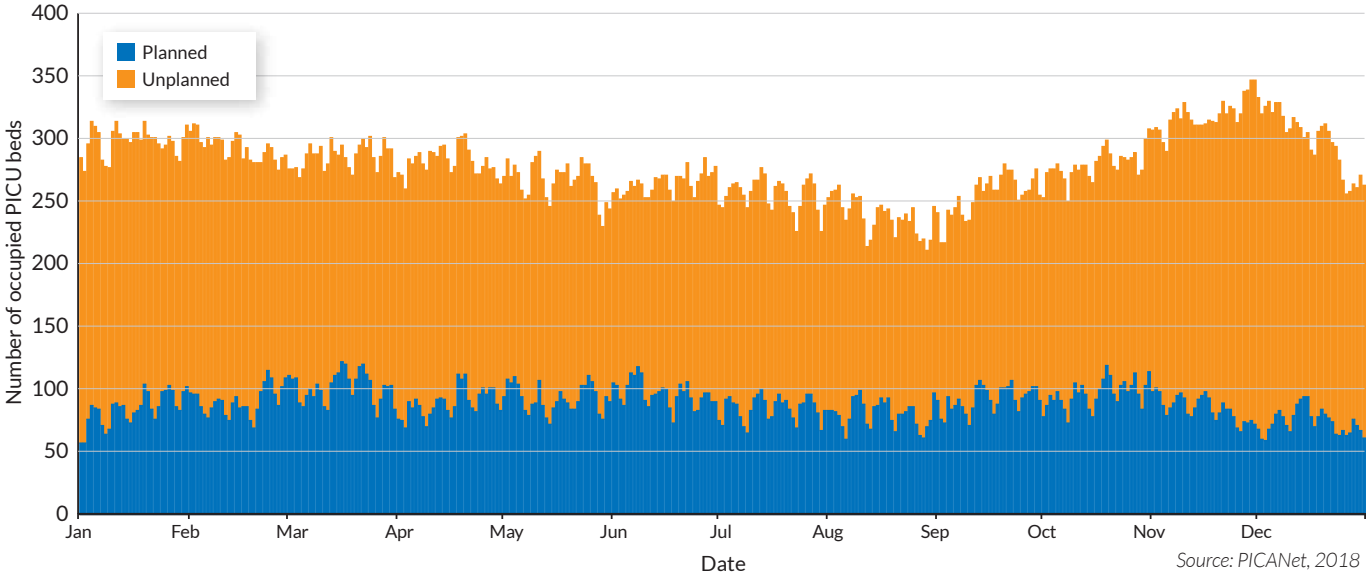
Quality of care declines when staff morale is low and staff numbers are stretched, with adverse events, such as unplanned extubation and hospital acquired infection, becoming more likely. Increased adverse events will in turn lengthen PICU stay, increasing strain further. (see section '*Patient experience, quality & outcomes*' on page 75).

PICU capacity – national level

A full consideration of whether there is sufficient capacity across England to cope with current PCC demand is not possible as we do not have an accurate picture of all PCC beds and all associated PCC activity. However, we can use national audit data from the 24 L3 units to make an assessment, accepting that data from 12 of these units includes activity linked to L2 beds as well as L3 beds.

Figure 19 shows the number of children occupying a bed at midday every day throughout 2018. This should be interpreted with respect to there being a total of 359 NHS England and NHS Improvement commissioned beds across the same reporting units. It is evident that at a national level there are sufficient commissioned L3 beds for current demand.

Figure 19: Daily bed census of the total number of children occupying a bed at midday, together with the proportion relating to planned versus unplanned PICU admission (2018)



Source: PICANet, 2018

However, within the year there is marked variation in the number of occupied beds, from a nadir of 220 at the end of August to a peak of 350 in early December. The latter coincides with a predictable surge in viral respiratory infections and occurs at a time when staff sickness is also at its highest. As a result occupancy of available beds runs at a very high level at this time.

The majority of units consider capacity as something that is static across the year, aiming to open the same number of beds year round. In the context of the predictable variation in demand this is not an efficient use of resources over summer and results in considerable strain over winter. Current commissioning contracts are based on total activity and beds to be delivered across the whole year, and do not explicitly encourage a more flexible approach to seasonal variation in delivery.

However, a limited number of providers have developed approaches which are able to flex the number of beds that are opened over the year, with a planned reduction in bed numbers below baseline over summer months and a corresponding increase above baseline over winter. A more flexible approach to staffing is needed to better balance the workforce requirements against the predictable demands of winter, which is achieved through flexible workforce approaches including annualised hours, flexible taking of leave, and curtailment of courses over winter.

IN PRACTICE

Approaches to opening more beds in the winter

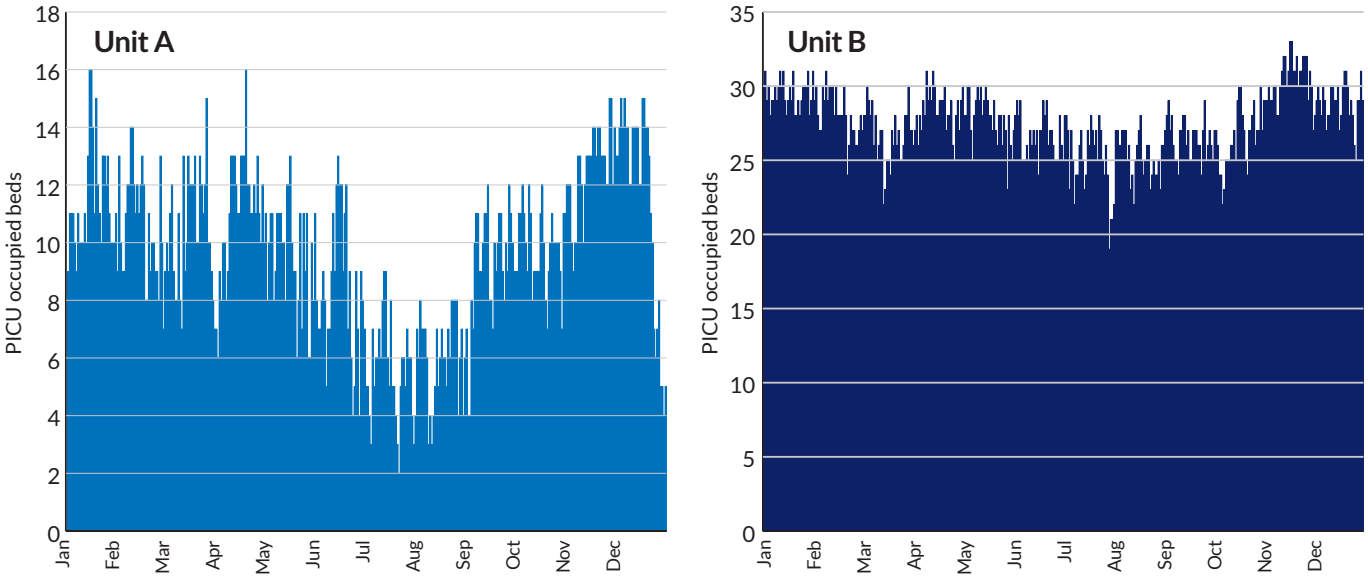
Oxford University Hospitals NHS Foundation Trust (Oxford Children's Hospital) | Guy's and St Thomas' NHS Foundation Trust (Evelina London Children's Hospital)

- Nursing staff have the option of working annualised hours, and taking more annual leave over the summer months compared to the winter.
- A 'flex' system allows staff to 'flex off' shifts when staffing exceeds patient demand, and repay these shifts at other times, principally the winter. This can be done at short notice and is closely monitored to ensure equal opportunities for all staff and to avoid excessive extra hours being owed.
- Nurse training /education, study time, and staff appraisals are all undertaken avoiding the peak winter months.
- Short term (3-5 month) contracts for external staff are offered through NHS Professionals over the winter months
- Elective surgical scheduling is reduced over winter.

Across England the variation in demand between summer and winter is in the order of 100 beds. A baseline level of around 360 commissioned beds should therefore ideally be translated into the opening of around 310 beds during summer and the opening of around 410 beds during winter, 50 beds above the current baseline. This equates to the opening of around 2 additional beds per unit on average.

However, from GIRFT data it is clear that some units experience a larger seasonal variability in bed numbers than others, who may run at more consistent levels across the year. Typically, larger units with higher volumes of planned surgical activity experience less seasonal fluctuation in their bed census compared to smaller units who may run at a very low bed census over summer (see **Figure 20**).

Figure 20: Seasonal variation in activity, with an example of higher variability (unit A) and lower variability (unit B)



Source: PICANet, 2018

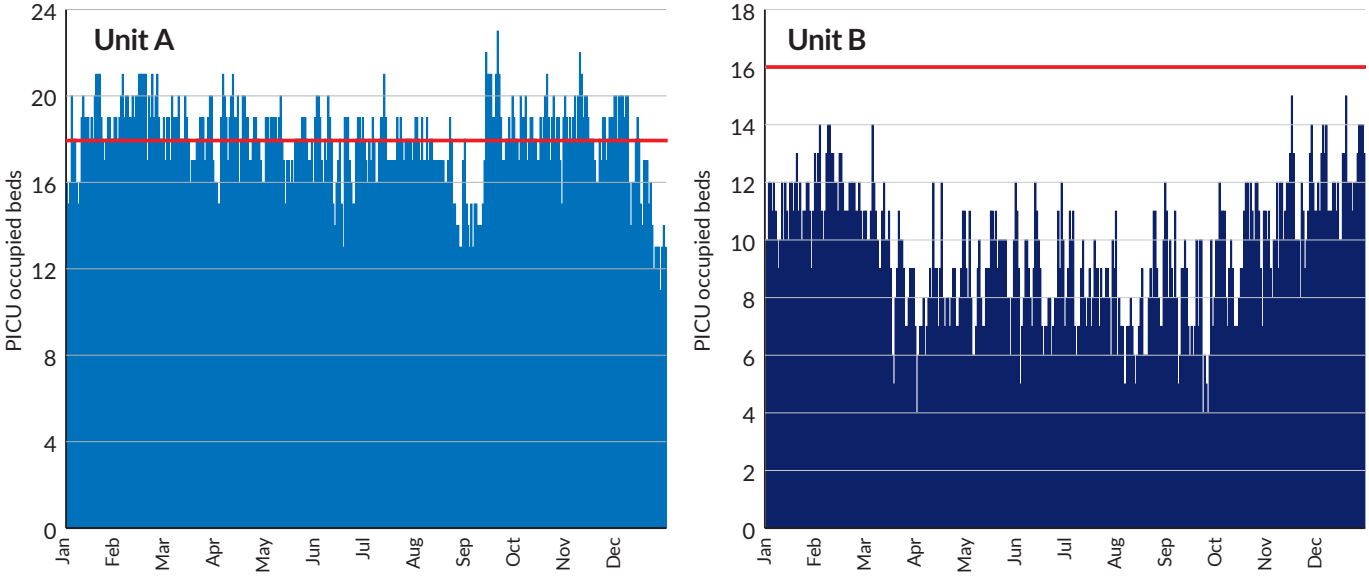
It is recommended that a flexible capacity approach be adopted, wherever possible, with each unit setting a baseline number of beds, informed by the commissioning contract, but setting a modified (lower) bed target over summer months and a higher bed target over winter months. The detail will need to vary from unit to unit based on the characteristics of each unit (see **Figure 20**). Any plans will require co-ordination and integration at an ODN level to ensure that a clear, deliverable plan to manage winter 'surge' is agreed for each ODN.

PICU capacity – local level

Variation

Across England there are examples of units which have insufficient commissioned L3 capacity for demand and others which have excess commissioned capacity relative to demand. Figure 21 shows an example of both, with unit A having insufficient commissioned capacity to meet its demand, whilst Unit B has a consistent excess of commissioned capacity. This results in inequitable access to PICU across England.

Figure 21: Significant differences in commissioned capacity (horizontal red line) vs. patient demand in different units, resulting in inequitable access



Source: PICANet, 2018

It is essential that ODNs and NHS England and NHS Improvement regional teams regularly review the demand versus capacity balance across L3 hubs in their ODN. Unmet demand, for example children who are unable to be admitted to the L3 hub when it is the closest clinically appropriate L3 hub, may not always be apparent but must be factored into this review process. Additional L3 resource should be commissioned where it is evident that a unit is under significant strain.

The concept of 'refused' admissions

The term 'refused' admission has become common parlance in PCC. It is generally used when a PCC referral cannot be accommodated by a L3 hub and has to be transferred to a different L3 hub.

The term 'refused' is rather emotive and is sometimes interpreted as an indicator of a suboptimal retrieval service and/or L3 hub, when in fact it is almost always an indicator of insufficient L3 capacity in the hub. A move away from 'refusal' to different terminology would be helpful.

The current interpretation is generally that a child is judged to have been 'accepted', i.e. not rejected, if, following retrieval, the child is admitted to any L3 hub in the catchment area of the retrieval service. This would usually be the catchment of the ODN in which the transport service sits, but there are examples of transport services that work across more than one ODN or region. Even within an ODN there may be L3 hubs which are geographically far apart, so the system can currently record a low proportion of 'refused' transfers when the reality is that children are not being admitted to their closest, clinically appropriate L3 unit.

It is recommended that relevant data capture be reviewed, to remove reference to 'refusal' and to improve capture of how often the closest, clinically appropriate destination L3 hub is unable to accept a child requiring PICU admission. PICANet already collect a detailed dataset, via transport services, of every patient 'referral'. This includes sections on 'transport outcome' and 'admission outcome' which could be adapted to capture an improved understanding of this patient group.

In turn, the wording of related metrics, for example in the NHS England and NHS Improvement SSQD, would need to be revised to be consistent with the data collected through PICANet.

Need for national oversight

As demonstrated in **Figure 19**, page 53, there are currently 'winners' and 'losers' in terms of commissioning of L3 beds across England. Some of this can be improved through effective local (ODN) monitoring and adjustment, but PCC, as a low volume, high cost service, must also be viewed in a national context. It is essential that we use resources sensibly, and as efficiently as possible.

In section '*Configuration of paediatric critical care services*' on page 34, we recommended creation of a PCC National Oversight Group to monitor and, where necessary, make recommendations regarding ODN configuration, and L2 and L3 bed distribution across England (Recommendation 3). Whilst creation of a national group may appear at first glance to be counter to the NHS direction of travel towards more local decision-making and allocation of resources, with the creation of ICS', GIRFT data has highlighted that the current regional model of PCC service planning and commissioning can result in important inconsistencies of service provision. There is potential for even greater heterogeneity of service provision with the move from regional to ICS decision-making, reinforcing the importance of establishing a group with national oversight.

Occupancy

Bed occupancy is widely used as the summary metric of the strain of a unit. Put simply it is the proportion of available bed capacity that is used for patient care, over a specified time period. Historically, PICU services have typically been commissioned to an average target occupancy of 80%, recognising that the system has to be able to accommodate unpredictable levels of unplanned demand, and that above this threshold it has been shown that refusals and cancelled operations begin to increase. A PICS QS recommends that occupancy should not exceed 85% for more than two consecutive months.

Inconsistent reporting of occupancy

Occupancy of PCC beds has been reported monthly since 2010, at midnight on the last Thursday of each month, through the NHS England and NHS Improvement Sitrep system that captures neonatal, paediatric and adult critical care data. Prior to November 2018 all 'open' and 'occupied' PICU beds were reported, but since then only open and occupied L3 beds should be reported. It is apparent that some providers are still including L2 beds in their data submission. Furthermore, there is often quite a discrepancy between the number of open L3 beds that are declared and the number of commissioned L3 beds in that provider.

COVID-19

Since March 2020 the monthly Sitrep system has been suspended and replaced with a daily Urgent and Emergency Care Sitrep system. The NHSE paediatric critical care Directory of Services has also compiled twice daily updates of all providers, including how many PCC beds are occupied by adult patients.

Occupancy is also reported quarterly through the NHS England and NHS Improvement SSQD and should be reported using the 'total number of occupied bed days (OBD; midnight census) in the time period' as the numerator and the 'number of commissioned PICU beds multiplied by days in period' as the denominator. It is apparent that some providers report the numerator using the bed day definition used by NHS Digital within the hospital admitted patient care (APC) record, rather than an occupied bed day (midnight census), and others report the number of staffed 'open' beds in the denominator rather than the number of commissioned beds. The end result is inconsistency and occupancy reporting that cannot easily be interpreted or benchmarked.

How is a bed day defined?

There is merit in considering occupancy in terms of the number of patients occupying a bed at a particular point in time. It avoids the situation of 'double counting' if more than one patient occupies a particular bed during a day, but it has the disadvantage that the work and resource use associated with caring for a patient who was discharged shortly before the census time point will not be captured.

Also, it is increasingly not the bed day currency or language that is used for measuring critical care activity within the NHS, whether in commissioning contracts, or reporting of activity to PICANet, or to SUS, or to the National Cost Collection. These activities use the NHS Digital APC record definition of a bed day, the same as the HRG definition, which is when PCC activity is delivered for four or more hours within a 24 hour period (a calendar day).

How will calculated occupancy differ between these definitions?

Calculated occupancy will be higher if the HRG definition of a bed day is used, because it is possible for more than one patient to occupy a PICU bed, and thereby generate an HRG, if one patient is discharged and another patient is admitted. The degree to which calculated occupancy will differ will depend on how often this event occurs, which will be related to the average length of stay in a PICU bed (see *Appendix 4*).

Let us consider a unit which runs at 100% occupancy using occupied bed days (midnight census) and has an average length of stay of eight days. On average, every eight days a discharged patient can be replaced with a different patient admitted to the same bed. On that day two HRG bed days are recorded through that one bed (providing each patient is in the unit for four or more hours) but only one occupied bed day (midnight census). This will have the effect of increasing calculated occupancy by up to 12.5% relative to the OBD-derived value. A PICU with 80% occupancy using an OBD approach would equate to up to 90% occupancy using an APC/HRG bed day approach.

The disparity between the two methods of count occupancy increases as average length of stay decreases since there will be more occasions when two patients can occupy a single bed over the course of a day, so the difference in calculated occupancy will be greater. If average length of stay is four days use of HRG bed days could increase calculated occupancy by up to 25% relative to the OBD-derived value. In this unit 80% occupancy using OBDs would equate with up to 100% occupancy using APC/HRG bed days.

As average length of stay is shorter for patients occupying a L2 (HDU) bed than a L3 (PICU) bed, the discrepancy between occupancy reported using midnight occupancy and that reported through HRG bed day occupancy will be greater for L2 beds/units (see also *Appendix 4*).

What definition should we be using in occupancy reporting?

Understanding the difference in definition between OBD and HRG bed day, and the impact that use of one rather than the other could have, is critically important. Clear, unambiguous guidance, with precise definitions, is the key to improving the reporting of occupancy metrics.

Whilst use of the same bed day definition across all PCC reporting would be attractive, moving across to HRG bed days for occupancy reporting would create a situation in which values >100% could be generated, even when a system is not under particular strain. This would be particularly likely for L2 units, with a shorter average length of stay. Furthermore, a system of occupancy reporting based on midnight bed census data is currently used across all critical care age groups.

It is recommended that occupancy continue to be reported using a midnight bed census (OBD) approach. However, increased precision is needed in order to better understand the strain on L3 beds. Current reporting guidance does not adequately differentiate activity and capacity relating specifically to L3 beds, with the result that combined L2 and L3 data is often reported. It is recommended that occupancy of L3 and L2 beds should always be reported separately.

How should the denominator, available bed capacity, be reported?

The capacity of a unit can be described in terms of the number of funded beds, through NHS England and NHS Improvement and other sources, or in terms of available staffed 'open' beds. At times of high staff sickness, maternity leave, turnover and vacancies there may be a significant gap between the number of funded beds and the number of staffed beds.

Reporting the number of staffed 'open' beds should take into account the complexity of patients in the unit at that time, as well as the nursing skill-mix on duty. The recommended nurse:patient ratio for a L3 patient is 1:1, with uplift if the patient is of high complexity or nursed in a cubicle, but it is 1:2 for a L2 or L1 patient. Failure to take into account the lower nursing requirement for HDC level patients is impacting on the accurate reporting of numbers of staffed 'open' beds.

IN PRACTICE

Use of a daily Sitrep to understand capacity, staffing (relative to acuity), and patient flow

Used across South Thames PCC Network PICUs

Figure 22: South Thames PCC Network PICUs daily Sitrep

South Thames Paediatric Network PICU Status Template

Constants	
Trust:	Evelina London
L3 commissioned beds =	23
L2 commissioned beds =	0
Nursing Establishment =	26

PLEASE CHOOSE TO ENABLE MACROS IF ASKED

South Thames Paediatric Network

Email addresses this should be sent to:

Addresses must be separated with ";" e.g.: personA@hospital1.nhs.uk; personB@hospital2.nhs.uk

To permanently save changes to bed numbers or the email distribution list, click this button: Save changes to template

Send PICU Status Email

Please click HERE for guidance on completing this template

Evelina London - 22/04/21 07:34						
Completed by:	Name:			Day Consultant:		
	Job Title:			Night Consultant:		
Staffing - Nursing Establishment: 26						
Bedside Nurse Staffing - Day Shift		22		plus 2 retrieval nurses	Mandatory Field	
Staffed L3 Beds - Day Shift		20		plus 2 in charge	Mandatory Field	
Bedside Nurse Staffing - Night Shift						
Staff Off Sick (isolation)						
Known Issue or Mitigations for etc.						
Acuity - L3 x 23 Commissioned Beds		Forest	Sky			
Total calculated from L1 - 3 volumes	Total Patients	18			Mandatory Field (OR enter per-level volumes)	
	Grand total	18				
		Bay / Cubicle	Bay / Cubicle			
	L3 ECMO	0 / 0			Mandatory Field	
	L3+	0 / 0			Mandatory Field	
	L3	8 / 0			Mandatory Field	
	L2	6 / 2			Mandatory Field	
	L1	2 / 0			Mandatory Field	
L3 beds Occupied by 12 - 17 Year Olds		1			Mandatory Field	
L3 beds Occupied by 18+ Year Olds		0			Mandatory Field	
L1 or L2 Patients Receiving 1:1 Nursing		10				
L3 Patients Not Receiving 1:1 Nursing		0				
Patients with a suspected or confirmed diagnosis of PIMS-TS		0				
Calculated Acuity % ((6 L3 x 1) + (6 L2 in bay x 0.5) + (2 L1 in bay x 0.5) + (2 L2 in cubicle x 1) + (1 additional nurse per 10 pts x 18) = 15.8 15.8 / 22 nurses =		72%				
Additional Nurses Required to Meet PICS Standard of 80% Acuity		0				
RAG Rating		Amber		Amber due to patient location and complexity of many level 2 patients		
Bed Availability						
Discharges From L3 Beds Expected in the Next 12 Hours		6			Mandatory Field	
(calculated from vols below) Expected Discharges Yesterday that Did Not Occur:		2				
Due to:	No Transport				Mandatory Field	
	No Specialist Bed				Mandatory Field	
	No DGH Bed				Mandatory Field	
	Perceived Patient Acuity Too High					
	Other Reasons	2		1. Requires Mental Health Nurse, 2. Social issues + complex care requirements	Mandatory Field	
Elective Cancellations on the Day of Surgery Yesterday		0			Mandatory Field	
No. of Refused, Unplanned Admissions Yesterday		0			Mandatory Field	
Planned Elective Admissions Going Ahead		3				
Bed Availability (declared)		2				
ECMO Bed Availability		2				
Projected Bed Availability in 6 Hours		2				
Outliers						
(calculated from vols below) Outliers		0				
Paediatric Patients in Adult ICU Pending PICU Bed Availability		0				
Children Requiring Admission to PICU for Specialist Care From Another PICU / NICU		0				

Send PICU Status Email

Send PICU Status Email

When reporting the number of funded beds, this should take into account all sources of funding, and not be confined to NHS England and NHS Improvement regional team funding. Many L3 providers receive funding over and above NHS England and NHS Improvement regional team funding, for example relating to patients from Northern Ireland, Scotland, Wales, and the Isle of Man. A small number also receive funding to support NHS England and NHS Improvement highly specialised services, including specialised liver services and liver transplantation, ECMO and ventricular assist device support, complex airway surgery, pulmonary hypertension, heart failure and cardiac transplantation. As the occupancy numerator, the number of reported OBDs, will include activity linked to these additional funding sources, so should the denominator, the number of funded beds.

It is recommended that the total number of funded beds should be used as the denominator for reporting occupancy. The number of funded L3 beds should be used when reporting L3 bed occupancy and the number of funded L2 beds used to separately report L2 bed occupancy.

However, it should be recognised that this approach to defining occupancy may underestimate 'unit strain' for a unit with high staff sickness, maternity leave, and/or vacancies where there could be a significant gap between funded capacity and available staffed capacity.

It is important to appreciate the difference between L3 beds and L3 activity. Occupancy of L3 beds should capture the number of patients occupying these funded/designated beds, regardless of the complexity, or level, of care being delivered to each patient at midnight i.e. occupied L3 beds will include all children whether they are receiving care at L 0, 1, 2 or 3.

Recommendations

Recommendation	Actions	Owners	Timescale from date of publication
6. Adopt approaches to flex the number of L3 beds that can be opened, to better align staffing with predictable flux in demand, and improve winter surge capability	**a** NHS England and NHS Improvement regional teams to encourage/drive a flexible approach to managing bed capacity over the year, by incorporating differential activity targets (beds or bed days) to match anticipated seasonal demands within contracts.	NHSE/I regional teams	Within 12 months
	b L3 providers to implement a system that targets the opening of fewer L3 (and L2) beds over summer months and increased beds over winter months, through innovative staffing solutions.	L3 provider	For immediate action
	c ODNs to ensure that this approach is introduced by their L3 providers, and is able to deliver additional L3 beds over winter months across the ODN	ODN, L3 provider.	Within 12 months
7. Ensure that monitoring is in place to identify a L3 unit that is under strain, so that a plan of remediation can be developed.	**a** ODNs and NHS England and NHS Improvement regional team should review regularly (at least quarterly) the demand versus capacity balance of each L3 provider in the ODN. The following should be included in this review process: i) Occupancy of the unit – average occupancy target <85% ii) Adverse consequences of unit strain: • Out of hours discharge (20.00 to 08.00) – target <10% • Cancelled elective surgery on the day due to a lack of a L3 bed – target <4% iii) Number, and proportion, of urgent referrals of children from ODN spoke hospitals, that cannot be accepted by the L3 ODN hub provider that is closest to the child and family home – target <5% of referrals (where L3 provider is clinically appropriate) iv) The unmet demand described in iii) should be incorporated into the review process, and any capacity modelling that is done.	ODN, NHSE/I regional teams.	For immediate action
	b Where these targets are not being met ODN and NHS England and NHS Improvement regional teams should work with the L3 provider to develop solutions. This may require commissioning of additional L3 activity if evidence suggests that existing L3 capacity is being used efficiently.	ODN, NHSE/I regional teams, L3 provider.	For immediate action
	c The ODN should notify the NOG where compliance with the above targets is not met.	ODN	Within 12 months
8. Make revisions to improve the reporting of 'refused' admissions	**a** Encourage the use of alternative terms (and the avoidance of 'refusal') for a situation in which a L3 provider is unable to accept a PICU referral as a result of a lack of L3 capacity at that time, to provide a more detailed understanding and audit of this patient group.	CRG, PCCS, and provider transport services.	For immediate action
	b Adaptation of the existing PICANet 'referral' dataset would provide the appropriate forum through which to capture and report this data.	PICANet	Within 12 months
	c Refusal (using current terminology) should not be confined to occurrences when a child is transferred out of ODN ('out of catchment'), but to the recording of every instance in which a child is not able to be transferred to the closest, clinically appropriate, L3 ODN hub.	CRG, PCCS, PICANet, and provider transport services.	Within 12 months
	d ODNs should ensure that every PCC transport service is capturing this data and is reporting the revised dataset to PICANet, and to other relevant PCC dashboards.	ODN, Transport service.	Within 24 months

Recommendation	Actions	Owners	Timescale from date of publication
9. Ensure clear, consistent reporting of bed occupancy metrics	**a** All bed occupancy metrics should be reported separately for L3 beds and L2 beds, in order to aid interpretation and benchmarking	NHSE/I, CRG, PCCS, PICANet.	For immediate action
	b Occupancy should be defined as: i) The number of occupied beds at midnight (occupied bed days) *divided* by the number of funded beds. ii) The number of funded beds should consider all funding sources and not be confined to NHS England and NHS Improvement regional team funding only.	NHSE/I, CRG, PCCS, PICANet.	For immediate action
	c Explore development of a national, real-time, electronic PCC critical care bed occupancy dashboard populated directly by hospital PAS/EPR systems	NHSE/I, NHSX.	Within 24 months

Pathways, flow and efficiency

Specialist pathways

As described in section '*Configuration of paediatric critical care services*' on page 34, specialist paediatric pathways are often poorly aligned. This presents a particular problem for the family of a child with multiple complex medical problems, who can be under the care of three or four different tertiary paediatric centres. Through a Children's Strategic Forum, PCC ODNs should work collaboratively with colleagues from other specialist paediatric pathways to improve alignment of services in the future (Recommendation 2).

Spoke to hub pathways

Across England there are around 10,700 children, coded as an emergency or non-elective admission, who are transferred from a spoke hospital to a tertiary hub hospital every year. This represents around 1 in every 30 spoke hospital admissions (3.3%). There is considerable variation across the ten ODNs (range 2.7% to 5.3%), with an even greater variation across all 130 spoke hospitals (range 1.6% to 14.8%). Local systems with a higher rate of transfer place a greater burden on specialist hubs, as well as using additional resources during the transfer process (ambulance and crew, accompanying staff etc).

It is not possible, at this stage, to equate a higher rate of spoke to hub transfer with a lower level of capability, or efficiency, within a spoke hospital. Potential confounding factors include the threshold for admission in each spoke hospital, which may be different and result in denominator populations that are not directly comparable, local variation in deprivation and ethnicity, and differences in associated underlying health conditions. A future GIRFT paediatric workstream could contribute to a better understanding of this variation.

Spoke to hub PICU transfers

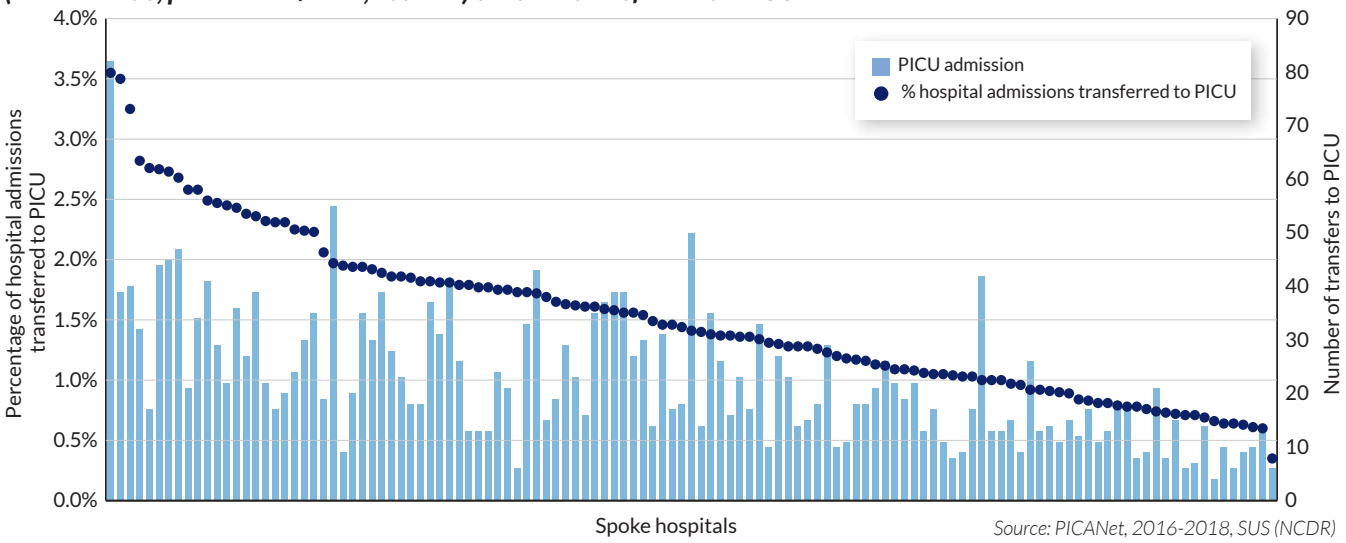
If we focus specifically on spoke hospital admissions, coded as emergency or non-elective, that result in a linked hub PICU admission, we again see considerable variation. Across the ten ODNs an average of 0.8% of spoke admissions are transferred to PICU (range 0.5% to 1.1%), with greater variation across all 130 spoke hospitals (0.1 to 1.6%). Furthermore, if we also consider patients transferred to PICU directly from the emergency department of spoke hospitals (for whom no record of hospital admission exists), the apparent rate of spoke to PICU transfer increases to 1.1% (range 0.2% to 2.4%). This is highly suggestive of local variation in PCC capability, highlighted in section '*Configuration of paediatric critical care services*', but again confounding factors may be present. In addition, local diagnostic casemix heterogeneity may be present.

Acute respiratory patients

To reduce heterogeneity a similar analysis was undertaken focusing on children admitted to a spoke hospital with an acute respiratory condition, namely acute bronchiolitis, pneumonia or lower respiratory tract infection (LRTI), or acute asthma.

Across England there were 62,500 such admissions to spoke hospitals and 1.5% resulted in a PICU transfer. At ODN level this varied from 1.0% to 2.3% of spoke admissions, and at spoke hospital level from 0.3% to 3.6% (see **Figure 23**).

Figure 23: Proportion, and number, of children admitted to spoke hospitals with an acute respiratory illness (bronchiolitis, pneumonia/LRTI, asthma) that are transferred to PICU



Source: PICANet, 2016-2018, SUS (NCDR)

ODNs should develop clear pathways for common conditions, identifying aspects of care that should be delivered in every spoke hospital, additional aspects of care that should be possible within L2 spokes, and criteria for transfer to a L3 provider. As a priority these should be developed for acute respiratory and LTV pathways.

It is important that positive aspects of current delivery are maintained as much as possible, as long as evidence supports safe, quality care and outcomes. This may require an ODN to approve local deviation, or derogation, from current guidance and standards pertaining to L1 and L2 interventions and designated status. The ODN should provide appropriate education and training support to spoke hospitals who are not designated as L2 providers, who are going to continue to undertake elements of care that are over and above current definitions of L1 care.

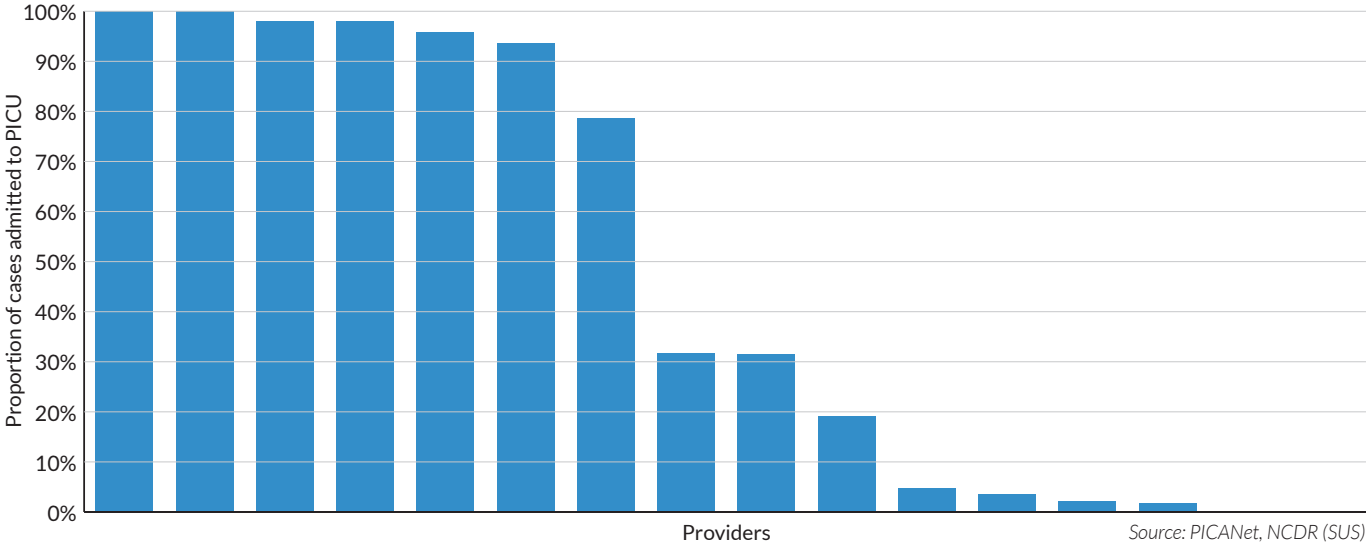
Pathways within L3 providers

Specialist surgical pathways

A number of surgical pathways rely heavily on L3 beds, such as the cardiac surgical pathway, with the vast majority of elective and emergency cases admitted to a L3 bed. In other surgical pathways the need for a post-operative bed will depend on patient and operation specific factors, and in others a L3 bed should rarely, if ever, be needed. During GIRFT deep dives we heard examples of providers routinely admitting children undergoing tonsillectomy associated with even mild obstructive sleep apnoea through a L2/3 bed, a procedure that in most providers would not result in L2/3 admission.

Benign idiopathic scoliosis typically affects otherwise healthy teenage girls and if it results in significant curvature of the spine may need to be corrected, with insertion of metal rods to create good spinal alignment and stability. In some centres this surgical pathway is delivered without any reliance on L3 or L2 beds, typically through delivery of enhanced care on the orthopaedic/spinal ward of the hub hospital. In other centres all of these cases are routinely admitted to a L3 bed, whilst in others it is routine admission to a L2 bed (see **Figure 24**). We found that few of the idiopathic scoliosis patients admitted to a L3 bed required L3 care during the admission.

Figure 24: Proportion of children undergoing surgical correction of idiopathic scoliosis that are admitted to a L3 unit. Only 16 providers who undertake this surgery are shown



Source: PICANet, NCDR (SUS)

Craniotomy procedures are undertaken in those L3 hubs with paediatric neurosurgical services (n=15). Again, there is considerable variation in the frequency with which children undergoing these procedures are admitted to a L3 bed, ranging from 7 to 85%. We found that few of the craniotomy patients admitted to a L3 bed required L3 care during their admission.

IN PRACTICE

Effective surgical pathway for idiopathic scoliosis

Sheffield Children's NHS Foundation Trust | Alder Hey Children's NHS Foundation Trust

- Comprehensive pre-operative MDT with work up for pre-op optimisation, involving surgical team, anaesthesia, respiratory/LTV, physiotherapy.
- Identification of patients suitable for post-operative care on the orthopaedic ward, within a 4-bedded post-operative HDU, and those requiring a Level 2 HDU bed for delivery of non-invasive ventilation
- Anaesthetic and surgical techniques tailored to facilitate extubation in theatre.

IN PRACTICE

Effective surgical pathway for open craniotomy cases

Great Ormond Street Hospital for Children NHS Foundation Trust

- A specialist HDU area on the neurosciences ward is staffed by a nursing team who have extensive experience of caring for paediatric neurosurgical patients
- Children with arterial lines, central lines and external ventricular drains can be managed on the ward following theatre
- Avoiding post-operative ventilation, and the requirement for sedation, allows neurological examination and assessment of an awake patient

L3 providers of these surgical pathways should develop pathways that minimise reliance on post-operative L2 or L3 beds, aiming to deliver post-operative care within the surgical ward whenever possible.

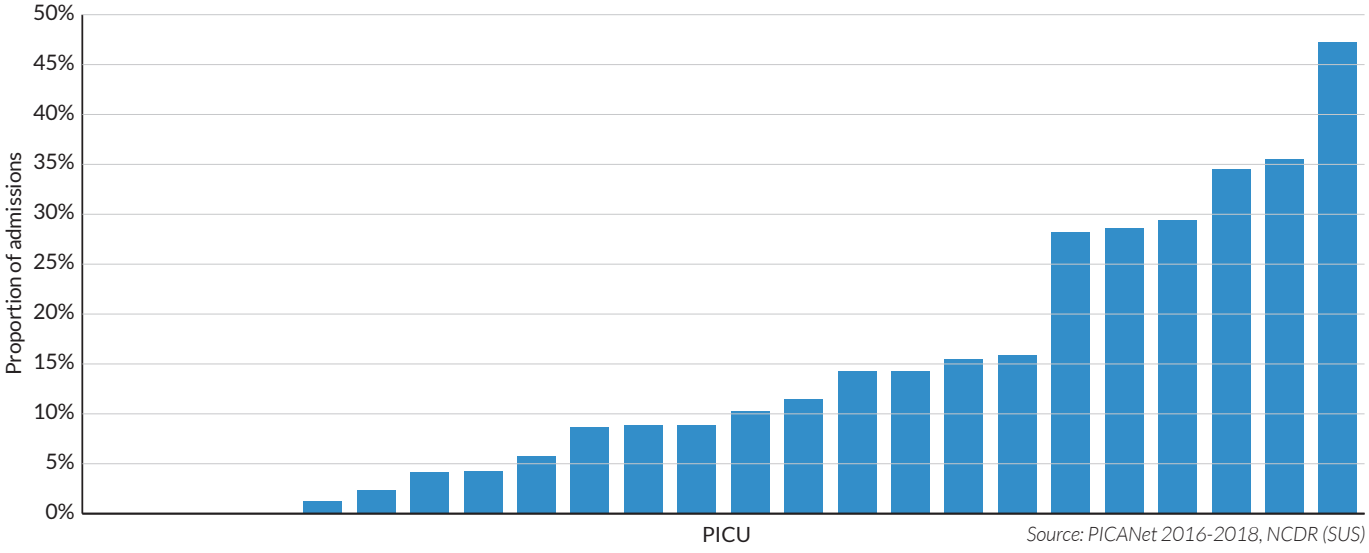
Medical pathways

Relative dependence on L3 beds across a number of medical pathways was also explored.

Acute bronchiolitis is caused by a respiratory virus and typically affects the lungs of infants in the first 12 months of life. It can lead to low oxygen levels and increased work of breathing, requiring additional respiratory support. Some forms of respiratory support can be delivered within paediatric wards whilst more advanced forms of respiratory support will require admission to a L2 or L3 bed.

Across L3 providers the average rate of admission to a L3 bed for infants admitted to the hospital with acute bronchiolitis is 5.7%, but varies from 0.8% to 10.7%. Some of this variation could be accounted for by known patient risk factors that could lead to more severe disease, for example prematurity or underlying lung disease, but additional analysis reveals that a lot of the variation is explained by the admission of higher volumes of L0 and L1 patients to L3 beds in some providers than others (see **Figure 25**).

Figure 25: Proportion of PICU admissions with acute bronchiolitis who only receive L0 or L1 care during their PICU stay



Source: PICANet 2016-2018, NCDR (SUS)

Exactly the same was found in our analysis of children admitted with a diagnosis of pneumonia or lower respiratory tract infection, highlighting the fact that step-up pathways for children requiring HDC are much better developed in some providers than in others.

Making efficient use of L3 beds

Efficiency can be considered in a number of ways, including whether there is judicious use of L3 beds for those patients who require L3 care, but also by considering whether the pathway for patients requiring L3 care is associated with a shorter length of PICU stay, better outcomes, and fewer adverse events. Length of stay, adverse events and outcomes will be considered in section '*Patient experience, quality and outcomes*' on page 75. Here we will consider the judicious use of L3 beds.

Threshold for admission

A number of metrics allow us to compare the threshold for admission across different providers.

Severity of illness at the point of L3 admission can be measured using the Paediatric Index of Mortality (PIM) score, a validated risk adjustment model that estimates the probability of death (POD) for each admission. L3 units vary in the

proportion of admissions that fall into the lowest risk stratum (less than 1% predicted POD), from 24 to 75%. Similarly, the average POD varies from 1.2 to 5.7% between different units, highlighting variation in severity of illness at the time of L3 admission.

The **complexity of care** that is required by each patient can also be examined using the HRG system, which can be simplified further from eight categories to four categories by looking at the level of PCC delivered. The highest level of care delivered on day one of the admission, or across the whole PCC episode, can be used to provide a measure of differing admission thresholds.

Applying the highest level of care criterion it is again apparent that there is wide variation in the threshold of admission. Across all providers the proportion of admissions that reach L3 care is 64%, but this ranges from 13 to 88%. Overall 19% of admissions do not reach L2 or L3 care, with data from combined L2/3 units showing a higher % than that for L3-only units (30% vs 6%).

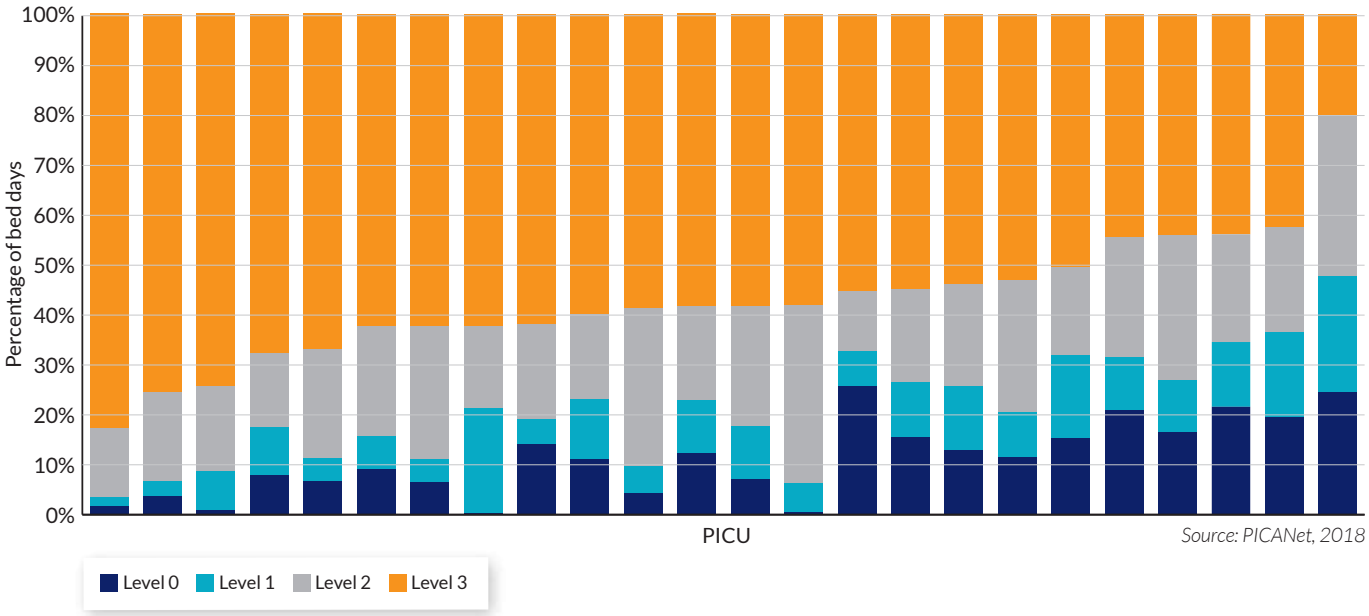
Use of resources

From a resource utilisation perspective, it is more relevant to consider the numbers of bed days rather than the number of admissions. In general, L0 or L1 patients will have a shorter PCC stay so would be expected to have a lesser impact on the efficiency with which resources are used.

It is to be expected, and is entirely appropriate, that a proportion of L3 unit bed days will be utilised to deliver care at levels below L3 since step-up and step-down components of a child's PICU stay will be captured. However, variation in this proportion across providers may provide us with additional insights about how L3 beds are being used.

Figure 26 shows a breakdown of the proportion of PICU bed days delivered at each level of care for every L3 provider. Across all providers the proportion of total activity that is L3 activity is 59%, but this ranges from 20 to 83%. Overall, 19% of bed days are delivered at L0 or L1, with data from combined L2/3 units again showing a higher % than that for L3-only units (26% vs 14%).

Figure 26: Proportion of total PICU bed days delivered at level 0, 1, 2 and 3 for all L3 providers



Source: PICANet, 2018

There is wide variation between L3 providers in the efficiency with which L3 beds are used. There is currently insufficient oversight or reporting of metrics that provide an indication of how judiciously L3 beds are being used. Improved reporting through national audit (PICANet) and PCC dashboards will be needed in order to deliver better use of resources.

In addition, there is often no financial disincentive to filling a L3 bed with a L0 or L1 patient as most providers are commissioned using a model that does not consider the complexity of care being delivered, despite there being a five-fold difference in the cost of delivering care between XB09Z (L0) and XB01Z (the highest HRG within L3). This is further considered in *Commissioning and funding* see page 96.

Models of delivery of high dependency care (L2 care) within L3 providers.

We encountered a number of different models of L2 care through GIRFT deep dives. The models can broadly be divided into those that deliver a 'centralised' model and those that deliver a more 'distributed' model of care, as discussed below.

Centralised L2 care

Centralised delivery of L2 care can either be delivered within a combined L2/3 unit, or within a separate, discrete L2 unit. In the former, senior clinical supervision is universally provided by intensivists, whilst in the latter model practice varies with supervision by intensivists, general paediatricians, or a combination. A centralised L2 unit typically accepts patients from any speciality.

Distributed L2 care

Distributed delivery generally involves delivery of HDC across a number of ward areas, usually within designated specialty ward beds rather than a discrete unit. Senior clinical supervision is usually provided through the specialist teams, though in some cases additional HDC support is put in place, along with an outreach team where this exists. 24/7 supervision by an intensivist is unusual in providers with a distributed model of L2 care.

IN PRACTICE

System of critical care support within a distributed HDU model

Birmingham Women's and Children's NHS Foundation Trust (Birmingham Children's Hospital)

- HDU+ is a clinical service providing review of patients receiving HDU-level care outside of the PICU environment.
- A critical care consultant, working closely with the PCC outreach nursing team, rounds on HDU patients from all specialties across the hospital, seven days a week. A second round, delivered by a PCC middle-grade doctor / ANP, takes place every night.
- The HDU+ team work closely with the primary team as well as with the PICU team. Every patient discharged from PICU in the previous 24 hours is also reviewed as a 'step-down' review.
- Since implementing the service the PICU unplanned admission rate has decreased, and there has been a >30% reduction in level 1 and 2 patients in PICU (>1000 fewer bed-days per year), releasing PICU beds for level 3 care, and delivering safe HDC beyond PICU.

Is one model better than another?

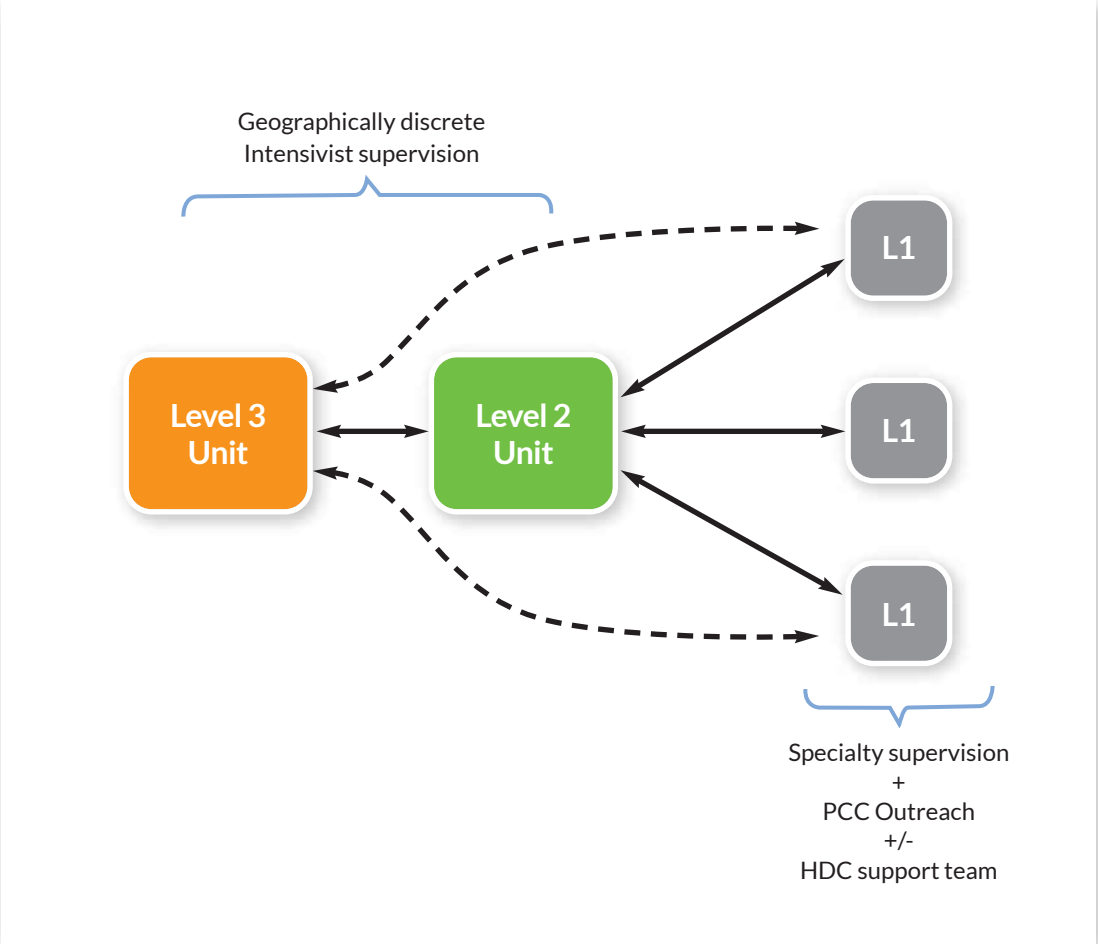
There is currently a paucity of data pertaining to L2 beds, as too few L2 units are capturing and reporting data. More robust data with which to explore the relative efficiency of different service configurations is needed and will hopefully be facilitated by the capture of L2 bed activity through PICANet in the near future.

Through the process of GIRFT deep-dive visits we observed that with a distributed model of L2 delivery there is often a 'ceiling' to the range and/or intensity of care that can be offered, such that some L2 interventions that are possible in providers using a centralised model are not possible in a distributed model. An example of this is the delivery of acute non-invasive ventilation to an older child. We observed that this was rarely possible within a distributed model of HDC delivery, and generally required admission to a L3 bed. Our impression is that this ceiling effect is, at least in part, explained by the challenge within a distributed model of providing 24/7 supervision by critically care trained medical and nursing staff.

With respect to a centralised model of care we observed that co-location of L2 and L3 beds in a combined unit was, in general, less efficient, in terms of higher bed utilisation by L 0 and 1 activity, than having separate L2 and L3 units. This may be because the judicious use of L3 beds is in sharper focus in a L3-only unit. A model of separate L2 and L3 units, both under the supervision of intensivists, is used in Liverpool and is associated with the lowest use of L3 beds by L0/1 patients (3.0% of total activity), as well as the shortest duration of PICU stay post-extubation (1.1 days).

Supplementing a centralised multi-specialty L2 unit with satellite, distributed HDC beds within specialty wards appears to be a model that works well, particularly when these specialty ward areas are also supported by the PCC team. This reduces dependence on the L2 unit beds for delivering some of the specialist surgical pathways, for example the scoliosis surgery and craniotomy pathways, and also supports delivery of specialist medical interventions, such as low-level inotropic support to cardiac patients and intracranial pressure monitoring and/or external ventricular drainage in children with hydrocephalus. (see **Figure 27**).

Figure 27: Schematic describing a proposed model of PCC delivery within a L3 provider



Other factors that impact on L3 bed efficiency

Long stay admissions

As reported in 'About paediatric critical care' above, average length of PICU stay is increasing steadily over time. Much of this is explained by a small proportion of admissions which consume a large number of bed days and increase average length of stay. Only 3.3% of admissions across England stay in PICU longer than 28 days but together they consume 34.5% of all bed days (see **Figure 4** on page 25). In some units these long stay admissions utilise a much larger proportion of bed days than others (range 17% to 54%).

Some of this is explained by an increasing population of children with complex needs who are more likely to have a prolonged stay in PICU. However, it is difficult to delineate this group clearly using current coding and data capture. In adult practice, use of a co-morbidity index (e.g. the Charlson comorbidity index) allows identification of groups of patients with differing degrees of comorbidity and, importantly, different levels of mortality risk if admitted to hospital. However existing comorbidity indices are not applicable to paediatrics as the relevant comorbidities are very different.

Development of a paediatric comorbidity index would be valuable in identifying children with different levels of underlying complexity and would support the development of more robust paediatric mortality risk prediction models.

LTV pathway

A recent NCEPOD report[17] highlighted that it is taking too long to get children who are dependent on long-term ventilation discharged to home, and too often they are remaining in a critical care bed long after they are clinically stable and fit for critical care discharge. The GIRFT review has confirmed this but has also been able to identify providers in which the LTV pathway works well.

IN PRACTICE

Effective LTV pathways that minimise the time a child spends in PICU

Alder Hey Children's NHS Foundation Trust | University Hospitals of Leicester NHS Trust (Leicester Royal Infirmary)

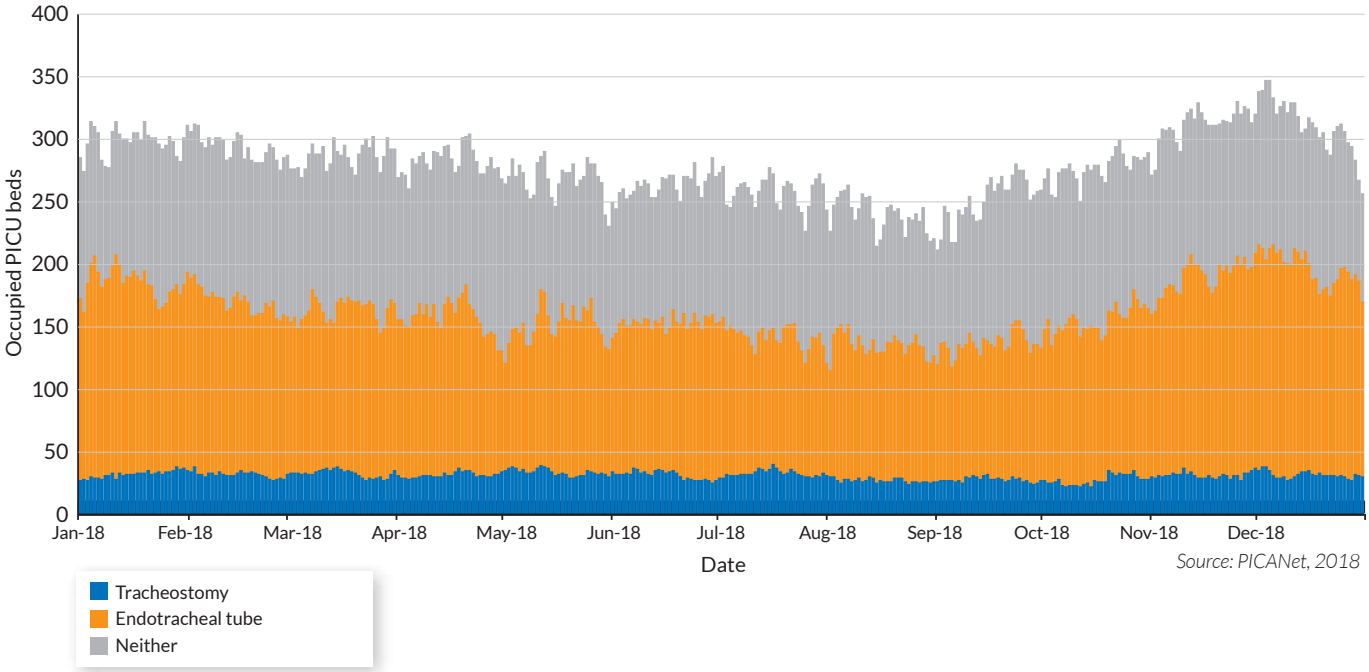
- Tracheostomy ventilated patients are managed outside PICU, in either a ward bed or an HDU (level 2) bed, wherever possible.
- Transitional care beds for clinically stable LTV patients awaiting discharge home.
- Stable home non-invasive ventilation patients are managed on the paediatric ward.
- A dedicated multidisciplinary team co-ordinates care, both within hospital and at home.
- WellChild nurses provide parental education and support along with the complex care team, facilitating discharges across the region.
- LTV and critical care teams work closely, with some clinicians having clinical responsibility across both LTV and critical care, and others across LTV and respiratory medicine.
- Early intervention and treatment via virtual clinics keep admission rates to hospital.

LTV encompasses children who require home ventilation via a mask (non-invasive ventilation) and those who require home ventilation via a tracheostomy (invasive ventilation). A limitation of current ICD and OPCS coding is that it is not possible to easily identify these children, resulting in a NCEPOD recommendation to improve the coding possibilities for the LTV patient group. As any change to ICD or OPCS coding can take a number of years to full implementation it is recommended that PICANet consider adding a limited number of data fields to their dataset in order to better identify this patient cohort within the overall PCC population. Separation of non-invasive LTV patients from tracheostomy LTV should be possible with careful selection of data fields.

[17] *NCEPOD, 2020. Balancing the Pressures, www.ncepod.org.uk/2020ltv/LTV_Full_Report.pdf*

In 2018 tracheostomy ventilated patients represented 3.8% of all PICU admissions and consumed 9.6% of all bed days. **Figure 28** shows the proportion of PICU beds that were occupied each day by children receiving tracheostomy ventilation, along with the number of children receiving invasive ventilation via an endotracheal (temporary breathing) tube for comparison.

Figure 28: Midday bed census data (2018) showing the number of children each day receiving ventilation via a tracheostomy. For comparison the number of children receiving ventilation via an endotracheal tube is also shown



Source: PICANet, 2018

The proportion of bed days utilised by tracheostomy ventilated children varies markedly across providers from 0.1 to 33.8%. It is clear that in some providers the LTV pathway is contributing significantly to inefficient use of L3 beds, with these children rarely requiring additional critical care interventions beyond ventilation. Importantly, this also represents a poor child and family experience, surrounded by critically ill children and their stressed families, loud monitoring alarms and high ambient light levels 24/7.

Alternative pathways within a L3 provider include care within a L2 unit (where one exists), or within a dedicated LTV ward or unit, or care within a general/respiratory ward. Delivery of care within a L2 unit shifts the problem from L3 beds but frequently results in precious 'acute' L2 beds becoming blocked for long periods of time. It was not at all clear from GIRFT visits that a dedicated LTV ward or unit is better at reducing dependence on L2 and L3 beds, in fact some of the best examples we heard about involved delivery of care for LTV patients within a general/respiratory ward.

Assessment of stability of LTV patients

A clinical assessment of the stability of an LTV patient has been advocated as useful in determining where care should be delivered, and, importantly, also in determining whether a child occupying a PICU bed meets criteria for NHS England and NHS Improvement funding, with responsibility moving from NHS England and NHS Improvement to CCG after 90 days of 'clinical stability' on the PICU. However, application of this 'rule' has been problematic, not least because any assessment of stability is highly subjective and open to interpretation.

PCC HRGs can help in differentiating children who are stable from those that are unstable, but the potential value of HRGs has not been realised.

Appendix 3 provides further detail regarding how different PCC interventions delivered to a patient on tracheostomy ventilation determine the HRG category on that day. Patients who map to XB05Z – XB01Z (L3) should be considered unstable and be cared for within a L3 bed, but the majority of patients who map to XB06Z (L2), and all those that map to XB07Z (L1), should be considered stable and generally be cared for in a suitable ward environment.

Networked care

In the future, an improved networked solution for delivering hospital care for these children is needed, with designated spoke hospitals able to accept them for step-down care from the L3 hub and to admit them acutely from home when admission criteria suggest it is safe to do so. Every ODN should prioritise development of this pathway.

L2 spoke hospitals within an ODN will be expected to support this pathway, but ODNs should consider whether any other spoke hospitals can also contribute, particularly where they have already been providing this care and/or are geographically isolated. In this situation consideration should be given to delivering this care through an L1+ model, with NHS England and NHS Improvement regional team or ICS support.

Delayed discharge

Children should, ideally, be discharged to the ward within four hours of a decision to discharge (PICS QS), though this must be interpreted alongside the recommendation that children should not be discharged from PICU overnight. Failure to discharge a child when they are fit for discharge will increase strain on PCC beds. Collection and reporting of delayed discharge information is inconsistent at present. Although 16 L3 providers (76%) reported collecting delayed discharge data they used five different definitions of delay, capturing delays exceeding 4, 6, 8, 12, and 24 hours. Only 10 providers were able to report the number and percentage of discharges that were delayed. These units reported an average rate of delayed discharge greater than 24 hours of 9.6% (range 2.3 to 17.1%).

The current NHS England and NHS Improvement Quality Dashboard for PCC does not capture or report this data. ACC units report both 4 hour and 24 hour delayed discharges. As a minimum it is recommended that L3 providers collect and report discharges that occur more than 24 hours after the patient is deemed fit for discharge from a L3 bed. This could be achieved by adding this metric to the NHS England and NHS Improvement SSQD and to PICANet.

IN PRACTICE

Facilitating timely discharge from PICU

Guy's and St Thomas' NHS Foundation Trust (Evelina London Children's Hospital)

- Potential discharges for that day are highlighted on a daily Sitrep, which is widely circulated via email by the on-call PICU consultant at 7.30 – 8.00 each morning.
- This is picked up by the Paediatric Nurse Practitioner (PNP), and is usually augmented by a conversation between the PICU nurse in charge and the PNP that morning.
- Children identified for potential discharge the next day are identified during a 4pm bed 'huddle' with the hospital manager, paediatric consultant and PICU consultant. Plans are made, including identifying the ward location and ensuring medical and nursing teams are forewarned.
- All discharge paperwork is completed by the PICU team overnight. The bed is confirmed again by the night time PNP at 6am and a departure time is identified.

Repatriation to referring hospitals

It is possible to reduce demand on ward beds within the L3 hospital by discharging children directly back to spoke hospitals whenever clinically appropriate, particularly when the child was transferred into PICU from a spoke hospital. This process is called repatriation and it is particularly important for L3 hospitals with a high proportion of PICU admissions that are transferred in from other hospitals. It will not always be appropriate, particularly for children requiring ongoing specialist care, but should always be considered.

Across England only 23% of children are repatriated from PICU back to a spoke hospital. In some hospitals this pathway works well and results in greater than 50% repatriation, but it is time-consuming and is dependent on regular, effective senior staff communication between the hub PICU and the referring hospital.

IN PRACTICE

Repatriating children to spoke hospitals

University Hospitals of North Midlands | Imperial College Healthcare NHS Trust (St Mary's Hospital)

- Early identification (ideally the day before discharge) of children approaching PICU discharge and initial contact made with the other hospital (via PICU nurse and middle grade) requesting a bed.
- Where there is a block to repatriation an early escalation process is put in place, with matron to matron and/or consultant to consultant discussions.
- On rare occasions escalation to a senior manager for discussion may be required.

L3 providers should aim to repatriate children to the referring hospital whenever it is safe and clinically appropriate to do so.

Recommendations

Recommendation	Actions	Owners	Timescale from date of publication
10. Undertake research to develop a comorbidity index for children (research recommendation)	**a** National Institute for Health Research (NIHR) to consider commissioning research to develop a tool to identify children with important comorbidities, that can be used to improve coding, audit, and to improve mortality risk prediction in hospitalised children.	NIHR , PCCS SG, PICANet .	Within 24 months
11. Develop network clinical pathways, which clearly describe aspects of care that are to be delivered within each spoke hospital, and implement regular monitoring of spoke activity and spoke to hub PICU transfers.	**a** Develop written network pathways of care for at least the following, identifying aspects of care that should be delivered in spoke hospitals (L1, 2), and criteria for referral to L3: i) Care of a child with a tracheostomy ii) Care of a child on home non-invasive ventilation requiring admission to hospital iii) Care of a child on home invasive (tracheostomy) ventilation requiring admission to hospital iv) Care of an infant with bronchiolitis requiring acute continuous positive airway pressure (CPAP) v) Care of an older child requiring acute CPAP	ODN	For immediate action
	b ODNs should ensure that positive aspects of current delivery are maintained as much as possible, as long as evidence supports safe, quality care and outcomes.	ODN	For immediate action
	c Where necessary the ODN should approve local deviation, or derogation, from current L2 guidance and standards where L1 spokes are approved to deliver elements of care that are above current definitions of L1 care.	ODN	Within 12 months
	d ODN to monitor the frequency with which PCC elements of these and other pathways are being delivered within each spoke hospital, through regular collection and review of Paediatric Critical Care Minimum Dataset (PCCMDS) data.	ODN	Within 24 months
	e ODN to monitor the rate of spoke to PICU transfer across their providers, and aim to drive down the rate through implementation of improved pathways and enhanced PCC education to spoke hospitals.	ODN	Within 24 months
12. Ensure that L3 beds are used efficiently, with alternative pathways in place to minimise the use of L3 beds by patients who do not require L3 care.	**a** Level 3 providers should develop a PCC system that enhances step-up and step-down pathways beyond PICU, thereby reducing the proportion of L0/1/2 activity delivered in designated L3 beds.	L3 provider	For immediate action
	b Monitor bed day utilisation to ensure that use of L3 beds to deliver L0/1 care is kept to a minimum. Target: <10% of bed days in L3 beds should be L0/1.	L3 provider	For immediate action
	c Hospitals providing paediatric services should have a single 'hospital wide group' responsible for the co-ordination and development of care for critically ill children (Paediatric Critical Care Society (PCCS) Quality Standard).	L3 provider	For immediate action
	d Within L3 providers this group should be actively involved in ensuring that effective step-up and step-down pathways are in place to avoid L3 admission as much as possible.	L3 provider	For immediate action

Recommendation	Actions	Owners	Timescale from date of publication
12. (continued)	**e** L3 providers should monitor and report delays in critical care discharge of greater than 24 hours from the time when the patient is deemed fit for critical care discharge. Target: <5% of discharges.	L3 provider	For immediate action
	f Consideration should be given to adding this metric to the NHS England and NHS Improvement Speciality Services Quality Dashboard (SSQD), and to PICANet and other relevant dashboards.	NHSE/I, CRG, PICANet.	Within 12 months
13. Develop improved long-term ventilation (LTV) pathways, to deliver hospital care, when it is necessary, as close to the child and family home as possible.	**a** ODNs should develop a clear pathway for children on home ventilation who require hospital admission, aiming to deliver that care within an ODN spoke hospital close to the family home wherever possible.	ODN, L3 provider, and provider respiratory teams.	Within 12 months
	b Level 3 providers and ODNs should develop an improved pathway for children dependent on long-term ventilation that delivers care in a non-critical care environment unless the child is clinically unstable.	ODN, L3 provider, and provider respiratory teams.	Within 12 months
	c HRG data should be used to monitor whether care is being delivered in the right place. Indicative targets for patients recorded as receiving tracheostomy ventilation: L3 beds: <25% of related bed day activity should be L2 (XB06Z), <10% L1 (XB07Z). L2 beds: <20% L1. These targets are indicative and should be informed and modified by future data from the paediatric intensive care audit network (PICANet) using a best practice approach (target top quartile).	L3 provider, PICANet. PICANet	Within 12 months Within 12 months
	d PICANet should consider adding coding terms with which to identify this cohort of patients within PCC national audit, ensuring that tracheostomy ventilated and non-invasively ventilated patients can be identified separately.	PICANet	Within 12 months

Patient experience, quality and outcomes

Patient experience

A positive patient experience is difficult to define precisely but in the context of the journey of a critically ill child, and their family, there are a number of important contributors:

- good paediatric ward care, with early detection of patient deterioration;
- early intervention, and good critical care support;
- access to a PCC bed when it is needed;
- good communication between the PCC team and the family;
- good clinical care delivered by the PCC team;
- delivery of safe care, within a culture of safety reporting and learning;
- good clinical outcomes;
- rehabilitation to full recovery, or a well-managed palliative care experience.

Early detection of patient deterioration

Every spoke and hub hospital in England reports using an early warning system, embedded within bedside monitoring on their paediatric wards, but there are too many different systems in use and a lack of consistency between hospitals within a network. It is anticipated that a new national paediatric early warning system, being developed by NHS England and NHS Improvement and RCPCH, will be rolled out across all paediatric providers in 2021/22 after piloting. It is essential that adoption of the new system is made mandatory for all providers.

Early intervention and good critical care support

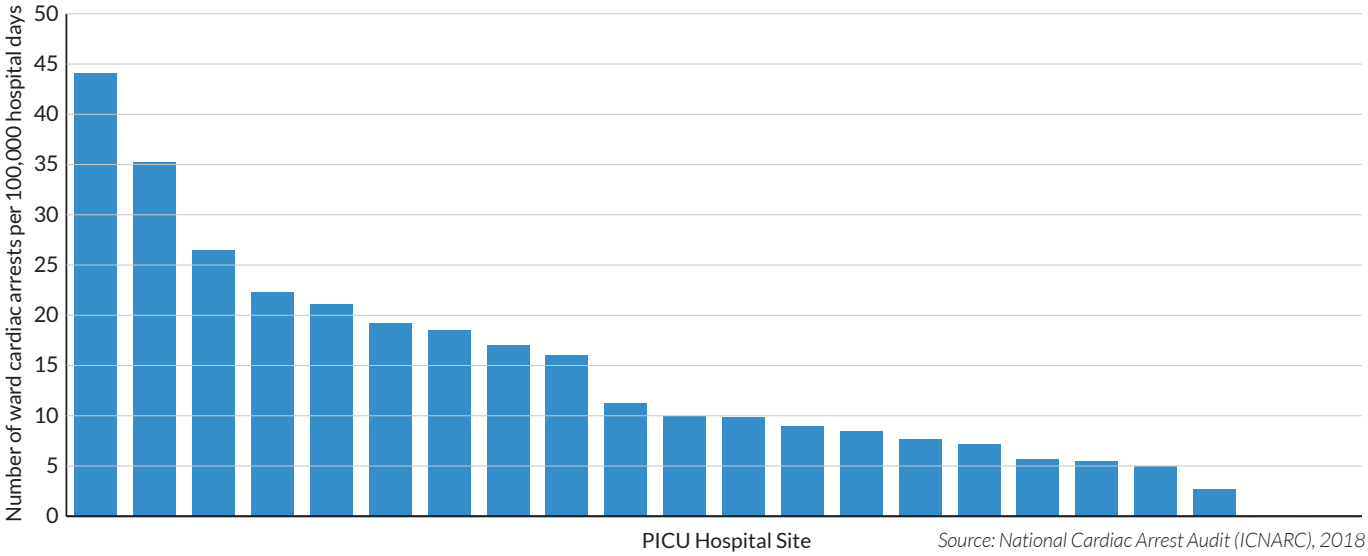
The emphasis has shifted over time from a rather narrow focus on PICU towards an appreciation that the scope of PCC is much wider, and that the responsibility of the PICU team extends into delivery of HDC and care of the critically ill child more generally. This has been reflected in a change in name of the UK professional society from Paediatric Intensive Care Society (PICS) to Paediatric Critical Care Society (PCCS).

The degree to which there is effective integration of the PCC system across a whole organisation is variable. Overall, 74% of specialist paediatric teams within L3 hub hospitals agreed or strongly agreed with the statement 'the PICU team is interested in the care of critically ill children outside PICU', but this was 50% or below in five L3 hubs.

Cardiac arrest on paediatric wards

Failure to detect patient deterioration, and to intervene early, may result in cardio-respiratory arrest on the ward. Although a rather blunt outcome, and one that occurs with a very low frequency, it is perhaps the best we currently have to assess and compare PCC system performance. All L3 providers return data to the National Cardiac Arrest Audit (NCAA). **Figure 29** shows the rate of ward cardiac arrest for all L3 hubs, expressed as the number per 100,000 hospital days in order to correct for hospital size. Overall, the rate is 14.6 per 100,000 hospitals days, but this varies from 0 to 44 across L3 providers suggesting that in some organisations the system of early detection and intervention could be improved.

Figure 29: Rate of ward cardiac arrest for all L3 providers, expressed as the number of events per 100,000 hospital days



Source: National Cardiac Arrest Audit (ICNARC), 2018

L3 providers should monitor rates of ward cardiac arrest and aim to drive down the rate over time through implementing improvements across the PCC pathway.

Critical care outreach teams

Critical care outreach teams were first developed in ACC, in response to the publication of Comprehensive Critical Care (2000).

Their aim is to intervene beyond the boundaries of the critical care unit to prevent unnecessary mortality and morbidity by responding early to signs of physiological deterioration, allowing for timely intervention and admission to critical care where necessary. Early intervention may avoid PCC admission completely or result in admission to a L2 bed rather than later admission to a L3 bed, improving efficient use of resources.

Outreach models work in different ways, but the results should be similar across all trusts:

- identifying patients who would benefit from critical care at an earlier stage;
- intervening with appropriate treatment, which could be ward-based or involve a critical care admission;
- educating ward staff to facilitate earlier critical care referral.

In addition, an effective escalation plan should be put in place. The team is typically nurse-led though some teams incorporate a PICU consultant or registrar.

IN PRACTICE

Establishing a clear escalation plan

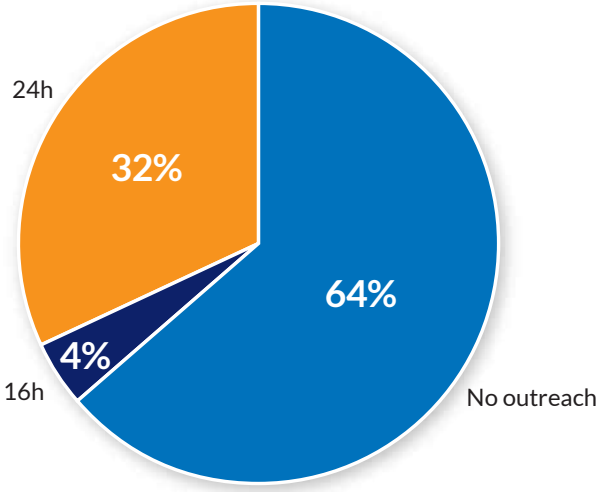
University Hospitals Bristol NHS Foundation Trust (Bristol Royal Hospital for Children)

- In 2017 a new three level response hierarchy was implemented to improve early detection of deterioration and intervention.
- Minor deteriorations in Paediatric Early Warning Score trigger a review by the PCC outreach team, whilst more significant deteriorations trigger either a rapid review, attended by the paediatric registrar, HDU registrar and PICU registrar, or a medical emergency team ('resus' team) call.
- The aim is to bring senior decision-makers to the bedside in a timely fashion to facilitate appropriate escalation of care.
- Rates of cardiac arrest on the ward have fallen as a result.

From our deep-dives visits it is clear that outreach teams, where they work well, establish strong relationships and networks across the hospital between the emergency department, paediatric wards, paediatric anaesthesia and critical care units.

Currently only nine L3 providers (43%) have an outreach team and their availability varies from a 5-day daytime service, to a 7-day 24 hour service (see **Figure 30**). It is recommended that every L3 provider put in place a system of PCC outreach that is available 24/7.

Figure 30: Current provision of PCC outreach teams across L3 providers (showing availability on a Sunday)



Source: PCC GIRFT Questionnaire, 2020

Delivery of safe care, within a culture of safety reporting and learning

The critical care unit is a high-risk environment in which complex, often invasive, interventions are delivered to children with organ system failure and limited physiological reserve. Errors and adverse events are inevitable, but the important thing is that when then they occur, they are recorded, reported and shared throughout the PCC team, so that learning occurs and patient safety incidents can be reduced over time. This requires a multifaceted approach in order to deliver effective and sustainable change.

Accountability is essential but the culture within a unit should be open, honest, transparent, and one in which responsibility for a patient safety incident is not ascribed to an individual but is viewed more as a weakness in system design.

From deep-dive visits it is apparent that there is excellent safety monitoring going on across PICUs, as well as systems in place to learn and improve practice. We heard of many excellent initiatives driving quality improvement, including a new approach to encourage sharing and learning from excellent practice and other focused pieces of work that have driven down patient safety incidents.

IN PRACTICE

Recognising and reporting excellent practice

Birmingham Women's and Children's NHS Foundation Trust (Birmingham Children's Hospital)

- Learning from excellence (LfE) has two aims – to learn from what is working well, and to provide positive feedback to colleagues.
- Staff submit 'excellence' reports when they witness excellence at work. These are the shared directly with the individual or team to provide positive feedback and demonstrate the impact of excellent work.
- Selected cases are investigated to consolidate learning and to generate improvement ideas.
- Over 10,000 reports have been submitted in this trust since 2014 and a community of practice has developed around the NHS, and overseas.
- The approach has been embedded into quality improvement projects.

IN PRACTICE

Quality improvement methodology to reduce unplanned extubation

University Hospitals Bristol NHS Foundation Trust (Bristol Royal Hospital for Children)

- As part of a PICU Quality and Safety Improvement programme, RESTRAPPED is an initiative that has led to a reduction in the rate of unplanned extubation (UE).
- Any staff member is empowered to speak up around endotracheal tube (ETT) safety, with bedside nurses documenting ETT safety as part of their safety checks.
- Any unsecure ETT is reported and a trained 'restrapper', from the senior nursing or physiotherapy team, will attend to restrap the tube using a unit approved method, supported by a comprehensive guideline and checklist.
- Real-time monitoring of the UE rate using a statistical process control chart is reviewed monthly in a clinical governance meeting. This allows early detection of a change in rate, enabling the team to understand themes through incident reporting, and put in place measures to regain control of the process.

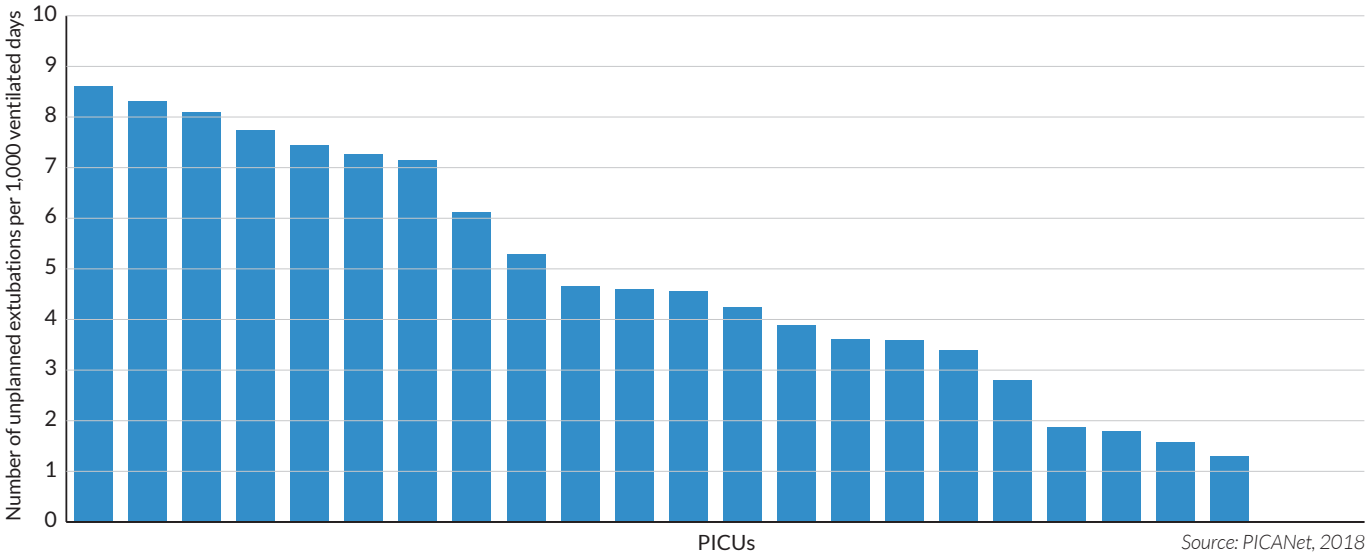
Unplanned extubation (UE)

Unplanned extubation occurs when an endotracheal (temporary breathing) tube comes out of a patient's airway at a time that is not planned. It is potentially life-threatening if the patient is unable to breath for themselves and if not detected and responded to quickly.

In most units collection of UE data is embedded within daily PICANet data capture, linked to PCCMDS data capture, which ensures better data capture than reliance on incident reporting which is known to significantly underestimate the frequency.

The rate with which UE occurs is very variable across L3 providers (see **Figure 31**). Although this is suggestive of differences in overall quality of patient care, there are additional confounding factors that will impact on the rate. The potential consequences of an UE will depend on the stage of weaning from the ventilator at the time of the event, with lower risk if the event occurs in the context of a child who is on low ventilator settings and is only lightly sedated.

Figure 31: Rate of unplanned extubation in each L3 unit, expressed as the number of events per 1,000 days of ventilation via an endotracheal tube



Source: PICANet, 2018

Consideration should be given to adding an additional field to capture UE events that result in re-intubation of the patient, as this represents a more worrying subset of UEs.

Healthcare associated infections (HCAIs)

Critically ill children are at greater risk of acquiring a hospital or healthcare associated infection (HCAI). In part, this relates to the presence of one or more invasive tubes and lines for monitoring or therapeutic purposes, as well as an immune system that is compromised by critical illness.

Patients who experience HCAIs have a more prolonged length of stay in ICU and hospital, and increased mortality. Surveillance monitoring and interventions to drive down the HCAI rate are therefore important. A national surveillance system called the Infections in critical care quality improvement partnership (ICCQIP) was introduced in 2016 to facilitate capture of HCAI and allow benchmarking across ICUs; adult, paediatric and neonatal.

Within the GIRFT review we captured information relating to bloodstream infections associated with an indwelling central venous line (central line associated bloodstream infections, CLABSI), and urinary tract infections associated with an indwelling urinary catheter (catheter associated urinary tract infections, CAUTI). There were 18 out of 24 units (75%) that reported collecting CLABSI data but only 14 were able to provide their CLABSI rate. As of July 2020, only four units (16.7%) had reported CLABSI rates through ICCQIP since November 2018. The situation with respect to CAUTI is similar with eight units reporting that they capture events but only six able to provide their CAUTI rate.

It is recommended that all L3 providers introduce a system to capture and report rates of CLABSI and CAUTI, and that they contribute regular data to ICCQIP to facilitate meaningful benchmarking. It is recommended that ICCQIP HCAI definitions be used to ensure consistent reporting between providers.

Unplanned readmission to PICU within 48hrs

This metric is reported through the NHS England and NHS Improvement QD and is intended to provide a measure of how often children are discharged from a PICU before they are ready, requiring early readmission. Readmissions relating to planned procedures or other planned events are not included.

However, the rate of readmission will be influenced by factors that are beyond the control of the PICU. The casemix and complexity mix of admitted PICU patients will influence the rate, as will the step-down capability of the system beyond PICU. In addition, a provider with a combined L2/L3 unit will appear to have a lower rate of readmission than a provider with separate L3 and L2 units, as step-down from a L3 bed to a L2 bed will generate a L3 unit discharge in the latter arrangement but not in the former.

For these reasons caution should be used in over-interpreting this metric, and further refinement of this metric would be advantageous. Separation of activity being delivered in L2 and L3 beds, as recommended, will improve interpretation if the metric is adapted to record 'unplanned readmission to a L3 bed'.

Good clinical care and outcomes

Reassuringly, 94% of paediatric specialists within L3 hubs rate the standard of clinical care delivered by the PICU team as good or excellent, and less than 2% rate it as below average. Similarly, 99% of spoke hospitals rate the standard of care delivered by PICU teams as good or excellent.

Communication from the PICU team is rated somewhat less positively but 78% of paediatric specialists within L3 hubs still rate it as good or excellent and only 3% rate it as below average or poor. Across spoke hospitals 72% rate it as good or excellent, so there is room for PICUs to improve communication both within their hub and with clinical colleagues working in spoke hospitals.

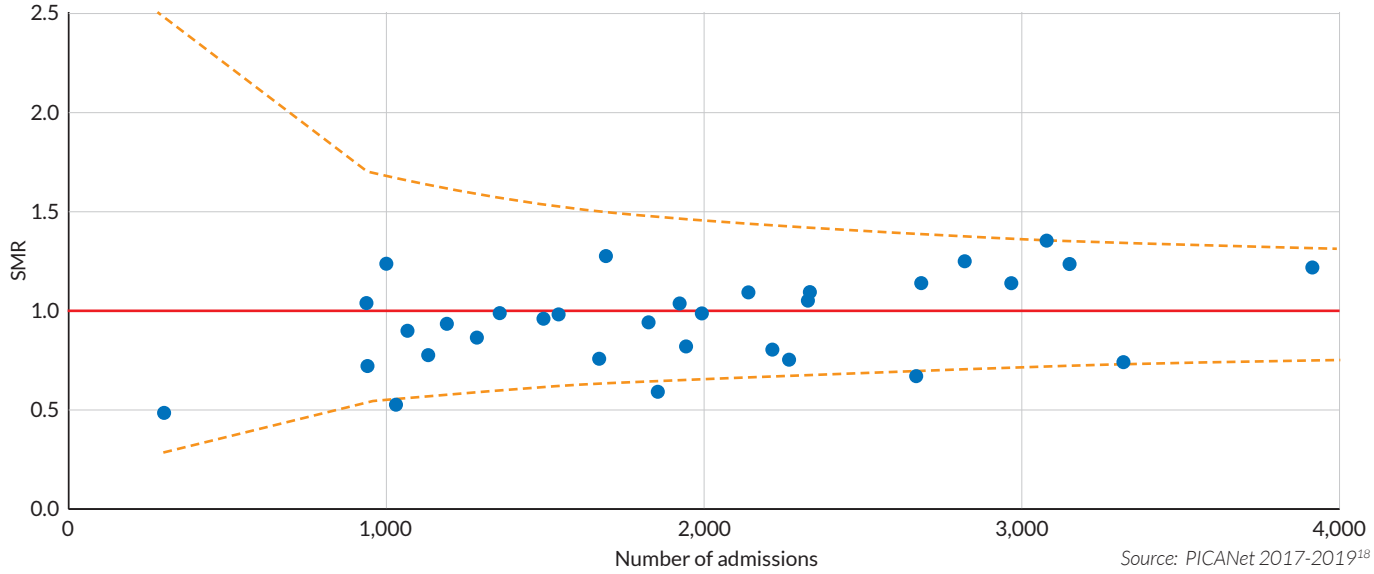
Mortality

For many years risk adjusted mortality has been the principle focus for benchmarking PICU performance, at least from the perspective of a patient relevant outcome measure. As risk adjusted mortality has fallen progressively over time so the risk adjustment tool (PIM) has been recalibrated. In addition to the annual reporting of a standardised mortality rate (SMR) for each unit, time series plots, called Risk Adjusted Resetting Sequential Probability Ratio Test (RA-RSPRT) plots, can provide units with changes in their standardised mortality over time and alert them to episodes of unexpected increases in mortality.

Risk adjustment, through PIM-3, captures elements of patient diagnosis, in the form of specified high and low risk diagnoses, type of admission (unplanned, planned, whether admitted post-cardiac surgery), whether ventilated or not, along with a limited number of acute physiological variables (oxygenation, blood pressure, acid-base).

SMR data is presented as a funnel plot, with the SMR value for each unit shown in relation to the total activity occurring in that unit (see **Figure 32**). Importantly, data is viewed and interpreted with reference to outlying confidence limits which are set wider for units with lower activity levels to reflect there being less statistical confidence in the value of SMR for a smaller unit. This caution is important in ensuring that minor deviations in SMR, which naturally occur over time, do not fall outside the confidence limits, triggering a formal governance process and review.

Figure 32: Risk adjusted standardised mortality ratio (SMR) by health organisation



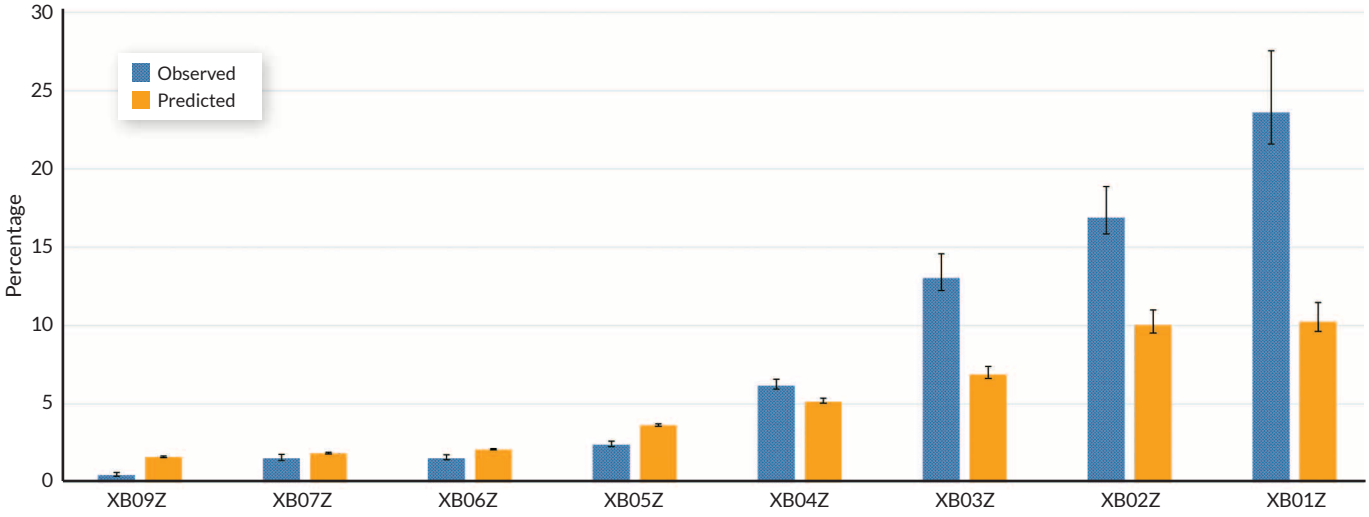
Source: PICANet 2017-2019[18]

[18] *Paediatric Intensive Care Audit Network, 2020. Annual Report, Summary Report. https://www.picanet.org.uk/wp-content/uploads/sites/25/2021/02/PICANet2020_AnnualReportSummary_v1.0.pdf*

However, from the perspective of assessing relative performance between units, too narrow a focus on whether or not a unit lies within the confidence limits will obscure the fact that there is widespread variation in SMR, with a greater than 2-fold difference between the lowest and highest SMR units. Whilst SMR, and therefore relative rank or position, may vary from year to year, there are units that can be identified as consistently delivering a very low SMR over many years (implying excellent care), and yet we understand little about what this means, how it is delivered, and what others can learn.

A number of factors over and above the existing PIM variables are known to impact on risk of mortality, including deprivation, ethnicity, casemix, presence of comorbidities and/or life limiting conditions, as well as the complexity of care required in PICU. **Figure 33** shows predicted death rates, based on PIM-3, and observed death rates according to the HRG level on the day of PICU admission. It can be seen that requirement for a higher complexity of care on the day of PICU admission (indicated by a lower HRG number) is associated with additional mortality risk over and above that predicted by PIM-3.

Figure 33: Predicted and observed death rates by initial (day 1) HRG category



Source: PICANet 2017-19 data

It is recommended that further work be undertaken to explore refinements in paediatric mortality risk prediction.

End of life pathway

More than 50% of children admitted to PICU have a life limiting condition (LLC). These children are 75% more likely to die in PICU than those who do not have a LLC[19]. Pathways for end of life care are inconsistent across L3 providers. Whilst the majority of PICUs do have access to a consultant in paediatric palliative care medicine within their organisation (82%), and meet regularly to discuss patients, a few still do not. The proportion of total hospital deaths that take place in PICU varies from 50 to 96%, reflecting variation in the effectiveness of end of life and parallel planning counselling, and palliative care options outside of PICU.

IN PRACTICE

Rapid ethics review by a paediatric bioethics team

Great Ormond Street Hospital for Children NHS Foundation Trust

- The team consists of clinicians, chaplains, ethicists, psychosocial experts, lawyers and previous parents of children cared for at GOSH
- Rapid ethics reviews are available for clinicians, researchers, families and children
- Meetings usually occur with the family, and sometimes the child
- Ethics education and training sessions, and sessions to combat moral distress, are delivered to the ICU team

[19] *Fraser LK, Parslow R Children with life-limiting conditions in paediatric intensive care units: a national cohort, data linkage study.Arch Dis Child 2018: 103: 540-547. https://pubmed.ncbi.nlm.nih.gov/28705790/*

Managing differing expectations between the family and the specialty clinical team can be difficult and an area that can be facilitated by the palliative care team. Rapid access to an ethics review may also be useful.

The breadth and depth of data capture relating to end of life care is currently very limited despite this area being highlighted as one of the highest rated challenges facing the PICU clinical team. Current coding does not allow easy identification of these children and does not capture the frequency with which there is consideration of end of life planning or involvement of the palliative care team.

The only existing PICANet data fields, collected at discharge, establish whether a child is being discharged for palliative care and, separately, whether a child is being discharged to a hospice. These events are rare, being recorded in only 0.7% and 0.3% of discharges. It is unclear whether this represents underreporting.

Improved capture of data relating to children with LLCs, and to end of life considerations in a wider sense, would be valuable. It is recommended that PICANet consider adding a limited number of data fields to better capture and describe this important pathway.

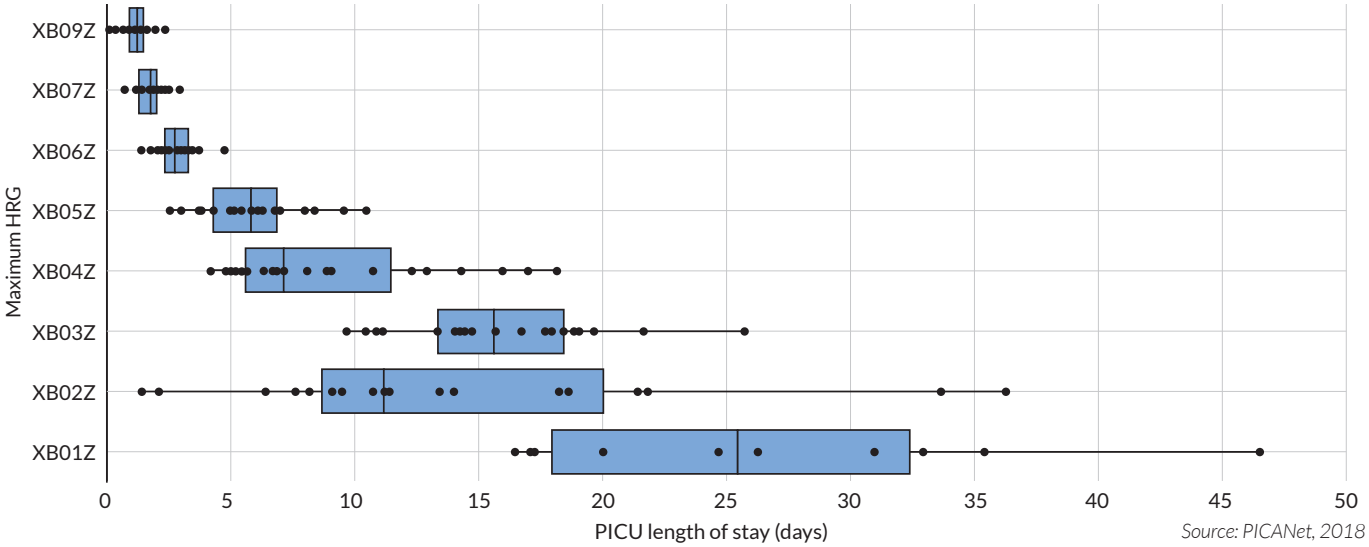
Length of stay

The length of time a patient remains in the PICU is often used as a surrogate for the efficiency of a unit. Length of stay (LoS) data is not evenly distributed so it is usual to present the median value along with the inter-quartile range (IQR) as a measure of variation (rather than mean and standard deviation).

However, LoS must be interpreted carefully when comparing units because many factors can affect it significantly. A patient's age, primary diagnosis, severity of illness at admission, length of ventilation, and also the complexity of care they require will all affect LoS. **Figure 34** shows length of stay data for all PICU admissions (median, IQR) broken down by the highest HRG level of care received throughout the PICU stay, reinforcing the relationship between increasing complexity of care and increasing length of stay.

Figure 34: PICU length of stay by maximum HRG level reached during PICU stay.

Box and whisker plots with inter-quartile ranges are shown.



Source: PICANet, 2018

In addition, LoS is affected by whether care is delivered in a L3-only unit or a combined L2/3 unit, with a longer LoS found in combined L2/3 units as higher volumes of L2 care are delivered in this model than within a system that discharges a patient once L3 care is no longer needed.

It is recommended that an adjustment model be developed, and adjusted LoS data be reported. This will allow more meaningful benchmarking of units and provide a useful metric of unit efficiency.

Unit or bed type

It is important that the scope of the national audit, PICANet, be expanded to capture, as a minimum, data pertaining to L2 beds across both hub and spoke hospitals. This is supported by all key stakeholders. It will be imperative that activity occurring in L2 and L3 beds be differentiated to support valid data interpretation.

Near real-time reporting of data

Within an ideal system data should be processed rapidly after collection and presented back in near real-time, via a system that is easy to access, using a visual presentation format that supports easy interpretation.

At present, few L3 providers have systems in place that match these ideals, but a number of providers set delivery of this objective as a key GIRFT objective. The roll out of electronic patient records (EPRs), including core aspects of electronic prescribing and clinical informatics, will improve data timeliness and data quality, will release staff time for patient and family care, and, importantly, will open up great opportunities for audit, benchmarking and research. In 2019, 82% of L3 providers had a fully integrated EPR in place. It is important that all providers implement a fully integrated EPR in the near future, following the guidance and recommendations of NHSX to ensure compliance with system standards. With EPRs available across all providers there will be great potential in future to integrate routinely captured PCC data to supply metric data in close to real time.

Whilst there is functional capability within PICANet (via a web portal) to provide regular reporting, if requested by units, the reality is that for many the focus is still on review of the PICANet annual report.

The Model Health System is an NHS England and NHS Improvement data-driven improvement tool that supports health and care systems to improve patient outcomes. It provides benchmarked insights across the quality of care, productivity and organisational culture to identify opportunities for improvement. The Model Health System incorporates the Model Hospital, which provides hospital provider-level benchmarking. Access to the Model Health System is available for all NHS commissioners and providers in England.

It is recommended that a single portal, such as Model Hospital, be used to deliver near real-time review across a range of PCC metrics and data sources relating to productivity and efficiency, safety, quality and outcomes. It is important that those with expertise in dashboard development work collaboratively with relevant stakeholders to ensure that a dashboard meets the needs of its users, working across clinical, managerial, commissioning, service delivery, audit and research domains.

Recommendations

Recommendation	Actions	Owners	Timescale from date of publication
14. Implement strategies to improve early detection of patient deterioration and ensure timely paediatric critical care intervention	**a** All paediatric providers to implement the national paediatric early warning system when this becomes available.	All providers	Within 12 months
	b Every L3 provider should put in place a system of 24/7 critical care outreach.	L3 provider	Within 24 months
	c L3 providers should monitor rates of ward cardiac arrest, via data collated by the National Cardiac Arrest Audit (NCAA), and drive down the rate over time through improvements across the PCC pathway.	L3 provider	Within 24 months
15. Undertake work to enhance the reporting of PCC outcomes, and deliver improved metrics of unit performance	**a** Undertake work to explore further improvements in mortality risk prediction, recognising additional risk factors beyond existing paediatric index of mortality (PIM) variables.	PICANet, PCCS SG, NIHR.	Within 24 months
	b Develop models to allow presentation of risk adjusted outcome metrics, including length of ventilation and length of stay.	PICANet , PCCS SG.	Within 24 months
	c Deliver reporting that differentiates activity delivered through L3 beds and other (non-L3) beds, to improve the validity of L3 benchmarking comparisons.	PICANet, PCCS SG.	Within 12 months
16. Deliver near real-time reporting of a set of core quality metrics relevant to critical care	**a** Develop a unified, single dashboard and portal through which data can be viewed, bringing together the expertise of relevant partners including GIRFT, Model Hospital, PICANet, NHS England and NHS Improvement (SSQD), and NHSX. The dashboard should contain up to date data, integrate relevant and existing data sources without requiring duplicate data entry, export data from EPR systems wherever possible, and be interactive and flexible. The dashboard must be easily accessible to all clinical staff working in PCC.	GIRFT, NHSE/I, CRG, Model Hospital, PICANET, NHSX .	Within 24 months (Develop strategy within 12 months)
	b Ensure that key adverse events are captured in the dashboard, including: i) Rate of unplanned extubation, and requirement for reintubation after unplanned extubation. ii) Rate of central line associated bloodstream infection (CLABSI).		
	c Ensure that key outcome measures are captured including: i) Risk adjusted mortality. ii) Risk adjusted length of invasive ventilation (via endotracheal tube). iii) Risk adjusted PICU length of stay.		
	d Ensure that key performance and efficiency measures are captured including: i) Average L3 bed occupancy. ii) Rate of same day cancellation of elective surgery due to lack of a critical care bed. iii) Rate of delayed discharge >24hrs. iv) Rate of out of hours discharge (20.00 to 08.00). v) Use of L3 beds to deliver L0/1 care. vi) Use of L3 beds to deliver care to children requiring ventilation via a tracheostomy, including how often this care is L1, L2 and L3.		

Workforce

Clinical workforce

Although often regarded as a 'high tech' speciality, paediatric critical care is less about delivery of high technology interventions and more about the delivery of good bedside care by staff with specialist critical care skills. These skills are over and above the core skills expected of every paediatric nurse, allied health professional, junior doctor, or consultant. Fewer than 50% of general paediatric consultants have undergone additional training in paediatric critical care.

Recruitment and retention of PCC trained medical and nursing staff is one of the three greatest challenges faced by L3 providers. Critical care nursing is stressful, which can lead to high turnover and recruitment issues. Those working in critical care do not receive any salary uplift or other benefits to incentivise them to work in this high-stress environment.

Staff costs represent approximately 80% of the total costs of running a PICU. Reliance on temporary staff to fill vacancies and rota gaps will increase costs further. The degree to which PICUs depend on temporary staffing to open beds is highly variable, with reported expenditure on temporary consultant staffing as high as 79% of the amount spent on substantive consultant staff (average 13.3%), 23% of the amount spent on substantive middle grade staff (average 5.2%), and 37% of the amount spent on substantive nursing staff (average 7.4%).

Nursing staff

An average annual turnover of 11% of registered nursing staff (range 2% to 25%), together with an average vacancy rate of 4.5% (range 0% to 12%), highlight the challenge. In particular, there is a shortage of senior nurses with PCC experience, hence an increasing reliance in many units on a strategy to appoint junior nurses, even newly qualified nurses, and provide them with PCC training. A number of highly successful 'in-house' training programmes have been developed, equipping a future generation of paediatric nurses with valuable skills which will be useful in any clinical setting, whether or not they remain working in PCC.

During GIRFT visits we heard about local initiatives that have been successful in reducing nursing staff turnover.

IN PRACTICE

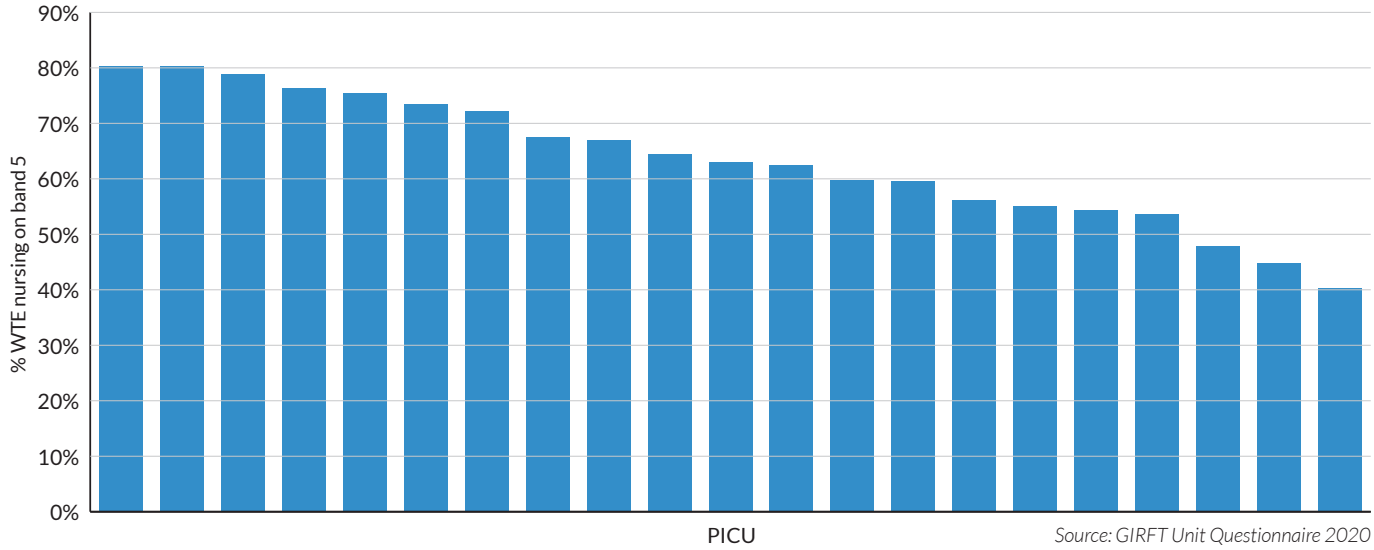
Strategies to improve nursing staff retention

University Hospital Southampton NHS Foundation Trust (Southampton General Hospital) | University Hospitals Bristol NHS Foundation Trust (Bristol Royal Hospital for Children) | Manchester University NHS Foundation Trust (Royal Manchester Children's Hospital)

- Nurses must feel valued, safe, happy at work, and have support and opportunities to develop.
- A multi-faceted approach: starting new nurses as a cohort for peer support, a structured induction programme bringing together taught sessions and bedside coaching supported by the PICU education team, a comprehensive education programme, and additional developmental opportunities to work with the research, education and data teams.
- Nurses participate in the same education programme as junior doctors.
- Hands on presence of consultants to support junior doctors and nurses.
- A staff wellbeing programme with components around psychologist support, at both team and individual levels, reflective debriefs, signposting to external support services, buddy and peer group support, and team social events outside work.

Figure 35 shows the proportion of registered nursing staff within each PICU that are band 5, the most junior band. On average 2/3 of the PICU nursing workforce across England is band 5 (65%) but this proportion varies considerably from 40% to 80%. Some units use non-registered staff, working alongside registered nurses, to provide bedside care. Units that are more reliant on junior nurses, and non-registered staff, will require additional senior nurses in clinical supervisory roles and may, as a consequence, require a higher total nursing establishment.

Figure 35: Proportion of the total PICU nursing establishment that is band 5



Source: GIRFT Unit Questionnaire 2020

IN PRACTICE

Supplementing the nursing workforce with non-registered practitioners

Birmingham Women's and Children's NHS Foundation Trust (Birmingham Children's Hospital)

- Healthcare assistants deliver direct patient care to patients that require non-invasive ventilator support or are self-ventilating.
- They complete an in-house formal competency based training programme, overseen by the PICU education team.
- When providing bedside care they are assigned a registered nurse who is responsible for supporting the non-registered practitioner, providing indirect supervision. Care is delivered as a partnership between the non-registered practitioner, registered nurses, and parents/carers.
- As well as providing excellent care, development of this non-registered workforce has provided greater resilience to respond to patient demand and acuity. Some have developed into nursing associates, and others have gone into nurse training.

Medical staff

Similar challenges are faced with the filling of middle grade roles, with only a proportion of PICU junior doctor posts being filled by UK graduates and a heavy reliance on overseas fellows, on temporary tier 2 and tier 5 visas. In addition, many UK graduates working in PICU are on rotational posts linked to their core training speciality and will not have had prior experience of PICU.

It is currently not a requirement for paediatricians to undertake training and gain competencies in PCC before they take up a consultant post. This is in contrast to training in neonatal critical care which has been a mandatory requirement for many years. GIRFT data suggests that fewer than 50% of acute paediatric consultants have spent six months or more working in a PICU during their training. The low percentage is not explained by a lack of availability of PICU posts, given the heavy reliance on overseas fellows to fill middle grade rotas. It is recommended that in future all paediatricians in training complete at least six months of PCC training before taking up a consultant post in acute paediatrics.

Challenges in middle grade staffing have led to an expansion in the number of PICU advanced critical care practitioners (ACCPs) to support the middle grade rota. The development of this role is seen as providing a valuable career development option for senior critical care nurses and has been a great success. To date, approximately 60 WTE ACCPs have been trained and are in post across England, with a similar number going through training. Over 95% of ACCPs in post and in training are from a nursing background (ANPs). In some units ANPs fill up to 20% of middle grade posts, sometimes functioning in a senior middle grade role.

However, there are considerable financial costs associated with developing an ANP which has delayed ANP development in many organisations, as well as the cost to the nursing establishment of losing a skilled bedside nurse. Typical costs include those associated with a 3-4 year university course, back-fill of their nursing post whilst they are training, payment of a higher nursing salary band compared to their existing band, and the ongoing need to appoint a middle grade doctor until they are felt able to move from a supernumerary role to an independent role.

IN PRACTICE

Running a successful ANP development programme

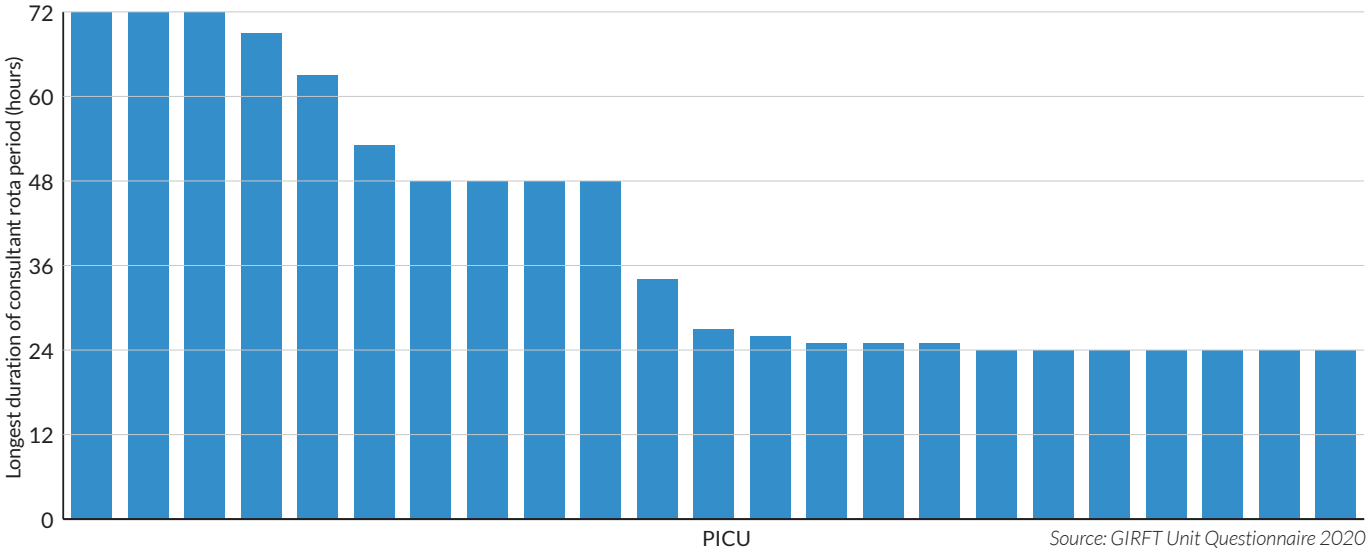
Guy's and St Thomas' NHS Foundation Trust (Evelina London Children's Hospital)

- Trainee ANPs are employed as part of the nursing and medical workforce.
- They are employed at band 7 and work 20% of their time as a clinical bedside nurse, with 80% as study leave and ANP duties.
- The trainee ANP works alongside medical staff on weekday shifts at the beginning of training, increasing to include night shifts and weekends as they progress to maximise their exposure and opportunity for development.
- When the ANP becomes an independent practitioner they are promoted to band 8a, and the number of medical middle grade doctors is reduced accordingly.

Consultants working in PICU have to be very hands on, and are frequently called overnight to provide senior support, particularly when the middle grade tier is occupied by doctors with limited PICU experience. Disruptions in sleep are common, which are known to increase the risk of errors in decision-making.

Rota patterns vary, with most units running a consultant of the week system (71%). PICU consultants are working up to 24 hours of consecutive on call in every PICU, typically over a weekend. In some this is 48 hours, and in others it can be as long as 72 hours (see **Figure 36**). This is not safe practice as it has the potential to result in significant sleep deprivation and errors in decision-making. Long periods of consecutive on-call are seen more commonly in smaller units, which may only have 5-7 WTE consultants, and there is, understandably, a desire to avoid consultants being expected to work every other weekend.

Figure 36: Longest duration of PICU consultant consecutive on-call



Source: GIRFT Unit Questionnaire 2020

It is recommended that no PICU consultant should be on duty for more than 25 hours consecutively (24 hours on service plus a 1 hour handover period). This will require an expansion in consultant WTEs in some units, in order to avoid an excessive frequency of weekend on-call.

In the setting of a consultant providing a back-up 'second on' role, with little or no expectation of being disturbed overnight, it may be acceptable for a longer period of consecutive on-call but this should be seen as exceptional and agreed locally.

We heard one example of a PCC transport service that is still, at times, covered by the on-call PICU consultant. In the event that the consultant is required to participate in a transfer, an informal arrangement of cross cover from another clinical service provides support for PICU, but this cover may not be someone who has completed PICU training. It is recommended that no consultant should be providing clinical cover to a critical care unit and to the retrieval/transport service at the same time.

Other staff

A detailed review of allied health professional staffing in PICU was beyond the scope of the GIRFT review. Analysis of data collected during the pilot phase of the project established that accurate attribution of staffing specific to PICU was going to be problematic, as in many providers this level of detail was not provided.

However, limited data was captured around access to physiotherapy and pharmacy expertise. 24/7 availability of a physiotherapist, able to provide bedside respiratory physiotherapy if required, exists in all but two L3 providers (90%), but in only 77% of spoke hospitals. Only 42% of PICUs have 24/7 access to a paediatric pharmacist for advice.

Staff wellbeing

Ensuring that staff feel valued and supported is crucial, and an increased emphasis is being placed on staff wellbeing programmes to tackle stress and burnout across all PICU staff groups, and to improve staff retention.

All units reported having a programme in place to support the wellbeing of staff. This exists in many forms but important elements that were highlighted included psychology support, mentorship, huddles, debriefs, and social events.

Nursing numbers

Current PICS standards recommend an establishment of 7.01 WTE per PICU bed, to include registered nursing staff and non-registered practitioners, for example health care assistants, who are contributing to bedside clinical care. An annual staffing survey is undertaken every November by PICANet, and included in the PICANet report each year.

Based on GIRFT questionnaire data the average number of registered nurses in post per PICU bed is 5.7 WTE/bed. This number does not include non-registered staff and may not reflect total funded establishment as vacant posts may not always have been included.

In addition, it is worth stressing that 7.01 WTE per bed is a quality standard that is relevant to delivery of care to children receiving L3 care, and one nurse caring for each patient. The correct value for delivery of care to children receiving L1 or L2 care will be much lower, as care should be provided with a nurse:patient ratio of 1:2.

Current reporting of nurse staffing does not take into account differences in the complexity of care being delivered, or the fact that some units are combined L2 and L3 units. It is recommended that the reporting of staffing data be refined to take additional factors into account.

Education workforce

Within hubs - PICU-level education

Over the past ten years there has been a shift away from reliance on universities to deliver, and quality assure, post-registration specialist nursing courses, to increased delivery of courses by tertiary paediatric centres. This has been driven by the need for greater flexibility in how modules are delivered, and to provide better value for money.

This approach has been embraced by the PCC community. Comprehensive guidance on course content and structure, curriculum and syllabus, and minimum course provider requirements have been published through PCCS and the educators' group (PCCS-E). Applications are assessed for validation and 'accreditation' of individual programmes.

The shift away from university delivery to local delivery has required additional investment in critical care educators. This has generally been achieved on a cost-neutral basis, or even at a profit, given the significant costs associated with sending nurses on university courses. Many L3 providers are now able to offer validated courses for novices in PICU (96% of units offer orientation programmes), through to experienced PICU nurses completing a Level 3 post-graduate specialist qualification (offered in 71% of units). A number of providers are able to offer places to nurses from other, typically smaller, providers, who may not have the breadth of clinical material, or staffing, to deliver the required syllabus and course content.

Across England there are 56 WTE PCC nurse educators delivering these programmes (range 0 to 7 per provider).

An education and training programme for medical staff should also be in place and include provision to ensure that all medical staff maintain competency in the practical skills necessary for PCC, including intubation and advanced airway techniques.

HDC-level education

With the publication of 'High dependency care – time to move on' there has been a greater emphasis on delivering course content that is relevant to the high dependency setting. Within the guidance there are specific recommendations relating to L1 and L2 competencies, and proposals for a HDC skills passport. These have been widely adopted and adapted as required for local needs. The PCCS educators group has published standards for 'Education in paediatric critical care Level 1 and 2' and a number of providers have received quality assurance 'accreditation' for delivering these courses. Again, some providers are able to allocate places to 'external' applicants from other hubs or from spoke hospitals in their ODN.

Delivery of education across ODNs

Outreach teaching delivered through regional transport services

Ever since the first PCC transport services came into being around 20 years ago, an integral function has been to provide outreach support and education to spoke hospitals, focused around the acute stabilisation of a critically ill child. In many instances this involves providing peer-review and discussion of individual cases, delivering theory study days, and running simulation of common scenarios. This teaching is well received and has been instrumental in ensuring that spoke hospitals can deliver effective interim care for critically ill children awaiting transfer by the transport service to a hub PICU.

Whilst there are undoubtedly elements of this teaching, and wider outreach support, that are highly relevant to the delivery of HDC for children it is not in itself a substitute for a comprehensive HDC course that covers the full L1 and 2 curriculum and competency requirements.

L1 and L2 education across ODNs

It is apparent that delivery of HDC education is piecemeal at present, with a host of local solutions. In some ODNs, course delivery is still highly dependent on spoke hospital staff accessing university affiliated courses, often at considerable cost. This was raised by a number of spoke hospitals as a barrier to nurses gaining HDC training. In many ODNs there is poor understanding of how many paediatric nurses have completed relevant PCC education and training modules.

Overall, few ODNs have developed a clear education strategy for the delivery of L1/2 education. Only four out of ten ODNs have appointed an educator within their core team appointments, and in three of the four it is less than a whole time position. We heard from one ODN that prior to the PCC national review recommendations, which did not explicitly include PCC educator posts within network core staffing, education had always been at the centre of their network plans. However, as a result of this omission in the recommendations, their existing network educator post was lost.

Only three ODNs currently deliver an HDC course for nurses, though some are able to access additional courses run through their L3 hubs. In Wessex, the model they are developing is for the ODN education team to deliver a course that covers L1 skills and competencies, and the L3 provider to run a L2 course (as well as the L3 specialist course). In other ODNs the aspiration is for the ODN team to deliver both L1 and L2 skills and competencies, through delivery of modular components. Spoke hospitals are keen for education to be available online wherever possible, supplemented with local in-situ training and mentorship.

Spoke hospitals rank the requirement for additional HDU-level education and training as their top challenge in delivering improved paediatric critical care. Education must be at the centre if spoke hospitals are to be empowered to develop additional skills and competence in the care of critically ill children. Within existing arrangements this will not be possible, and the 'model of care' proposed by the NHS England and NHS Improvement national review will not be delivered.

The requirement for training and up-skilling within spoke hospitals extends beyond the paediatric clinical team and will include anaesthetists and intensive care doctors, who will play an important supporting role in the delivery of PCC and who may feel that their clinical confidence has been diminished by years of centralisation of critical care.

It is recommended that ODNs develop a clear strategy for education that allows staff working in any provider to access L1 and/or L2 training. They should evaluate the staff resource that is needed to deliver this strategy, working closely with PCC educators within L3 hubs to review areas of potential overlap and potential for collaborative working.

ODNs should ensure that HDC education is delivered via PCCS-Education (PCCS-E) group approved courses and providers and follows the PCCS-E standards for education in paediatric critical care level 1 and 2 specialist nursing.

It is recommended that NHS England and NHS Improvement national review team undertake a central review of what resources have been distributed to PCC ODNs, together with the core functions that have been funded, and consider the paucity of resource available for PCC education across the PCC ODNs. It is hoped that additional resource can be made available to ODNs through NHS England and NHS Improvement so that an effective education strategy can be delivered across every ODN. This in turn will improve the wellbeing, confidence and resilience of staff, improve patient care and outcomes, and reduce PCC resource use.

Recommendations

Recommendation	Actions	Owners	Timescale from date of publication
17. Ensure that clinical staff are available, in appropriate numbers and with relevant critical care expertise, and working to acceptable roster patterns.	**a** Ensure that reporting of PCC staffing levels is adjusted to take into account the complexity of care being delivered, and reported according to staffing guidance and standards. (Separate reporting of whole-time equivalent staffing pertaining to L3 beds is recommended.)	PCCS, L3 provider, PICANet.	For immediate action
	b Every L2 and L3 provider should have 24/7 access to a physiotherapist with paediatric respiratory competencies who is available to attend the bedside if required, and access to 24/7 advice from a pharmacist with knowledge of paediatric prescribing.	L3 provider, L2 provider, ODN.	Within 24 months
	c Consultants working in PICU should not be on duty for more than 25 consecutive hours.	L3 provider, PCCS.	Within 12 months
	d No consultant should be providing clinical cover to a critical care unit and to the transport service at the same time.	L3 provider	For immediate action
18. Ensure that clinical staff working with critically ill children have access to appropriate PCC education and training.	**a** Individual organisations and ODNs should have up to date knowledge of the number, and proportion, of their registered nursing staff that have completed an accredited high dependency course and are competent in delivery of L1 and L2 care.	All providers, ODN.	Within 12 months
	b It is recommended that >80% of registered nursing staff working in an HDU area should have completed a relevant HDU course.	ODN	Within 24 months
	c All paediatric trainees should complete a period of at least six months' training in PCC prior to becoming a consultant in acute paediatrics.	RCPCH, HEE.	Within 48 months
	d ODNs should develop a clear, written strategy for delivering L1/2 education across their ODN. i) They should evaluate the staff resource required to deliver the strategy, working closely with PCC educators within L3 hubs to review areas of potential overlap and potential for collaborative working. ii) There should be clarity regarding the elements of L1/2 education delivery that will be the responsibility of the ODN, and those for which responsibility will lie with individual providers within the ODN. iii) They should ensure that HDC education across the ODN is delivered via PCCS-Education (PCCS-E) group approved courses and providers and follows the PCCS-E standards for education in paediatric critical care level 1 and 2 specialist nursing.	ODN	Within 12 months
	e NHS England and NHS Improvement should consider the paucity of resource available for PCC educators across the ODNs, which present a significant barrier to improving delivery of PCC across spoke hospitals, and consider allocation of additional resource for this function.	NHSE/I	Within 12 months

Data capture and reporting

How should data capture and reporting work?

Within each organisation a vast range of data is collected to inform day to day decision-making and service planning. In addition, there is a requirement to flow data to outside sources for the purposes of quality assurance, capacity and occupancy reporting, audit, research, commissioning, pricing and payment.

For many of these there is considerable overlap in the data requirements, making it important that a co-ordinated approach to reporting is adopted if accurate, consistent reporting is to occur. Implementation of electronic patient records (EPRs) across the NHS will assist in this regard. At present, only 82% of L3 units use an EPR, and fewer still have access to a PICU clinical information system. It is recommended that all L3 units have access to an EPR, incorporating, as a minimum, electronic prescribing, and a clinical information system that captures patient monitoring and intervention variables.

In the GIRFT review we have focused on three data flows that require reporting of PCC activity by each organisation. These are SUS, National Cost Collection and PICANet. The key characteristics of these data flows are summarised in **Table 5.**

Table 5: A summary of the key characteristics of data flows to Secondary Uses Service (SUS), National Cost Collection (NCC) and PICANet

Data flow	Breadth	Purpose	Level	Responsible team	Who looks at data
SUS	L 1, 2 & 3	Commissioning	*Patient level*	Information team	NHS England and NHS Improvement commissioning teams
NCC	L 1, 2 & 3	Setting tariff / prices	*Organisation* (aggregated annual data)	Finance team	NHS pricing team
PICANet	L3 (some L2)	Audit	*Patient level*	Clinical team	Local clinical & management team

In all three data flows activity is reported according to the number of bed days delivered at each HRG level. We are therefore able to explore the accuracy and consistency of activity reporting.

Data capture and flow in hub hospitals

PICANet has excellent (>98%) capture of all PICU (L3) activity across England and is of high quality, with regular audits of data validity. We are therefore able to use PICANet as the gold standard against which to compare SUS and NCC data, but can only do this for L3 activity (HRGs XB01Z to XB05Z). **Table 6** presents a comparison of all PCC activity reported to PICANet, SUS and NCC in 2018/19.

Table 6: PCC HRG activity reported to PICANet, SUS and NCC in 2018/19

Aggregated bed day data from all 21 PICU providers is shown.

HRG	PICANet	SUS	NCC
XB01Z	2642	1454	3270
XB02Z	782	806	1646
XB03Z	5976	2560	6252
XB04Z	18160	11860	14783
XB05Z	41095	22535	41919
XB06Z	25025	28033	37699
XB07Z	10903	10193	22819
XB09Z	11420	27615	21602
Grand total	**116,003**	**105,056**	**149,990**
Level 3 Total (XB01-05Z)	**68,655**	**39,215**	**67,870**

A total of 68,655 L3 bed days were reported through PICANet by 21 L3 providers, but the same providers returned only 39,215 L3 bed days to SUS. Therefore 43% of total L3 activity, based on PICANet data, was not recorded in SUS. At an individual provider level there was highly variable and unpredictable agreement between SUS and PICANet data, from under-reporting in SUS by 2,303 bed days for one HRG to over-reporting by 294 bed days in another.

Furthermore, whilst every L3 provider should be returning all PCC activity to SUS, including elements of PCC that are delivered in HDC areas of the organisation, we found evidence that this is happening in only 23% of L3 providers. The poor accuracy of SUS data reporting was highlighted previously by the NHS Digital PCC HRG Expert Working Group, and a series of communications and road-shows were undertaken in 2016 to raise awareness across providers, with representatives from clinical, information, and finance teams involved. Accuracy remains poor despite these interventions.

The picture with respect to reporting of PCC activity to the NCC annual exercise shows similar inconsistencies. SUS and NCC should capture all PCC activity occurring in an organisation (L1, 2 and 3) so higher levels of activity are to be expected. A total of 105,506 bed days were reported through SUS, compared to 149,990 reported in the NCC exercise by the same providers.

It is clear that the quality, accuracy, and completeness of PCC activity reporting through SUS are poor, even within L3 providers. The same is true of PCC activity reporting through NCC. Significant improvements are needed across all providers, with greater collaboration and communication between clinical, information and finance teams. PICANet data should be used as the gold standard source of XB01Z to XB05Z (L3) HRG data.

However, PICANet does not have anywhere near complete capture of L2, or L1, activity so we cannot use it as a gold standard against which to assess all SUS and NCC data. Only 50% of L3 providers return any L2 bed activity to PICANet, and this does not represent all L2 bed activity occurring in these organisations.

Level 3 providers should capture all PCC activity occurring across their organisation and include this data in SUS and NCC reporting. In the short-term the scope of PICANet should be expanded to capture activity being delivered in L2 beds as well as L3 beds. This will require additional resources. Ideally, in the longer term, all PCC activity should be captured within the national audit, including activity that is undertaken in L1 beds.

Data capture and flow in spoke hospitals

One of the early KPIs for ODNs is to understand levels of HDC activity that are being undertaken across their spoke hospitals. Knowledge of activity levels should also play an important part in the designation process for L2 spoke hospitals.

Unfortunately, there is no national audit of HDC activity currently, though there have been a number of short-term regional audits, and a more longstanding audit in the South West. A detailed observational study found that around 8% of paediatric admissions to spoke hospitals involve the delivery of HDC interventions, based on capture of PCCMDS data[20]. Approximately half of this activity related to L1 interventions and half to L2 interventions.

Is PCCMDS data being collected in spoke hospitals and flowing to SUS?

All paediatric providers should be capturing HDC level activity through daily collection of PCCMDS in their high dependency areas and flowing this activity to SUS linked to the patient's admission record (APC record).

Awareness that this was not happening led to the introduction of a CQUIN in 2018/19, in an attempt to improve HDC data capture across spoke hospitals.

In 2020, 49 spoke hospitals (50% of those completing the GIRFT questionnaire) reported that they were collecting PCCMDS daily in their HDU beds, but the remaining 50% were not.

However, when we look at the flow of PCCMDS data to SUS we find only 31 hospitals (24% of all spoke hospitals) that are submitting this data to SUS. Furthermore, the volumes of activity being recorded through SUS are extremely low, with fewer than 2% of paediatric admissions having linked HDC data. The CQUIN has not delivered the desired goal.

Why is data not being captured?

A challenge raised by every ODN is the lack of an IT solution to support capture of PCCMDS data. Some local solutions have been developed but many providers report a paper based collection of data, with subsequent entering of data onto a bespoke hospital database by clinical staff. This data then has to be integrated with the patient administration system (PAS) of the hospital if it is to be linked to the patient record for submission to SUS via the APC process.

Summary of data capture and flow

Within L3 providers the capture of PCCMDS data within PICUs is very good, with PICANet providing the IT solution, but in other HDC areas it is often poor, with no access to the PICANet solution in these areas. The flow of accurate data to SUS is poor.

Within spoke hospitals the capture of PCCMDS data is poor, with no access to PICANet and no alternative 'national' IT solution. The flow of PCCMDS data to SUS across spoke hospitals is very poor. The lack of data is hugely problematic for ODNs and NHS England and NHS Improvement commissioning teams in understanding current activity levels and making robust recommendations for future configuration of PCC services.

It is recommended that all hospitals are given access to a suitable IT solution for capturing PCCMDS. Ideally this would be a single solution across England, though the key requirement is that any solution must meet recommended system specifications. As PICANet expands to capture L2 data it will be developing a software solution to facilitate capture of PCCMDS, as well as other key variables. In principle, the same PCCMDS module could be used to capture PCCMDS in any paediatric provider, though this level of expansion would require additional resource and relevant approvals.

Given the unreliability of the current system using SUS, and the failure of a number of initiatives to improve reliability, it is recommended that an alternative data source be used for capture and reporting of PCC activity. A single, high quality data source that can be used for multiple purposes (audit, activity reporting, commissioning, payment) is the preferred option.

Given its high quality and data completeness, it is proposed that greater use be made of PICANet data through sharing and/or integration of PICANet data with SUS/HES and other data sources. Options would include sharing/integration of PICAnet data into either the national commissioning data repository (NCDR) within NHS E/I or into NHS Digital. Appropriate data sharing rules would need to be put in place to ensure that data governance regulations are upheld, and that data can be easily made accessible to those who need to see it.

[20] *Morris KP, Oppong R, Holdback N, Coast J. Defining criteria and resource use for high dependency care in children: an observational economic study. Archives of Disease in Childhood, 2014: 99: 652-658.*

PCCMDS and HRG recommendations

The NHS Digital PCC HRG Expert Working Group undertakes regular review of the PCC dataset (PCCMDS) and associated HRG structure. During the process of GIRFT review these structures have proven invaluable in developing measures of unit productivity, efficiency and performance, and in spotlighting the need for certain GIRFT recommendations.

HRG XB09Z (L0) is currently labelled as Enhanced Care within the PCC HRG classification and terminology. However, the same term is increasingly being used in ACC to describe L1 or L1+ care. It is anticipated that this will be an area of development and growth over the coming years across ACC. For this reason, it is recommended that XB09Z be given a different label. As it describes care being delivered to a child who does not meet any of the PCC diagnostic and activity codes it is proposed that it be labelled as 'general care'.

HRG XB01Z currently captures 'extracorporeal membrane oxygenation (ECMO)' or 'aortic balloon pump' or 'ventricular assist device (VAD)'. It is the most complex level of care and associated with the highest cost and tariff. However, over the past few years the VAD pathway has evolved and it is now possible for some children on VADs to be weaned off breathing support, and at times be cared for within an HDC bed rather than a PICU bed. It is recommended that the HRG system be reviewed to ensure that children on VADs are assigned to an appropriate HRG based on the complexity of care they are receiving, such that XB01Z continues to be assigned in the early acute phase of treatment but alternative HRGs are assigned as the complexity of care is scaled back.

Recommendations

Recommendation	Actions	Owners	Timescale from date of publication
19. Improve the accuracy and completeness of PCC data capture and flow	**a** All providers should implement a full electronic patient report (EPR). This should include automated data capture from ventilators, monitoring and infusion devices, and electronic prescribing. Ensure digital connectivity standards are specified to allow capture and automated upload of PCC activity.	All providers	Within 36 months
	b Ensure that every paediatric provider has access to a digital solution, and necessary hardware, to support the routine capture of PCC activity (PCCMDS). Consideration should be given to whether PICANet can provide this solution.	NHSE/I, PICANet, HQIP.	Within 12 months
	c Ensure that PCCMDS is collected in all PCC areas of each organisation. (As a minimum data should be captured in all L2 and L3 beds.)	All providers	Within 12 months
	d Improve the accuracy of PCC activity data being submitted to the secondary users service (SUS), and to the national cost collection (NCC). i) Ensure that PCC activity data that leaves the organisation is sense checked by clinical, information and finance teams before submission. ii) Use PICANet data as the gold standard comparator for XB01Z to XB05Z healthcare resource group (HRG) data.	All providers	For immediate action
	e Expand the scope of PICANet to capture activity occurring in all L2 beds, in both hub and spoke hospitals. This will require additional funding. (In the longer-term consider further expansion to capture all PCC activity)	PICANet, HQIP.	Within 24 months
	f NHS E/I to consider using PICANet, rather than SUS, as the preferred data source for PCC activity. (Alternatively develop a solution that automates the flow of PICANet data into SUS.)	NHS E/I, PICANet.	Within 12 months
	g Consider a future model in which a single high quality data source is used for multiple purposes, including audit, commissioning, pricing and payment. (Consider PICANet as a potential source.)	NHSE/I, NHS Digital, PICANet.	Within 24 months

Commissioning and funding

Background

Paediatric critical care is classified as a specialised service within the NHS as it is a low-volume, high-cost service that is not delivered in every hospital. Specialised services are planned nationally and regionally by NHS England and NHS Improvement. L1 PCC is part of delivering paediatric care in all hospitals and is therefore not considered as specialised, and is the responsibility of CCGs. NHS England and NHS Improvement has commissioning responsibility for L2 and L3 services.

Each specialised service sits within one of six National Programmes of Care (NPoC). Their role is to "provide leadership and oversight of the development and delivery of a comprehensive work programme that achieves demonstrable improvements in the quality, equity, value and outcomes of commissioned specialised services". PCC is one of ten specialised services within the Women and Children NPoC. Each has a national clinical reference group (CRG) made up of clinicians, commissioners, public health experts, patients and carers. They use their specific knowledge and expertise to advise NHS England and NHS Improvement on how specialised services should be provided. CRGs lead on the development of clinical commissioning policies, service specifications and quality standards.

The following elements of the PCC service are within the scope of the CRG:

- L3 PCC
- L2 PCC
- PCC transport services
- Paediatric ECMO services
- LTV

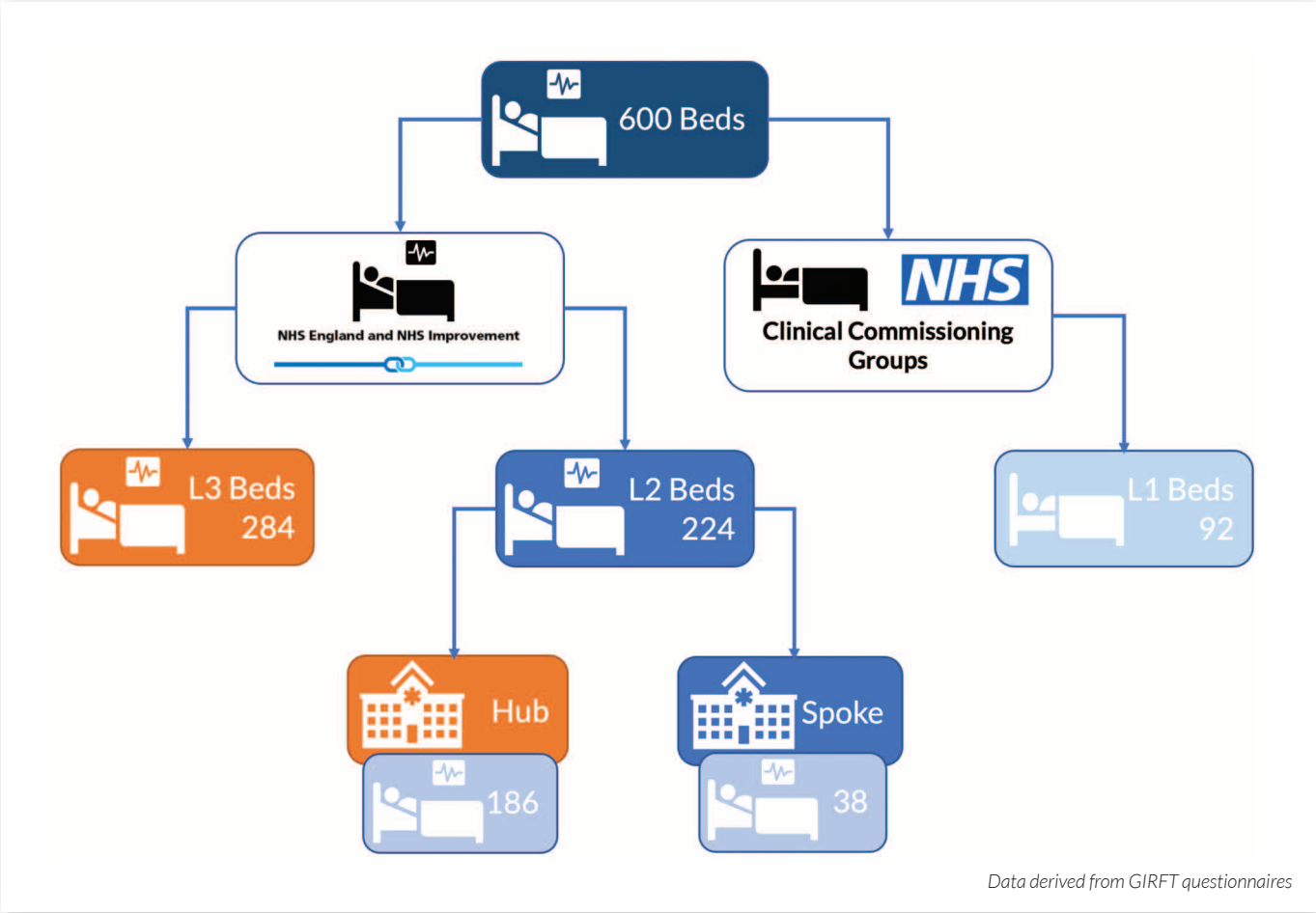
A service specification describes how each of these services should be commissioned and delivered. The current series of service specifications were written in 2015, and do not fully capture some of the more recent developments and recommendations. Of note, there is a requirement for greater recognition for the role of the ODNs in overseeing PCC services at a regional level.

It is recommended that each of the service specifications be updated to reflect the most recent guidance and recommendations, including those from the NHS England and NHS Improvement PCC National Review and PCCS Standards.

PCC commissioned beds across England

Based on data collated for the GIRFT review we estimate that there are 600 commissioned PCC beds across 153 hospitals in England, of which 508 are NHS England and NHS Improvement commissioned and 92 are CCG commissioned (see **Figure 37**). Of all NHS England and NHS Improvement L2 and L3 commissioned beds, 93% sit within 23 L3 hub hospitals, with only 38 NHS England and NHS Improvement commissioned L2 beds across 130 spoke hospitals.

Figure 37:Breakdown of all PCC commissioned beds across England



Are there sufficient commissioned beds?

An assessment of whether or not the number of commissioned beds is sufficient to meet demand requires accurate data on the utilisation of PCC beds. Unfortunately, reliable activity data is not available for all commissioned PCC beds, in particular PCC beds within spoke hospitals. It is possible, however, to look at data relating to those commissioned beds that generate the data that is submitted to PICANet.

There are 359 NHS England and NHS Improvement commissioned L2 (n=75) and L3 (n=284) beds within L3 hubs for which activity data is captured and submitted to PICANet. A total of 110,250 PCC bed days of associated activity were commissioned in 2018/19.

In 2018, 115,808 HRG bed days of activity were recorded in PICANet, 5,448 (5%) above the commissioned target. If we translate this into the total number of beds required across England to deliver this level of activity, we find that 342 beds are required (based on 80% occupancy (OBDs) with an average PCC LoS of 6 days), which is close to the actual number of commissioned beds (359). This analysis does not take into account local variation in demand for beds but overall, there are an appropriate number of commissioned PCC beds within L3 hubs across England to match the associated activity.

This overview hides significant variation that is evident between providers. In section '*Access, capacity and strain*' on page 51, we highlighted the considerable variation that is seen in metrics of occupancy and strain. Comparing the number of commissioned PCC beds against the number of beds needed to deliver the levels of activity reported to PICANet, we find variation across individual providers ranging from a surplus of 4.7 commissioned beds in one unit to a deficit of 4.3 commissioned beds in another. The 12 units that return PICU-only data to PICANet have a total deficit of 13 commissioned beds relative to delivered activity, whereas the 12 units that return combined PICU and HDU data to PICANet have a surplus of 31 commissioned beds relative to delivered activity.

These findings amplify the need for a PCC national oversight group (PCC NOG) which can make recommendations and assist ODNs and NHS England and NHS Improvement regional teams in ensuring that local demand and capacity are appropriately matched. More judicious, efficient use of L3 beds, together with an increase in the number of L2 beds, will also impact on the number of L3 beds that are needed, both locally and nationally (see section '*Future model of care and efficiency opportunities*' on page 105).

How much is spent on PCC services?

It is estimated, from GIRFT questionnaires, that a total of £260.5m of commissioned PCC income was received by 21 L3 trusts in 2018/19, with over 95% of this from NHS England and NHS Improvement. Reported income varied from £3.3m to £30.2m across providers. An additional £11.5m of NHS England and NHS Improvement income was received by spoke hospitals to deliver HDC, ranging from £0 to £4.2m across the ten ODNs. Data was not collected on the value of CCG HDC contracts but, based on there being approximately twice as many HDC beds in spoke hospitals funded by CCGs, we estimate it to be between £20 to £25m.

Total PCC commissioned income across England is therefore around £300m.

How is PCC commissioned and contracted?

In simplistic terms there are two key elements to commissioning of a PCC service and a commissioning contract. These are:

a) defining the expected volume of activity to be delivered;

b) defining the funding that will support the delivery of this activity.

There is currently no consistency in how PCC services are commissioned and contracted, even for services that are managed by the same NHS England and NHS Improvement regional team:

- 59% of contracts are activity based, cost and volume;
- 23% are block contracts, with a variable marginal payment rate for over- or under-performance against target activity;
- 14% are fixed block contracts, with no adjustment for over- or under-performance against target activity;
- 4% are aligned incentive payment in nature.

Too little attention is paid to the complexity of care being delivered. Only 50% of contracts include any form of complexity adjustment and in the majority, this is simply a differential funding level for PICU and HDU activity. Only 18% of commissioning contracts use HRGs to adjust funding for complexity of care, despite the fact that delivery of XB01Z costs around five times as much as XB07Z to deliver.

What does this mean?

At its extreme, a failure to account for complexity means that a full L3 bed day tariff is being paid when a child receives L0 care in a L3 bed, when this should be deliverable, in most instances, in a paediatric ward bed. At the opposite extreme it means that a trust that is delivering a high proportion of L3 care at 'higher' complexity HRGs (XB01Z to XB03Z) is not being appropriately funded.

It is recommended that a more consistent approach to commissioning of PCC services be adopted across England.

What should this approach look like?

The following steps are recommended as minimum requirements for future commissioning of PCC contracts:

1. Always use the APC/HRG definition of a bed day when describing activity (not OBD/midnight occupancy).
2. Establish a separate contract for L3 beds, to that for L2 beds (and any other beds).
3. State the target number of bed days being commissioned.
4. Include explicit reference to the corresponding number of beds being commissioned to deliver this target (see below).
5. Take patient complexity into account in contracting and when calculating funding.

Rationale for these recommendations

A detailed description of the difference between OBD and HRG definitions of a bed day is set out above in section '*Access, capacity and strain*' on page 51. All PCC activity reporting to PICANet, SUS and NCC uses the APC/HRG definition so it is important that it is used in commissioning contracts.

The variable efficiency with which L3 beds are being used has been highlighted, along with the limitations created by some units reporting L3 bed activity/metrics whilst others are reporting combined L2 and L3 bed activity/metrics. In future, it will be important to be able to compare like with like to a much greater extent. Similarly, it is important that in future, commissioning of L3 beds is clearly differentiated from other beds.

A bed day is the appropriate unit of currency for commissioning and payment so should form the principal basis for each contract. However, at an operational level a defined number of staffed beds are needed to deliver the contracted number of bed days. At present there is a poor correlation between the number of contracted bed days and the corresponding number of PCC beds that are defined in commissioning contracts. A discrepancy will have a number of knock-on effects, not least in affecting the accurate reporting of occupancy metrics. It is therefore important that a consistent mechanism be established by which the contracted number of bed days can be translated into a number of beds. This needs to be clear to both trust and commissioner.

It is important not to confuse L3 beds and L3 activity. Occupancy of L3 beds captures the number of patients occupying these beds, regardless of the complexity of care being delivered to each patient at midnight i.e. occupied L3 beds will include all children whether they are receiving care at L 0, 1, 2 or 3 care. Similarly, when describing a bed day target for L3 beds this will include all activity (L0,1,2,3) delivered in those beds and not be restricted to activity that maps to L3.

Number of contracted L3 beds

It is proposed that the following approach be used to translate contracted bed days into a corresponding number of beds for the purposes of consistent, transparent contracting:

$$\text{Number of contracted L3 beds} = \frac{\text{Target number of bed days* in a year} \times 1.03}{365}$$

* using the APC/HRG definition of a bed day

The adjustment factor (1.03) is needed to avoid a contract that expects all beds to be fully occupied each day, given the requirement for a unit to be able to react to unexpected variation in emergency demand. This adjustment factor delivers a result that equates to an average occupancy of L3 beds of 82-85%, based on midnight occupancy, assuming an average PICU length of stay of 6-8 days (see section '*How is a bed day defined?*' on page 57 and Appendix 4).

An alternative, and potentially simpler, interpretation of the above formula is:

2.9 L3 beds are commissioned for every 1,000 bed days of contracted L3 activity

In the event that a contract is based primarily on the number of L3 beds being commissioned then ~350 bed days of total activity would be expected per L3 bed, based on 85% midnight occupancy, assuming an average length of stay of seven days (Appendix 4).

Number of contracted L2 beds

The adjustment factor is different for L2 beds as average LoS will be shorter and there will be a larger discrepancy between HRG bed days and OBDs. An adjustment factor of 0.94 delivers a result that equates to an average occupancy of L2 beds of 82-85%, based on midnight occupancy, assuming an average HDU LoS of 3-5 days (Appendix 4).

$$\text{Number of contracted L2 beds} = \frac{\text{Target number of bed days* in a year}}{365} \times 0.94$$

* using the APC/HRG definition of a bed day

An alternative, and potentially simpler, interpretation of the above formula is:

2.6 L2 beds are commissioned for every 1,000 bed days of contracted L2 activity

In the event that a contract is based primarily on the number of L2 beds being commissioned then ~390 bed days of total activity would be expected per L2 bed, based on 85% midnight occupancy, assuming an average length of stay of four days (Appendix 4).

Complexity

PCCMDS, and the seven PCC HRGs (XB01Z to XB07Z), were initially developed as a currency to inform a future payment system for PCC services, with a detailed time in motion study across ten PICUs establishing that the cost of delivering a day at XB01Z complexity is approximately five times the cost of delivering a day at XB07Z complexity.

XB01Z to XB05Z are HRGs that describe L3 activity, XB06Z describes L2 activity, and XB07Z describes L1 activity.

Handling of XB09Z

After introduction of PCCMDS and HRGs it became apparent that some activity occurring within PICUs was not mapping to any of the HRGs as, in some patients, none of the 36 PCCMDS activity codes were being met. To identify and quantify this activity a new HRG, XB09Z, was added by the NHS Digital PCC HRG Expert Working Group. XB09Z activity is described as Level 0 care, which describes 'ward level' care.

XB09Z represents 10% of all PICANet activity across the 21 L3 trusts, but this varies from 1% to 23% between providers. XB09Z represents 26% of all SUS activity returned by the same 21 L3 trusts, and again shows wide variation from 2% to 40% between providers.

The higher volume of XB09Z reporting through SUS, compared to PICANet, is explained by coding rules that allow PCCMDS to be collected in all paediatric wards, and flow to SUS. At its extreme, an HRG code of XB09Z can be generated every day that a child is in hospital (and not receiving any of the PCC interventions). This presents an opportunity for providers to exploit current coding rules.

A tightening of rules relating to the location in which PCC is delivered would be possible, with a requirement for care to be delivered in a PICU or an HDU rather than in other settings. However, in many spoke hospitals L1, and even L2 care, is delivered in beds on a paediatric ward, rather than in a discrete HDU, so it would not be helpful to prevent flow of all PCCMDS/HRG data from paediatric wards. A rule restricting data submission from paediatric wards to XB07Z and XB06Z would be an option.

However, even within hub L3 units the volume of XB09Z activity reported to PICANet is very significant and highly variable between units (1% to 23% of their total activity). This activity represents an inefficient use of a L3 bed. Furthermore, the XB09Z HRG was not developed by the HRG EWG with the intention that the activity be funded, but to allow quantification of non-PCC activity within L3 units. It is therefore recommended that XBO9Z (L0) should not attract a tariff payment in any setting, as the cost of this care should be captured within the core HRG payment for that hospital admission.

Capture and monitoring of XB09Z activity through PICANet will remain important in benchmarking the efficiency of L3 and L2 services. XB09Z is currently labelled as 'enhanced care' within the PCC HRG classification. However, the term enhanced care is increasingly being used in ACC to describe L1 or L1+ care. In order to avoid potential confusion, it is recommended that a different label be used for XB09Z, with 'general care' being a suitable option.

Payment for PCC services

The variation in models of payment has already been highlighted, with 50% of L3 provider commissioning contracts not making any adjustment for complexity of care. This inconsistency translates into wide variation in the effective level of funding at each HRG level. This ranges across L3 providers from £705 to £2,713 at XB07Z, £1023 to £2713 at XB06Z, through to £1,789 to £6,533 at XB01Z. There is an urgent need for a more consistent, sophisticated approach to how PCC services are paid for.

The same challenge exists in neonatal critical care. The NHS pricing team has recently published a set of national benchmark prices for 2021/22 for both neonatal and paediatric critical care. Whilst not mandated for national use it is hoped that these will serve as a useful guide for agreement of local prices. The proposed benchmark prices for PCC are shown in **Table 7**.

Table 7: NHS pricing team proposed PCC benchmark prices for 2021/22

HRG	Price
XB01Z	£5,747
XB02Z	£3,832
XB03Z	£2,874
XB04Z	£2,395
XB05Z	£1,916
XB06Z	£1,437
XB07Z	£1,149
XB09Z	£766

Blended payment

Across the NHS there is a proposal to move away from an activity based payment model, as used in Payment by Results (PbR), to a model called blended payment. This is more analogous to a block contract model but incorporates the option to bolt on a variable component of funding to a fixed component of funding. To date, the variable component is being largely seen as a lever to incentivise higher volumes of elective surgical activity in the post-COVID-19 recovery plan. There is no clear guidance on how this model of payment might work for critical care services. At worst it could perpetuate a system that fails to take account of patient complexity, rewarding providers who fill L3 beds with low level patients and failing to appropriately reward providers who care for highly complex patients.

Future model of payment for PCC services

Much of the data that has been presented supports a future payment model that is activity based and built around HRG complexity adjustment. There are, however, understandable concerns that a rapid change in how services are funded could result in potential destabilisation of services, as it could result in marked fluctuation in PCC funding to some providers.

Those providers who are delivering a higher proportion of L0/1 care within L3 beds would be at greatest risk. Any change must therefore be gradual rather than a 'big bang' change.

Whilst we have emphasised the relationship between patient complexity and costs, principally staff costs, it is also true to say that a proportion of PCC costs are relatively fixed. In addition, the size of a unit will influence the balance between fixed and variable costs. Fixed costs include such things as trust running and overhead costs, capital costs associated with equipment, building and maintenance, and insurance costs. A PICU with only six beds will have a higher proportion of total costs that are fixed, and will be relatively more expensive, per bed, compared to a unit of 20 beds.

A funding model that combines an element of block funding, to open a set number of beds, with an element of variable funding, linked to patient complexity, could be a useful model for future PCC commissioning and funding. A transition approach could be used to increase the proportion of variable funding, reducing instability as any potential reduction in funding to a provider could be phased in gradually over time. For example, it would be possible to transition, in annual steps, the block:variable funding allocation from 90:10 in year 1 through to 50:50 in year 5, and so on.

This model and approach is broadly consistent with the philosophy of blended payments, though existing guidance would need to be adapted to support a variable component that is informed by HRGs.

A funding model for HDC services would not necessarily need to follow this approach as the difference in cost of delivering the two HDC HRGs, XB07Z and XB06Z, is not very different, and so a simpler model of funding may be more appropriate.

It is recommended that the PCC HRG EWG and the PCC CRG work together with the NHS pricing team to consider future PCC payment systems and the potential role of blended payments.

The national cost collection (NCC)

Each provider of PCC services must return an annual summary of the activity they have delivered and the associated costs for delivering that activity. These should be reported by HRG and all PCC activity across the organisation should be included. This exercise is the national cost collection, previously known as reference costs.

As reported in section *'Data capture and reporting'* above, the quality and accuracy of the activity data that is reported via the NCC is poor, bringing into question the validity of the overall return as accurate activity reporting is a fundamental part of establishing total costs.

A focus on the costs reported shows large variation between providers, and considerably more than would be expected from true variation in the costs of local delivery. **Table 8** focuses on PCC data returned to NCC in 2018/19 by the 21 trusts which provide L3 services.

Table 8: Aggregated average costs returned to the national cost collection (NCC; 2018/19) by L3 providers, together with the range of costs reported at each HRG level

HRG	Average	Range
XB01Z	£5,938	£1,236 to £9,553
XB02Z	£3,813	£1082 to £6,678
XB03Z	£2,844	£1,071 to £5,231
XB04Z	£2,653	£927 to £5,153
XB05Z	£2,186	£913 to £4,506
XB06Z	£1,642	£773 to £2,752
XB07Z	£1,267	£575 to £2,406

It can be seen that average reported costs increase, as expected, across the range of HRGs from XB07Z through to XB01Z. However, there is a very wide range of costs reported at each HRG level. The variation, which can be 5-fold or greater, points to poor quality of NCC data that is being submitted by providers. This was highlighted during deep-dive visits and the need for better quality, with greater sense checking of data and involvement of clinical teams prior to submission, was highlighted.

Commissioning and funding

Recommendation	Actions	Owners	Timescale from date of publication
20. Ensure that there is a consistent approach to commissioning of PCC services across ODNs.	**a** Establish a group with national oversight (PCC NOG) of PCC services across England. This group will be responsible for providing recommendations to NHS England and NHS Improvement regional teams and ODNs regarding: i) ODN configuration and potential reconfiguration – to ensure that spoke hospitals sit within the most appropriate ODN, ii) L3 bed distribution – to ensure capacity in each hub is appropriate to demand, including unmet demand, iii) L2 bed distribution across ODNs, within both hub and spoke hospitals.	NHSE/I, CRG, PCCS.	Within 12 months
	b Establish a clear and consistent approach to commissioning of PCC delivery across each ODN, with clarity over which aspects of PCC are the responsibility of CCGs, ICSs and NHS England and NHS Improvement regional teams.	NHSE/I	Within 12 months
	c Each ODN should have a limited number of spoke hospitals that are designated as L2 providers, with this service commissioned by NHS England and NHS Improvement regional teams.	ODN, NHSE/I central and regional teams.	Within 12 months
	d Each ODN should review the pathway for children on long-term ventilation and consider whether or not to designate additional spoke hospitals, over and above L2 and L3 designated providers, to support this pathway. Consideration should be given to using a model of L1+ beds in this situation.	ODN, provider respiratory teams, NHSE/I regional teams.	Within 24 months
21. Ensure that there is up to date guidance to support a consistent approach to commissioning of PCC services	**a** Review, and update accordingly, the existing PCC relevant service specifications. Ensure that recent guidance and recommendations from the PCC national review and updated PCCS Standards are appropriately captured, in particular the key roles of the PCC ODNs.	CRG, NHSE/I.	For immediate action
	b Adopt a standardised approach to commissioning of L2 and L3 beds, which incorporates the following principals: i) Always use the HRG definition of a bed day when describing activity (not occupied bed day [midnight occupancy]) ii) Establish a separate contract for L3 beds, to that for L2 beds iii) State the target number of bed days being commissioned iv) State explicitly the corresponding number of beds being commissioned to deliver this target • 2.9 L3 beds are commissioned for every 1,000 bed days of contracted activity • 2.6 L2 beds are commissioned for every 1,000 bed days of contracted activity v) Take patient complexity into account in contracting and when calculating funding	NHSE/I central and regional teams.	For immediate action

Recommendation	Actions	Owners	Timescale from date of publication
21. (Continued)	**c** Introduce a standardised approach to payment for PCC services. i) Ensure that payment is adjusted for patient complexity (using PCC HRGs). ii) Take note of national PCC benchmark prices in agreeing local prices. iii) Consider whether a blended payment approach could be developed for future commissioning and payment, with a fixed and variable, HRG based, component to funding.	NHSE/I central and regional teams, NHS pricing team.	Within 24 months
	d Change the label that is used for HRG XB09Z from 'enhanced care' to reduce potential confusion with L1 adult critical care. Consider using the term 'general care' as an alternative.	NHS Digital, Casemix HRG EWG.	Within 12 months
	i) Make recommendations about how XB09Z activity should be funded in future.	CRG, NHS pricing team, Casemix HRG EWG, NHSE/I.	Within 12 months

Future model of care and efficiency opportunities

Important goals that a future model of care should aim to achieve include:

- early identification of patient deterioration and timely intervention
- delivery of high-quality step-up and step-down care (L1, L1+, L2) without reliance on L3 beds
- delivery of high-quality L3 care to avoid complications and accelerate PICU recovery
- step-down from L3 level as soon as possible

Table 9 summarises the facilitators for delivering these goals, the potential benefits, and outcome measures that can be used to measure progress against these goals.

Table 9: A summary of the facilitators, potential benefits, and outcome measures with which to monitor success of a future model of care

Features of Quality PCC	Facilitators	Potential benefits	Outcome measures
Early identification of patient deterioration and timely intervention	Good ward staffing levels	Reduced rate of unplanned PCC admission	Number of unplanned L3 admissions
	High staff skills/ competence	Reduced rate of spoke to hub PICU transfer	% of spoke hospital admissions transferred to PICU
	Effective use of PEWS and escalation	Potential for L2 admission, preventing L3 admission	% of HDC staff with an accredited HDC course
	High levels of HDC education & training	Reduced rate of ward cardiac arrest	Rate of ward cardiac arrest
	PCC outreach team		
Ensure that the hospital PCC system can deliver high quality step-up and step-down care (L1, L2) without reliance on L3 beds	Sufficient number of L2 beds, distinct from L3 beds	Reduced prevalance of L3 admission	Population prevalance of L3 admission
	Appropriate numbers of HDC staff to deliver L1 and L2 care	Reduced occupancy of L3 beds	L3 bed occupancy
	High levels of HDC education & training	Reduced surgical cancellation rate	Elective on the day surgical cancellation rate
	Clear and effective medical and surgical pathways	Increased resilience to cope with winter surge	Proportion of L3 bed utilisation for tracheostomy ventilation
	Clear and effective LTV pathway	Reduced proportion of L3 bed utilisation by L0/1 patients	Proportion of L3 bed utilisation by L0/1 patients
	PCC outreach team	Reduced use of L3 beds across medical and surgical pathways	Proportion of L3 bed utilisation by L2 patients
		Shorter L3 unit LOS	LOS in a L3 bed
		Lower likelihood of requiring readmission to a L3 bed	Rate of unplanned 48 hr readmission to a L3 bed
Provide high quality L3 care to avoid complications and accelerate PICU recovery	Good PICU staffing levels	Shorter LOV	% of PICU staff with an a ccredited PIC course
	High staff skills/ competence	Shorter LOS	LOV (via ETT)
	High levels of PIC education & training	Fewer adverse events and complications	LOS in a L3 bed, LOS post-extubation
	Good senior supervision and support	Lower mortality (risk adjusted)	CLABSI rate
	Staff wellbeing		UE rate
			Mortality rate (risk adjusted)
Step-down from L3 level as soon as possible (to high quality step-down care)	Sufficient HDC and ward beds to allow discharge when ready	Reduced rate of delayed discharge	Rate of delayed L3 discharge
	Sufficient number of L2 beds, distinct from L3 beds	Reduced rate of out of hours discharge	Rate of out of hours L3 discharge
	Clear and effective medical and surgical pathways		
	Clear and effective LTV pathway		
	PCC outreach team		

Potential impact on demand and efficient use of PICU resources

Table 10 below summarises the potential PCC bed day opportunity if recommendations within this report are actioned. It focuses on efficiencies discussed throughout this report but specifically in section: '*Pathways, flow and efficiency*' on page 62.

- Reduction in L3 bed utilisation by L0/1 activity
- Reduction in L3 bed utilisation by L2 activity
- Reduction in L3 bed utilisation by tracheostomy ventilated patients
- Reduction in length of invasive ventilation (excluding tracheostomy ventilation)
- Reduction in unplanned spoke to hub PICU transfers

Table 10: Potential PICU bed day opportunity linked to recommendations

Improvement	National Average		Best quartile	
	Target	Bed day activity opportunity *	Target	Bed day activity opportunity *
Minimise the use of L3 beds by patients who do not require L3 care *(recommendations 4 and 12)* Opportunity = reducing the proportion of L0/1/2 activity delivered in designated L3 beds *Data: PICANet Jan - Dec 2018*				
L0/1 care	19.4% L3 bed activity for L0/1 care	**5,000 bed days**	11.3% L3 bed activity for L0/1 care	**10,500 bed days**
L2 care	21.5% L3 bed activity for L2 care	**2,500 bed days**	17.4% L3 bed activity for L0/1 care	**5,300 bed days**
Develop improved LTV pathways - Deliver ventilation care in a non-critical care environment unless the child is clinically unstable *(recommendation 11 and 13)* Opportunity = Reduction in L3 bed utilisation by tracheostomy ventilated patients *Data: PICANet Jan - Dec 2018*				
Tracheostomy ventilated care	9.6% L3 bed activity for trach vent care	**3,500 bed days**	2.6% L3 bed activity for trach vent care	**8,500 bed days**
Ensure that L3 beds are used efficiently *(recommendation 12)* Opportunity = Reduction in length of invasive ventilation (excluding tracheostomy ventilation) *Data: PICANet Jan - Dec 2018*				
Invasive ventilation (excluding tracheostomy ventilation)	5.5 days of ventilation	**4,400 bed days**	4.8 days of ventilation	**8,300 bed days**

* Activity opportunities are annual figures, based on one year of activity data. Unless specified, activity that could be avoided is shown

Note: the above calculations are not adjusted for casemix or demographics.

Table 10: Potential PICU bed day opportunity linked to recommendations (continued)

Improvement	National Average		Best quartile	
	Target	Bed day activity opportunity *	Target	Bed day activity opportunity *
Develop improved pathways and enhanced PCC education to spoke hospitals *(recommendation 11e))* Opportunity = Reduction in spoke to hub PICU transfers @ 7.1 days average length of stay *Data: PICANet and HES Jan - Dec 2018*				
Spoke to hub transfers	1.1% spoke admissions transferred to PICU	**3,500 bed days**	0.7% spoke admissions transferred to PICU	**8,900 bed days**
Total		**18,900 bed days**		**41,500 bed days**

* Activity opportunities are annual figures, based on one year of activity data. Unless specified, activity that could be avoided is shown
Note: the above calculations are not adjusted for casemix or demographics.

It is recognised that it is not realistic to expect that every provider will be able to deliver best practice across each of these domains. In addition, there may be patient factors beyond the control of the PICU team which may impact on some of these metrics, for example patient casemix and complexity will impact on duration of ventilation. Nonetheless the data allows us to explore the order of magnitude of potential impacts.

Maximising the gains

It is important to stress that many of the recommendations contained in this report are inter-dependent and should be considered as an integrated 'bundle'. The potential opportunities identified above will not be possible if individual recommendations are cherry-picked, whilst others are ignored.

For example, it will not be possible to maximise the reduction in L0/1/2 bed day utilisation if there are insufficient L2 beds and other suitable step-up and step-down pathways within L3 providers, including suitable pathways for LTV patients. Sufficient L2 beds will not materialise without appropriate PCC commissioning. Potential improvements in delivery of PCC across spoke hospitals, and fewer spoke to PICU transfers, will not be possible without adequately resourced ODNs, sufficient PCC educators, and designated and commissioned L2 spoke providers.

Summary of potential opportunity

In the region of 18,900 PICU bed days could be released if all providers were to deliver at or below the national average across all of the above domains. This equates to approximately 47 fewer PICU beds (based on 2018 occupancy levels of around 89%), 13% of the current total NHS England and NHS Improvement commissioned PICU beds across England (359 beds). The current gross annual cost associated with this bed day opportunity is around £35m.

The potential PICU bed day opportunity increases to approximately 41,500 if all providers were to deliver at or below the best performing 25% across all of the above domains, with a gross annual cost associated with this bed day opportunity of around £77m.

However, these are gross cost estimates and net gains will be lower as, for example, commissioning of 'new' step-up and step-down beds (L0/1/2) will be required to allow some of the L3 bed day opportunities described above to be realised, and to facilitate a much more efficient use of beds across the PICU network.

It is evident that these recommendations have the potential to have a very significant impact in the future. It is noteworthy that ~80% of the potential gains relate to changes within the L3 provider compared to only 20% at ODN and spoke hospital level. This emphasises the need to ensure that robust, appropriately commissioned step-up, step-down L2 and LTV pathways are developed within L3 providers.

It should be noted that the potential opportunities illustrated above are all essentially independent of each other in terms of calculation related to each of the domains. The only area of overlap relates to L2 bed days and tracheostomy ventilated bed days although we did remove relevant bed days as part of our calculations to ensure, as far as possible, no double counting of opportunity.

Potential impact on quality of care

In the above section we have focused on the impact of delivering best practice on use of resources. There are, of course, additional benefits that adoption of best practice can bring, not least around patient and family experience and quality of care.

Some of these are summarised in **Table 11**.

Table 11: Potential patient safety and quality gains associated with targeting best practice

Metric	National average target	Top quartile target	2018 activity count	Activity if all providers at average or better	Activity opportunity (average)	Activity if all providers at top quartile or better	Activity opportunity (top quartile)
Number of ward cardiac arrests per 100,000 ward days	14.6	6.4	94	67	27	38	56
Rate of cancelled elective surgery on the day	8.2%	3.7%	535	351	184	208	327
Rate of unplanned extubation per 1000 ETT days	5.2	2.8	287	231	56	145	142
Rate of out of hours discharge (20.00 - 08.00)	15.5%	10.0%	2572	1775	797	1389	1183

- The number of families experiencing a cancellation of their child's surgery on the day of surgery could be reduced by 34% or 61% were all providers to deliver at the national average or best performing 25% level respectively.
- The number of children experiencing a cardiac arrest on a paediatric ward could be reduced by 29% or 56% were all providers to deliver at the national average or best performing 25% level respectively.
- The number of times that a breathing tube becomes accidentally dislodged in PICU could be reduced by 20% or 50% were all providers to deliver at the national average or best performing 25% level respectively.

COVID-19

A lot has been learned about how to reduce transmission of coronavirus to minimise case numbers. Much of this learning is translatable to other acute respiratory viruses that we encounter each winter. If some of the COVID-19 prevention and early detection measures become more widely adopted we could see a reduction in the number of children admitted each winter, which in turn would reduce pressure on PICU services. In addition, the development of novel coronavirus vaccines may provide the platform for the future development of vaccines against a range of common respiratory viruses.

Reducing the impact of litigation

Each of the GIRFT programme teams have been asked to examine the impact and causes of litigation in their field with a view to reducing the frequency of litigation and more importantly reducing the incidents that lead to it. It is important for clinical staff to have the opportunity to learn from claims, complaints, serious untoward incidents (SUIs) / Serious Incidents (SIs)/ Patient Safety Incidents (PSI), and inquests in order to improve patient care and reduced costs (both in terms of the litigation itself, but also the management of complications resulting from such incidents).

Clinical negligence claims, volume, and costs

NHS Resolution handles all clinical negligence claims against NHS trusts in England through the Clinical Negligence Scheme for trusts, CNST. All trusts, including foundation trusts are in the CNST scheme.

A review of all claims notified to NHS Resolution between 2015/16 and 2019/20 was undertaken. Claims related to paediatric critical care were identified by claims related to patients aged under 16 years at the time of the incident and attributed to intensive care speciality, and key word search in claim details for patients under 16 years with the following key words 'intubation', 'ETT', 'endotracheal', 'ventilation', 'inotrope', 'vasopressor', 'arterial', 'central line', 'PICC', 'RRT', 'renal replacement', 'cardiac arrest', 'CPR', 'echo', 'chest drain', 'PICU', 'paediatric intensive care'. Clinical review of available incident details to ensure only claims related to paediatric critical care were analysed. Although we made every effort to identify all claims, there are significant caveats through the above method and the number of claims and trends identified may be under-represented.

Between 2015/16 and 2019/20, 29 claims were identified related to the 21 trusts in England that deliver paediatric intensive care, varying from four to nine claims per year.

Total claims costs during this five year period is estimated at £32.6m, with annual claims between £0.4m and £12.2m, and median costs per claim estimated at £79,250 (IQR £57,500 - £145,000) (see **Table 12**) Two claims were of very high value, estimated at greater than £10 million each.

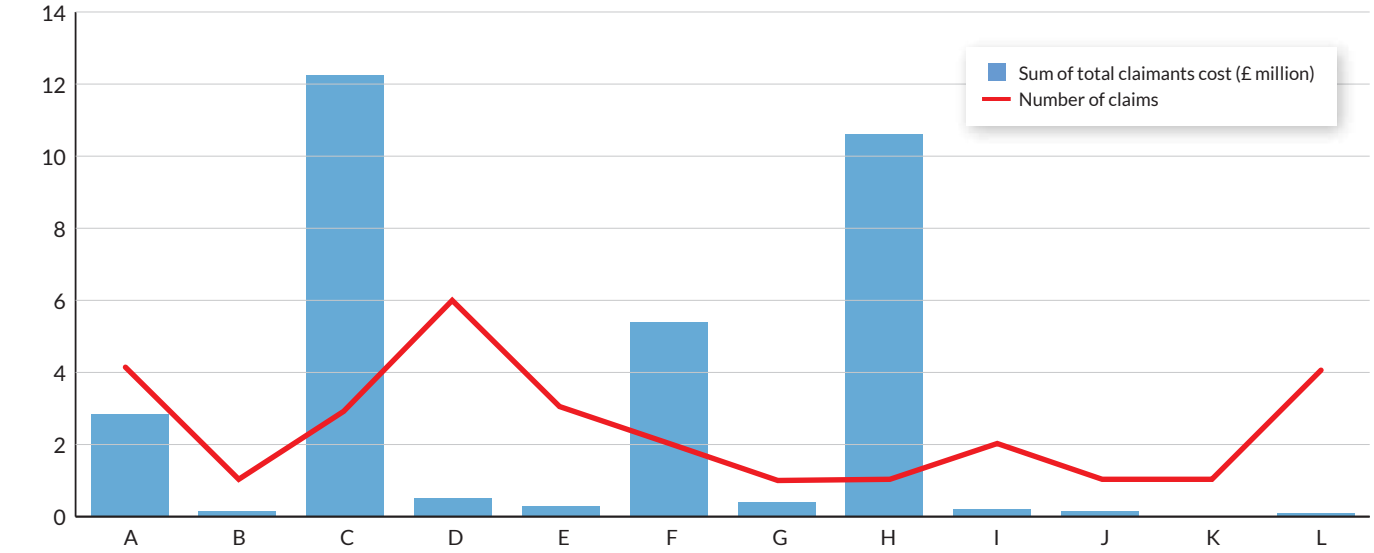
Table 12: Volume and cost of medical negligence claims related to paediatric critical care notified to NHS Resolution, 2015/16–2019/20

Notification Year	Number of claims	Total claimant costs (£ million)
2015/16	7	1.1
2016/17	5	0.4
2017/18	4	10.8
2018/19	4	12.2
2019/20	9	8.1
Grand Total	**29**	**32.6**

The length of time between incident date and notification of claim is median two years and seven months (IQR 1 year – 4 years 5 months); the longest time lag is eight years and this represents that claims can be notified up to three years after the child's 18th birthday. Three trusts represented 48% (14/29) claims; nine trusts received no claims in this period. The variation in claims number and costs are shown in **Figure 38**.

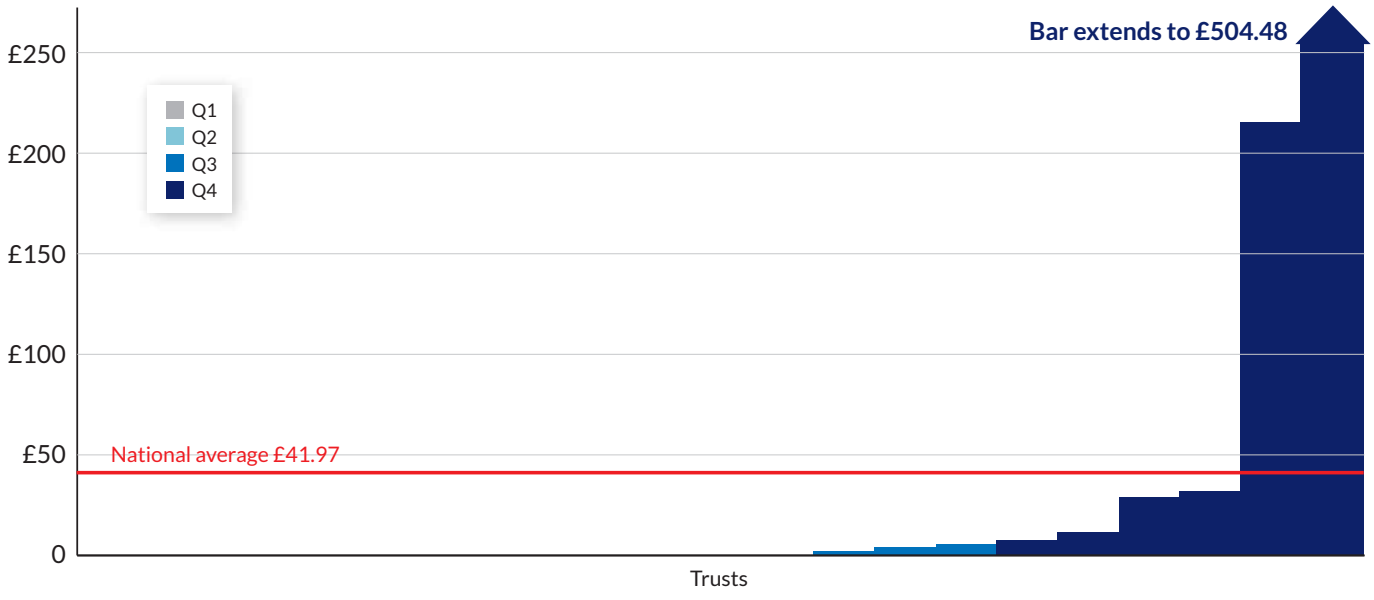
Figure 38: No. of claims across trusts and estimated sum of total claim costs.

Note nine trusts received no claims during this period



The national average estimated cost per litigation was £41.97 for every PICU bed-day delivered, based on cost of claims and national reference costs bed-days assigned to trusts delivering paediatric intensive care. There are notable differences between providers (see **Figure 39**); the best performing providers were estimated to have litigation costs of £0 per bed-day. This was the case for ten of the 21 units, nine of which had no claims in the 5-year period illustrating the small number of claims in the specialty. However, one provider generated an average of £504.48 per reference costs bed-day demonstrating how expensive these claims can be due to the age and long-term implications for the patients involved. The costs of litigation and subsequent benchmarked position for a provider has been delivered to each trust and can be used as part of a learning process via the GIRFT 5-point plan (see Recommendations).

Figure 39: Variation in England between trusts delivering paediatric critical care in estimated litigation costs per PICU bed-day as notified to NHS Resolution 2015/16 to 2019/20



Note: Activity denominator: reference costs bed days assigned to paediatric critical care units. Q refers to the quartile in which trusts are found. Data is based on claims for patients aged 18 years and under.

Demographics, causes and injuries

More male than female patients (17 male, 12 female) were involved in the claims and 28% (8/29) claims involved patients aged less than 1 year (see **Table 13**). A systematic review of paediatric malpractice (not specific to PCC) in US[21] reported higher claims for infants and in Agarwal et al.'s[22] large retrospective review of PCC adverse events, meant adverse events per patient was highest in children aged 30-364 days.

Table 13: Sex and age of patients involved in claims

Demographics		
Male	17	59%
Female	12	41%

Age at time of incident		
<1 year	8	28%
1-4 years	6	21%
5-10 years	7	24%
10-15 years	8	28%

Reviewing the causes and injuries/outcomes recorded by NHS Resolution and in the incident details, the commonest claim areas were related to positioning/ skin care/ nursing standards, delayed/inadequate treatment or missed/ delayed diagnosis, and transfer. The most frequent injury/outcome recorded was death, in 52% (15/29) claims. Claims may have more than one cause and/or injury/outcome identified (see **Table 14**).

Table 14: Causes and injuries identified (each claim may have one or more cause or injury)

Cause	
Positioning/ skin care/ nursing	10
Missed/delayed diagnosis OR delayed/inadequate treatment	9
Transfer	7
Respiratory/ airway	4
Vascular access	3
Failure to monitor or identify deterioration	2
Infection	1
Medication	1
Venothromboembolism (VTE)	1
Withdrawn/ withheld treatment	1
Other	1

Injury	
Fatality	15
Pressure Sores	5
Brain Damage	3
Scarring	3
Unnecessary Pain	3
Amputation - Lower	2
Burn(s)	1
Cosmetic Disfigurement	1
Developmental Delay	1
Nerve Damage	1
Thrombosis/Embolism	1

[21] *Najaf-Zadeh A, Dubos F, Aurel M, Martinot A, 2008. Epidemiology of malpractice lawsuits in paediatrics. Acta Paediatr 97:1486–1491*

[22] *Agarwal S, Classen D, Larsen G, et al, 2010. Prevalence of adverse events in pediatric intensive care units in the United States. Pediatr Crit Care Med.;2010; 11(5):568-578. doi:10.1097/PCC.0b013e3181d8e405*

Pressure sores or ulcers are common in a hospital setting, with an estimated 1,300 new ulcers reported per month affected in the NHS[23]. In PCC, variable incidence has been reported, between 0.8% - 27%[24, 25, 26, 27]. Paediatric critically ill patients represent a vulnerable cohort due to immature skin, compromised perfusion, decreased mobility, altered neurological responsiveness, fluid retention and high use of medical devices[26]. It is an important area of preventable harm and a focus of patient safety and quality improvement initiatives.

Delayed/ inadequate treatment and missed/ delayed diagnosis causes together represent diagnostic errors. A systematic review by Custer et al. found diagnostic errors in PCC populations were most common in infection/sepsis, with critically unwell patients at higher risk of misdiagnosis[28]. This may be related to the heterogeneity in patient cohort, with varying ages from neonate to adolescent and breadth of pathophysiology. Najaf-Zadeh et al's systematic review of paediatric malpractice, although not specific to PCC, identified claims were most frequently related to diagnostic errors of meningitis, gastroenteritis, and pneumonia[21]. Critical thinking and cognitive biases have been discussed when understanding why such errors may happen and strategies to reduce these[29, 30].

Incidents related to transfer and retrieval of critically ill children was the third most frequent theme identified. The nature of the claims relates to intra-hospital transfer and handover (between theatre and PCC), advice given by the retrieval team and delay/failure of patient being accepted for transfer. There were no claims identified related to care of the patient during transport. Retrieval and transfer of critically ill children is a high-risk activity and strong governance arrangements are in place to allow for cross -organisational learning within a team and across a network as part of commissioning agreements by retrieval teams[31]. Litigation claims and their discussion may provide additional information for learning.

All front-line clinicians should learn from clinical negligence claims. By facilitating improvement in patient safety and reducing the costs of litigation, NHS resources are not unnecessarily diverted from front line care. A best practice guide to learn from litigation has been published, providing guidance how trust legal departments, patient safety teams and front-line clinicians manage a claim and provide appropriate investigation of learning opportunities.

[23] *NHS England. Stop the Pressure (2020) Available at https://nhs.stopthepressure.co.uk/ Accessed June 2021.*

[24] *Curley MA, Quigley SM, Lin M. 2003. Pressure ulcers in pediatric intensive care: incidence and associated factors. Pediatr Crit Care Med. 2003;4(3):284-290. doi:10.1097/01.PCC.0000075559.55920.36*

[25] *Schindler CA, Mikhailov TA, Kuhn EM, et al. 2011. Protecting fragile skin: nursing interventions to decrease development of pressure ulcers in pediatric intensive care. Am J Crit Care. 2011;20:26–34; quiz 35*

[26] *Schindler CA, Mikhailov TA, Fischer K, et al. 2007. Skin integrity in critically ill and injured children. Am J Crit Care. 2007;16:568–574.*

[27] *Kottner J, Wilborn D, Dassen T, 2010. Frequency of pressure ulcers in the paediatric population: a literature review and new empirical data. Int J Nurs Stud 47(10): 1330–40*

[28] *Custer JW, Winters BD, Goode V, et al. 2015. Diagnostic errors in the pediatric and neonatal ICU: a systematic review. Pediatr Crit Care Med. 2015;16(1):29-36. doi:10.1097/PCC.0000000000000274*

[29] *Hiren Mehta, Adrian Plunkett, Thinking about thinking in paediatric critical care, Paediatrics and Child Health, 2021*

[30] *Schaller-Paule MA, Steinmetz H, Vollmer FS, Plesac M, Wicke F, Foerch C. Lessons in clinical reasoning - pitfalls, myths, and pearls: the contribution of faulty data gathering and synthesis to diagnostic error. Diagnosis (Berl). 2021 Mar 23. doi: 10.1515/dx-2019-0108. Epub ahead of print. PMID: 33759405.*

[31] *NHS England. Service specifications: Paediatric Critical Care Transport (2015) (https://www.england.nhs.uk/commissioning/wp-content/uploads/sites/12/2015/01/e07-spec-paedi-intens-care-retrvl-transp.pdf) Accessed June 2021*

[32] *Getting It Right First Time. Learning from Litigation Claims (2021) Available at https://www.gettingitrightfirsttime.co.uk/wp-content/uploads/2021/05/Best-practice-in-claims-learning-FINAL.pdf Accessed June 2021*

Recommendations

Recommendation	Actions	Timescale
22. Reduce litigation costs through application of the GIRFT programme's five-point plan.	**a** Clinicians and trust management to assess their benchmarked position compared with the national average when reviewing the estimated litigation cost per activity. Trusts should have received this information in the GIRFT 'Litigation data pack.'	For continual action
	b Clinicians and trust management to discuss with the legal department or claims handler the claims submitted to NHS Resolution included in the data set to confirm correct coding to that department. Inform NHS Resolution of any claims that are not coded correctly to the appropriate specialty via CNST.Helpline@resolution.nhs.uk	For continual action
	c Once claims have been verified clinicians and trust management to further review claims in detail including expert witness statements, panel firm reports and counsel advice as well as medical records to determine where patient care or documentation could be improved. If the legal department or claims handler needs additional assistance with this, each trusts panel firm should be able to provide support.	For continual action
	d Claims should be triangulated with learning themes from complaints, inquests and serious incidents (SI)/ patient safety incidents (PSI) and where a claim has not already been reviewed as SI/PSI we would recommend that this is carried out to ensure no opportunity for learning is missed. The findings from this learning should be shared with all front-line clinical staff in a structured format at departmental/directorate meetings (including multi-disciplinary team (MDT) meetings, morbidity and mortality meetings, and regional service meetings where appropriate).	For continual action
	e Where trusts are outside the top quartile of trusts for litigation costs per activity, GIRFT will be asking national clinical leads and regional hubs to follow up and support trusts in the steps taken to learn from claims. They will also be able to share examples of good practice where it would be of benefit to trusts.	For continual action

About the GIRFT Programme

Getting It Right First Time (GIRFT) is a national programme designed to improve treatment and care by reviewing health services. It 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.

Working to the principle that a patient should expect to receive equally timely and effective investigations, treatment, and outcomes wherever care is delivered, irrespective of who delivers that care, GIRFT aims to identify approaches from across the NHS that improve outcomes and patient experience, without the need for radical change or additional investment. While the gains for each patient or procedure may appear marginal, they can, when multiplied across an entire trust – and even more so across the NHS as a whole – deliver substantial cumulative benefits.

The programme was first conceived and developed by Professor Tim Briggs to review elective orthopaedic surgery to address a range of observed and undesirable variations in orthopaedics. In the 12 months after the pilot programme, it delivered an estimated £30m-£50m savings in orthopaedic care – predominantly through changes that reduced average length of stay and improved procurement.

The same model has been applied in more than 40 different areas of clinical practice. It consists of four key strands:

- a broad data gathering and analysis exercise, performed by health data analysts, which generates a detailed picture of current national practice, outcomes and other related factors;
- a series of discussions between clinical specialists and individual hospital trusts, which are based on the data – providing an unprecedented opportunity to examine individual trust behaviour and performance in the relevant area of practice, in the context of the national picture. This then enables the trust to understand where it is performing well and what it could do better – drawing on the input of senior clinicians;
- a national report, that draws on both the data analysis and the discussions with the hospital trusts to identify opportunities for improvement across the relevant services;
- an implementation phase where the GIRFT team supports providers to deliver the improvements recommended.

GIRFT and other improvement initiatives

GIRFT is part of an aligned set of workstreams within NHS England and NHS Improvement. It is the delivery vehicle for one of several recommendations made by Lord Carter in his February 2016 review of operational efficiency in acute trusts across England.

The programme has the backing of the Royal Colleges and professional associations and has a significant and growing presence on the Model Hospital portal, with its data-rich approach providing the evidence for hospitals to benchmark against expected standards of service and efficiency. The programme also works with a number of wider NHS programmes and initiatives which are seeking to improve standards while delivering savings and efficiencies.

Implementation

GIRFT has developed an implementation programme designed to help trusts and their local partners to address the issues raised in trust data packs and the national specialty reports to improve quality. The GIRFT team provides support at a local level through the NHS England regional teams, advising on how to reflect the national recommendations into local practice and supporting efforts to deliver any trust specific recommendations emerging from the GIRFT visits. GIRFT also helps to disseminate best practice across the country, matching up trusts who might benefit from collaborating in selected areas of clinical practice. Through all its efforts, local or national, the GIRFT programme strives to embody the 'shoulder to shoulder' ethos that has become GIRFT's hallmark, supporting clinicians nationwide to deliver continuous quality improvement for the benefit of their patients.

Glossary

ACC
Adult critical care

ACCP
Advanced critical care practitioner

AHP
Allied health professional

ANP
Advanced nurse practitioner

APC
Admitted Patient Care

BSA
Body surface area

CAUTI
(Urinary) catheter associated urinary tract infection - a form of HCAI

CCG
Clinical commissioning group

CLABSI
Central (venous) line associated blood stream infection - a form of HCAI

CPAP
Continuous positive airway pressure

CPR
Cardiopulmonary resuscitation

Craniotomy procedures
A surgical procedure that involves opening the skull to gain access to the brain

CRG
NHSE Clinical Reference Group

ECMO
Extracorporeal membrane oxygenation

Endotracheal tube
A tube that is inserted via the mouth or nose through which artificial ventilation can be delivered

EofE
East of England region of England

EPR
Electronic patient record

HDC
High Dependency Care

HDU
High Dependency Unit

Healthcare associated infections (HCAI)
An infection that is thought to have developed or been acquired whilst a patient is in hospital

HEE
Health education England

HFNC
High flow nasal cannulae (HFNC) therapy is a simple form of non-invasive respiratory support that has been introduced over the past 10 years as a step-up therapy when simple 'low flow' oxygen proves insufficient

HFOV
High frequency oscillatory ventilation

HQIP
Healthcare quality improvement partnership

HRG
Healthcare resource groups - developed to characterise groups of patients with similar resource utilisation under payment by results (PbR)

ICCQIP
Infections in critical care quality improvement partnership

ICD 10
International classification of disease (10th edition)

ICS
Integrated care system

Idiopathic scoliosis
A condition in which a curvature of the spine develops

iNO
Inhaled nitric oxide

IQR
Interquartile range

Level 1 care
Describes delivery of basic PCC (HDC)

Level 1+ care
Describes delivery of PCC that falls between L1 and L2 (though not a term that is formally recognised at present)

Level 2 care
Describes delivery of intermediate PCC (advanced HDC)

Level 3 care
Describes delivery of advanced PCC (intensive care)

LLC
Life limiting condition

LoS
Length of stay

LTV
Long Term Ventilation - can be delivered via a mask (non-invasive) or via a tracheostomy (invasive)

NCC
National cost collection - formerly known as 'reference costs'. An annual return from each Trust that describes the costs of delivering care.

NCEPOD
National Confidential Enquiry into Patient Outcome and Death - see *www.ncepod.org.uk*

NIHR
National institute for health research

NIV
Non-invasive ventilation -delivery of ventilation via a facemask or hood

NOG
National oversight group

NPoC
National programme of care

OBD
Occupied bed day

ODN
Operational Delivery Network

PCC
Paediatric Critical Care

PCCMDS
Paediatric critical care minimum dataset - a list of interventions (and some diagnostic codes) that describe the complexity of care being delivered on each PCC day

PCCS
Paediatric critical care society (formerly known as Paediatric intensive care society (PICS)

PCCS-E
Education groups of paediatric critical care society

PCCS-SG
Study group of the paediatric critical care society

PICANet
Paediatric Intensive Care Audit Network for the UK

PICU
Paediatric Intensive Care Unit

PIM
Paediatric index of mortality - a risk adjustment tool used in PCC

POD
Probability of death - derived from the PIM score

RCPCH
Royal College of Paediatrics and Child Health

SMR
Standardised mortality ratio

SSQD
Specialised services quality dashboard

SUS
Secondary Uses Service - the central NHS data repository or 'warehouse' through which all hospital episode data should flow

UE
Unplanned extubation i.e. accidental removal of an endotracheal tube

VAD
Ventricular assist device

WTE
Whole time equivalent

Acknowledgements

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I and the team would like to thank all PICU providers and PCC ODNs that we visited for their willingness to embrace the GIRFT process, and to engage in positive and honest discussion about their services.

I would also like to thank the wider PCC community for actively supporting the GIRFT review, in particular the Paediatric Critical Care Society (PCCS) council, the Paediatric Intensive Care Audit Network (PICANet) team, and the NHS England and NHS Improvement PCC national review team, in particular Peter Wilson, Janette Harper and David Barron, for having the vision to commission this GIRFT review.

Professor Kevin Morris

Appendices

Appendix 1: Mapping of PCCMDS codes to PCC Healthcare Resource Groups (HRGs)

HRG	Mapping of PCCMDS codes to HRG
HRG XB01Z	Extracorporeal membrane oxygenation (ECMO) **OR** Ventricular assist device (VAD) **OR** Aortic balloon pump
HRG XB02Z	Invasive Mechanical Ventilation (via either endotracheal tube or tracheostomy) or Advanced Respiratory Support (High Frequency Oscillatory Ventilation or Jet Ventilation) **Plus** one or more of: ■ Burns >79% body surface area (BSA) ■ >80 mls/kg volume boluses **OR** HRG XB03Z + Isolation in a single occupancy cubicle in the presence of a valid ICD10 code
HRG XB03Z	Invasive Mechanical Ventilation (via either endotracheal tube or tracheostomy) or Advanced Respiratory Support (HFOV or Jet Ventilation) **Plus** one or more of: ■ Haemofiltration ■ Haemodialysis ■ Peritoneal dialysis ■ Burns 50-79% BSA ■ Extracorporeal Liver Support (MARS) ■ Exchange transfusion ■ Inhaled nitric oxide (iNO) ■ Surfactant ■ Plasmafiltration **OR** HRG XB04Z + Isolation in a single occupancy cubicle in the presence of a valid ICD10 code
HRG XB04Z	Invasive Mechanical Ventilation (via either endotracheal tube or tracheostomy) **Plus** one or more of: ■ Vasoactive infusion ■ Intracranial pressure (ICP) monitoring or External Ventricular Drain ■ Burns 20-49% BSA ■ Intravenous thrombolysis ■ Cardiopulmonary resuscitation (CPR) in last 24 hrs **OR** HRG XB05Z + Isolation in a single occupancy cubicle in the presence of a valid ICD10 code

HRG	Mapping of PCCMDS codes to HRG
HRG XB05Z	Invasive Mechanical Ventilation via endotracheal tube **OR** Invasive mechanical ventilation via tracheostomy **Plus** one or more of: ■ Continuous intravenous infusion of a sedative agent ■ Invasive arterial monitoring ■ Central venous pressure monitoring ■ Epidural infusion **OR** Non invasive ventilation **Plus** one or more of: ■ Continuous intravenous infusion of a sedative agent ■ Invasive arterial monitoring ■ Central venous pressure monitoring ■ Epidural infusion ■ Vasoactive infusion ■ >80 mls/kg volume boluses ■ Haemofiltration ■ Haemodialysis ■ Peritoneal dialysis ■ Plasmafiltration ■ Extracorporeal Liver Support (MARS) ■ CPR in last 24 hrs ■ Intravenous thrombolysis ■ Burns >20% BSA ■ iNO ■ Surfactant ■ Exchange transfusion ■ Intracranial pressure (ICP) monitoring or External Ventricular Drain

HRG	Mapping of PCCMDS codes to HRG
HRG XB06Z	**Airway:** ■ Nasopharyngeal airway ■ Care of tracheostomy (first seven days of episode only) **Breathing:** ■ Non-invasive ventilation (including CPAP and BiPAP) (to max of 90 consecutive days of episode at 06Z) ■ Invasive ventilation via a tracheostomy (to max of 90 consecutive days of episode at 06Z) **Circulation:** ■ >80 ml/kg volume boluses ■ Vasoactive infusion (including inotropes and prostaglandin) ■ Temporary external pacing ■ Cardiopulmonary resuscitation in the last 24 hours **Diagnosis:** ■ Acute renal failure requiring dialysis or haemofiltration ■ Status epilepticus requiring treatment with continuous IV infusion **Monitoring:** ■ Invasive arterial monitoring ■ Central venous pressure monitoring ■ Intracranial pressure (ICP) monitoring or External Ventricular Drain **Other:** ■ Exchange transfusion ■ Intravenous thrombolysis ■ Extracorporeal liver support (MARS) ■ Plasmafiltration ■ Epidural infusion
HRG XB07Z	**Airway:** ■ Upper airway obstruction requiring nebulised adrenaline **Breathing:** ■ Apnoea – recurrent ■ Oxygen therapy plus continuous pulse oximetry plus ECG monitoring ■ Heated humidified high flow therapy plus continuous pulse oximetry plus ECG monitoring ■ Invasive ventilation via a tracheostomy (after 90 days of episode at XB06Z) ■ Non-invasive ventilation (including CPAP and BiPAP) (after 90 days of episode at XB06Z) **Circulation:** ■ Arrhythmia requiring IV anti-arrhythmic therapy **Diagnosis:** ■ Severe asthma (IV bronchodilator / continuous nebulisers) ■ Diabetic ketoacidosis requiring continuous insulin infusion **Other:** ■ Reduced level of consciousness (Glasgow Coma Score (GCS) 12 or below) and hourly (or more frequent) GCS monitoring

Appendix 2: Models for Level 3 PICU systems and ODNs

a) What does a good Level 3 PICU system look like?

Access/ Capacity

1. The PICU has the capacity to accept all patients who need to be admitted from their hospital wards (including emergency department/paediatric assessment unit), and surrounding catchment area (at the time they need to be admitted)
2. There should be a low same-day cancellation rate for planned surgery requiring a PICU bed
3. The hospital has a clear policy/plan for how to deal with winter pressure on PICU bed capacity
4. When this is a problem with either of the above there should be evidence of a within hospital action plan and dialogue between those commissioning the service and the clinical team/provider trust

Flow / discharge

1. Patients are discharged from PICU at an appropriate time when they no longer require L3 care
2. Step-up and step-down L2 care is available in the L3 hospital to reduce L3 demand and support early PICU discharge
3. Patients are transferred back to a spoke hospital where possible
4. There is no delay in discharging patients from PICU once the decision is taken

Outreach / deterioration

1. Deteriorating patients on wards should be detected appropriately and seen quickly by a critical care team where appropriate
2. Transfer from a ward and admission to critical care is timely and undertaken by suitably competent staff

Clinical care and clinical pathways

1. The PICU provides good clinical care, with a low complication rate
2. Relevant guidelines are in place to support staff and patient care
3. The unit follows evidence based practice with low usage of unproven therapies or investigations
4. Essential services are co-located in same hospital
5. Access to urgent investigations, including CT and MRI, is available
6. The hospital has a clear policy for admitting over-age patients and transitioning patients to adult services
7. The hospital has a clear policy for transitioning patients from neonatal to paediatric services
8. The hospital has a specific ward area for the care of LTV patients
9. The hospital is able to admit LTV patients from home to a ward or L2 area/unit avoiding the need for admission to a L3 bed (unless clinical condition requires ICU admission)

Staffing

1. Staffing of the PICU meets recommended standards (nursing, medical, AHP and others)
2. Staff vacancies are kept as low as possible
3. Staff sickness levels are low
4. Staff retention is good
5. A staff wellbeing programme is in place

Audit, safety, governance

1. The PICU has a culture of measuring quality and safety, reports relevant metrics, and responds to findings
2. A multi-disciplinary, cross specialty mortality review process is undertaken regularly, with written recording of discussions, conclusions and actions
3. The PICU submits complete and accurate audit and activity data to PICANet, SUS and Reference Costs
4. Patients are discharged with written handover documentation for the receiving team

5. Patients are not discharged from PICU overnight, wherever possible
6. The unit actively participates in audit, quality improvement and research
7. The unit has an active education programme for nurses and doctors with teaching time protected
8. The hospital and PICU have a fully integrated electronic patient record that includes electronic prescribing and full patient monitoring

Outcomes

1. There is short length of stay in PICU (when comparing like for like patients and diagnoses)
2. Risk adjusted mortality is low compared to other similar PICUs

Funding / spending / commissioning

1. The unit/provider trust negotiates a good tariff for equipment (ventilators, monitoring) and consumables
2. Charitable funds are not used for the purchase of essential equipment and consumables
3. A fund is available within the trust to cover the cost of replacing essential equipment
4. The PICU is commissioned using a system that takes into account patient complexity, using HRGs
5. Level 2 beds are commissioned as well as L3 beds

b) What does a good network look like?

1. The network has a clear and detailed understanding of in-patient paediatric care across all of its provider trusts
2. It has identified which patients can be looked after in each hospital, including which hospitals can provide elective and emergency general paediatric surgery
3. It is clear which hospitals function at PCC L1, L2 and L3
4. It has developed clear pathways of care for common illnesses
5. It has developed a robust system to capture all PCC activity across its provider trusts
6. Standalone L2 units should have guidance in place for delivering care to patients who need acute respiratory support (nasal high flow therapy and acute non-invasive CPAP and BIPAP)
7. Standalone L2 units should have guidance in place for delivering care to patients on chronic ventilation (non-invasive and tracheostomy) admitted from home or discharged from the L3 centre
8. There is clear guidance in place for when and how to communicate with the L3 centre / transport service for advice and support
9. There is an effective relationship and good communication between DGHs in the network and a) the transport service and b) the level 3 unit(s)
10. There is a clear network understanding of the relationship with 'adult' anaesthesia/ICU colleagues in the care of critically ill paediatric patients (for both a) acute stabilisation and b) ongoing L2 care at Level 2 centre
11. There is a clear understanding of the numbers of children <16 years of age who are looked after in 'adult' ICUs (total numbers in each adult unit, numbers transferred to PIC, median time to PIC transfer, numbers kept in adult unit, LOS)
12. It has in place an appropriate network board which includes clinicians, managers and commissioners and an independent chair.
13. It is clear how PCC is commissioned across the network
14. It has developed an education plan for the network and identified appropriate educators to deliver the education plan via PCCS-E validated courses
15. It has developed a robust system for governance across the network, which should include a system for monitoring and learning from safety incidents, and from excellent practice

Appendix 3: HRG allocation for children receiving tracheostomy ventilation according to which other PCCMDS interventions are present each day

HRG	Mapping of PCCMDS interventions to HRG
HRG XB01Z	Extracorporeal membrane oxygenation (ECMO) **OR** Ventricular assist device (VAD) **OR** Aortic balloon pump
HRG XB02Z	Invasive Mechanical Ventilation (via either endotracheal tube or tracheostomy) **Plus** one or more of: ■ Burns >79% body surface area (BSA) ■ >80 mls/kg volume boluses **OR** HRG XB03Z + Isolation in a single occupancy cubicle in the presence of a valid ICD10 code
HRG XB03Z	Invasive Mechanical Ventilation (via either endotracheal tube or tracheostomy) or Advanced Respiratory Support (HFOV or Jet Ventilation) **Plus** one or more of: ■ Haemofiltration ■ Haemodialysis ■ Peritoneal dialysis ■ Burns 50-79% BSA ■ Extracorporeal Liver Support (MARS) ■ Exchange transfusion ■ Inhaled nitric oxide (iNO) ■ Surfactant ■ Plasmafiltration **OR** HRG XB04Z + Isolation in a single occupancy cubicle in the presence of a valid ICD10 code
HRG XB04Z	Invasive Mechanical Ventilation (via either endotracheal tube or tracheostomy) **Plus** one or more of: ■ Vasoactive infusion ■ Intracranial pressure (ICP) monitoring or External Ventricular Drain ■ Burns 20-49% BSA ■ Intravenous thrombolysis ■ Cardiopulmonary resuscitation (CPR) in last 24 hrs **OR** HRG XB05Z + Isolation in a single occupancy cubicle in the presence of a valid ICD10 code

HRG	Mapping of PCCMDS interventions to HRG
HRG XB05Z	Invasive mechanical ventilation via tracheostomy **Plus** one or more of: ■ Continuous intravenous infusion of a sedative agent ■ Invasive arterial monitoring ■ Central venous pressure monitoring ■ Epidural infusion
HRG XB06Z	Invasive ventilation via a tracheostomy (to max of 90 consecutive days of episode at XB06Z)
HRG XB06Z	Invasive ventilation via a tracheostomy (to max of 90 consecutive days of episode at XB06Z)

Appendix 4: Theoretical PCC unit with 20 beds, running at 85% average occupancy, exploring the impact of average length of stay on the difference between occupied bed day (midnight census) and HRG bed day activity, and the corresponding implications for commissioning contracts.

Number of PCC beds	Average occupancy (midnight census)	Number of occupied bed days /year (OBDs)	Average length of PCC stay (days)	Adjustment factor to convert OBDs to HRG bed-days*	Equivalent number of HRG bed days /year	Apparent occupancy if HRG bed-days are used rather than OBDs	Number of PCC beds per 1000 HRG bed-days	Conversion factor for formula	HRG bed-days / bed
20	85%	6,205	3	1.333	8,273	113%	2.4	0.88	414
20	85%	6,205	4	1.250	7,756	106%	2.6	0.94	388
20	85%	6,205	5	1.200	7,446	102%	2.7	0.98	372
20	85%	6,205	6	1.167	7,239	99%	2.8	1.01	362
20	85%	6,205	7	1.143	7,091	97%	2.8	1.03	355
20	85%	6,205	8	1.125	6,981	96%	2.9	1.04	349

* Due to potential for recording double occupancy of a bed when one patient is discharged and a new patient is admitted on the same day.

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