HQIP
Healthcare Quality Improvement Partnership

PICANet

NOVEMBER 2016 ANNUAL REPORT

SUMMARY REPORT

Paediatric Intensive Care Audit Network

DATA COLLECTION PERIOD

JANUARY 2013 – DECEMBER 2015

UNIVERSITY OF LEICESTER

UNIVERSITY OF LEEDS

GIG CYMRU NHS WALES

HCA Hospitals
World-Class Healthcare

NOCA National Office of Clinical Audit

HSC Belfast Health and Social Care Trust

NHS National Services Scotland

KEY

Cambridge, Addenbrooke's Hospital	A
Brighton, Royal Alexandra Hospital*	B
Cardiff, Noah's Ark children's Hospital for Wales	C
Manchester, Royal Children's Hospital	D
London, Great Ormond Street Hospital - PICU/NICU	E1
London, Great Ormond Street Hospital - CCCU	E2
London, Evelina Children's Hospital	F
Hull Royal Infirmary	G
London, Kings College Hospital	H
Leeds General Infirmary	I
Newcastle, Great North Children's Hospital	K1K3
Newcastle Freeman Hospital	K2
Stoke on Trent, Royal Stoke University Hospital.	L
Nottingham, Queen's Medical Centre	M
Oxford, John Radcliffe Hospital	N
London, Royal Brompton Hospital	O
Liverpool, Alder Hey	P
Sheffield Children's Hospital (PICU)	Q
Southampton Children's Hospital	R
Middlesbrough, James Cook Hospital	S
London, St George's Hospital	T
London, St Mary's Hospital	U
Birmingham Children's Hospital	V
Bristol, Royal Hospital for Children	W
Leicester Glenfield Hospital	X
Leicester Royal Infirmary	X
Edinburgh Royal Hospital for Sick Children	Y
London, The Royal London Hospital	Z
Glasgow Royal Hospital for Children	ZA
Belfast, Royal Belfast Hospital for Sick Children	ZB
Dublin, Our Lady's Children's Hospital Crumlin	ZC
Dublin, Children's University Hospital Temple Street	ZD
London, Harley Street Clinic	ZE
London, The Portland Hospital	ZF
NWTS: North West and North Wales P.T.S	T003
Embrace: Yorkshire & Humber Infant & Children's Service	T002
CATS - Children's Acute Transport Service	T001
STRS - South Thames Retrieval Service	T004
KIDS Intensive Care & Decision Support	T005
SCOTSTAR - Edinburgh team	T016
IPATS –Irish Paediatric Acute Transport Service	T022
WATCh - Wales and West Acute Transport for Children	T024
NECTAR - North East Children's Transport and Retrieval	T026
SORT - Southampton, Oxford retrieval team	T008
NISTAR -Paediatric	T010

* Brighton is no longer designated as a PICU as of 2014 and so will not be included in future annual reports

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PICANet was established in collaboration with the Paediatric Intensive Care Society (PICS) and their active support continues to be a key component of our successful progress. The PICANet Steering Group (SG) has patient, academic, clinical, government and NHS members all of whom are thanked for their continuing assistance and advice. Members of the Clinical Advisory Group (CAG) provide a formal interface between PICANet and the clinical care teams and their valuable support and contribution is gratefully acknowledged.

We are also grateful for the support and commitment given by members of the PIC Families Group.

The PICANet Audit is commissioned by the Healthcare Quality Improvement Partnership (HQIP) as part of the National Clinical Audit Programme (NCA). HQIP is led by a consortium of the Academy of Medical Royal Colleges, the Royal College of Nursing and National Voices. Its aim is to promote quality improvement, and in particular to increase the impact that clinical audit has on healthcare quality in England and Wales. HQIP holds the contract to manage and develop the NCA Programme, comprising of more than 30 clinical audits that cover care provided to people with a wide range of medical, surgical and mental health conditions. The PICANet Audit is funded by NHS England, the Welsh Government, NHS Lothian/National Service Division NHS Scotland, the Royal Belfast Hospital for Sick Children, The National Office of Clinical Audit (NOCA), Republic of Ireland and HCA Healthcare.

FOREWORD

It is a great privilege and a pleasure for me to introduce the 2016 PICANet annual report. This gives me the opportunity to thank PICANet, on behalf of the Italian Paediatric Intensive Care Network (TIPNet), for the excellent work they have carried out that has inspired us since our launch in 2004. Data collection has expanded in Italy since then, thanks to private funding, and in 2010 TIPNet became a permanent database network, controlled by CINECA, collecting organizational and clinical data from 16 of the 21 Italian PICUs. An annual report is produced and discussed at our national meeting every year.

In 2015, at the PICANet annual meeting, we were given the opportunity to present our TIPNet findings and to compare populations and outcomes for the two networks which have many similarities and offer possibilities for future collaboration. On October 14th 2016 we will have the pleasure of discussing our annual report with Elizabeth Draper in Milan.

In order to support trials in the relatively small specialty of PIC we need to expand our horizons and collaborate with the wider international PIC Community. This will allow us to measure what we do, compare performance, improve our practice and provide evidence for standards.

We hope that our meeting in Milan will provide a great opportunity for us to forge a new and lasting collaboration between Italy and the UK providing us with an opportunity to standardize our data collection, benchmark performance and outcomes, and establish a programme of collaborative research across the wider PIC community in Europe. Other Countries such as the Netherlands, Portugal, Croatia, France and Switzerland are also moving in this direction.

Things are changing rapidly in Paediatric Intensive Care. In the last 20 years mortality rates have decreased to an all-time low of less than 5%. However one consequence of a reduction in mortality is an increase in the levels of chronic morbidity in the population. In paediatric intensive care we are now seeing children being readmitted with long term chronic diseases and severe disability. Morbidity is our most pressing challenge. As such we need to establish new outcome measures, revise our risk adjustment algorithms and review palliative care and end-of-life decision processes together.

Finally, as Michael Marsh stated in the Foreword to last year's PICANet report, *data are vital to inform choices, make decisions and enable the government to decide how to spend tax payers' money".* PICU beds are expensive, therefore they must be used efficiently. To achieve this we need to consider all aspects of PIC including our work environment, staffing levels, the cost of the service and the changing epidemiology of PIC over time. The standardisation and integration of data sources, both national and international, will provide a benchmark for PICU performance.

Times are difficult, but despite the major financial constraints we face our efforts are justified because **we have a wonderful job!** Thank you all.

Dr Ida Salvo
Tip.Net,
Italian Paediatric Intensive Care Audit,
Milan, Italy

EXECUTIVE SUMMARY

- In 2015 10 (29%) PICUs met the nursing establishment levels currently recommended by the Paediatric Intensive Care Society, this is an improvement compared to last year, when only 5 PICUs met the nursing establishment levels.

- Overall use of agency and bank nursing staff to ensure adequate staffing levels 'out of hours' showed a substantial reduction in 2015 with 18% of nurses on duty in NHS hospitals in London from agencies or bank staff compared with 27% in 2014.

- Most PICUs, 23 out of 27 (85%), meet the specified standard (PICS standards 2015) for consultant medical levels. Six units meet this target using locum consultant staff.

- Over 90% of parents of children in PICU rated the performance of both the doctors and the nurses very highly (scores of 9 or 10 out of 10) at the two points of data collection using the EMPATHIC-30 questionnaire in 2015.

- The number of admissions recorded in PICANet remained at just under 20,000 per year with slight annual fluctuations and no obvious annual increase in admissions over the 3 year period.

- The rates of invasive ventilation vary between 18% and 90% across all PICUs and also by geographical region (36%-93%) reflecting differences in admission criteria and patient case-mix in different regions.

- The overall prevalence of admission to PICU in the UK remains fairly static at 146 per 100,000 children per year. Boys under one year have a 36% higher prevalence for admission than girl of the same age.

- There was a 2.9% increase in the number of bed days delivered in the reporting period 2013-2015 compared with 2012-2014 continuing the trend of increased activity in some units. The majority of bed days are required by children <1 year of age (56%) reflecting the higher number of admissions in this age group (46%). Just over a quarter of patients have a length of stay of less than 24 hours and a further third stay between one and three days. One in 5 children remain on the same PICU for seven or more days.

- One in ten children admitted to PICU receive over half (58%) of the bed days delivered in 2013-2015

- Readmission to PICU within 48 hours is accepted as an important quality indicator of PICU care. Crude rates of emergency readmissions to the same PICU within 48 hours (required for the NHS England PIC data dashboard) are presented by health organisation. In 2013-2015 the average emergency readmission rate was 1.7%, varying between 0% and 5% between organisations. In 2015, the highest readmission rate was 3%.

- Data on unplanned extubation have been collected and analysed for 2015 as a further quality indicator that is required for the PIC dashboard and is calculated as a rate per 100 intubated days. Overall rates are very low ranging between 0 and 1.1 accidental extubations per 100 ventilated days.

- Further development in the reporting of referral and transport data has led to the production of new data tables, 79% of recorded referrals in 2015, are reported as being successfully accepted by a PICU. Of 15,844 transport events in the three year reporting period, 13,278 (84%) were non-elective admissions to a PICU destination. For 92% of non-elective journeys no critical incidents were reported. The team leader was a Consultant or ST4-8 grade staff member for the majority of the non- elective journeys (78%).

- One in five referrals for admission to a PICU are refused, with nearly two thirds of these refusals due to no staffed bed being available. While most children who require a PICU bed will eventually be admitted, the process of approaching many PICUs to find a bed is time-consuming and stressful for parents and carers and hospital staff.

- Deaths on paediatric intensive care units continue to be very rare: over 96% of children were discharged alive in 2013-2015. With the exception of one PICU, risk-adjusted performance of all participating health organisations fell within acceptable limits in each individual year and when aggregated across the three year period.

- Excess mortality was detected in 2015 for the PICU at Royal Manchester Children's Hospital. An investigation by PICANet suggested that this was not an issue with data quality and an external independent review panel have reported to the Trust.

RECOMMENDATIONS

1. Commissioners should continue to work closely with PICUs to ensure adequate staffing levels in accordance with professional standards.

2. Nurse Managers should ensure that the observed reduction in the use of Agency and Bank staff is maintained and shows continued improvement.

3. Commissioners should review the PICANet data concerning the year on year increase in critical care activity and ensure that sufficient resources are allocated to cover this increasing work load.

4. Options for long-stay, low acuity patients requiring care in specialist units should be investigated. This should form part of the ongoing critical care review.

5. Units should ensure complete and timely ascertainment of data submission to PICANet given the year on year increase in PIC admissions and seasonal variation in PIC requirement. This information is essential to facilitate appropriate resource planning and commissioning.

6. PICANet should work with the Paediatric Intensive Care Society and the Clinical Advisory Group to establish the standard for emergency readmission rates.

7. The 13% referral refusal rate due to a lack of staffed beds should be addressed in relation to staffing levels and organisational planning.

8. The current mortality risk adjustment model should be reviewed and its suitability for comparing risk adjusted SMRs between PICUs assessed in view of changing patient characteristics in paediatric intensive care.

9. PICANet should work with national and international partners to develop a new means of assessing case-mix adjusted outcomes for PICU that do not solely focus on mortality

BACKGROUND

PICANet was established in 2001 with funding from the Department of Health and started collecting data from English and Welsh Paediatric Intensive Care Units in November 2002. The PICUs at the Royal Hospital for Sick Children, Edinburgh and the Royal Hospital for Sick Children, Glasgow started submitting data in December 2004 and March 2007 respectively. The Royal Belfast Hospital for Sick Children joined in April 2008 and Our Lady's Children's Hospital, Crumlin and the Children's University Hospital, Temple Street, both based in Dublin, have submitted anonymised data to PICANet since 2010. The Harley Street Clinic PICU started contributing data in September 2010, and the PICU at the Portland Hospital from October 2013, allowing both these non-NHS units to compare their performance against the national benchmark provided by PICANet.

A full list of participating PICUs can be found in Appendix A of the online annual report section of the PICANet website.

GOVERNANCE

PICANet continues to receive support from the NHS Health Research Authority Confidentiality Advisory Group (CAG) (formerly the NIGB) to collect personally identifiable data on infants and children admitted to paediatric intensive care without consent.
(http://www.hra.nhs.uk/documents/2016/08/piag-register-master.xls).

Ethics approval has been granted by the Trent Medical Research Ethics Committee, ref. 05/MRE04/17 +5.

PICANet receives support and advice from a Clinical Advisory Group (CAG) drawing on the expertise of doctors and nurses working within the speciality and a Steering Group (SG), whose membership includes Health Services Researchers, representatives from the Royal Colleges of Paediatrics and Child Health, Nursing and Anaesthetics, a lay member and commissioners. We also have a PIC Families Group to consider the impact of admission to intensive care on children and their families. Appendices B, C and D provide a full list of CAG, SG and PIC Families group members. Additional support from the clinical community is provided through the UK Paediatric Intensive Care Society.

COMMISSIONING

The following organisations commission paediatric intensive care In the UK:

- England: NHS England Specialised Services
- Wales: Specialist Health Service Commission for Wales (SHSCW)
- Scotland: National Services Division of NHS National Services Scotland
- Northern Ireland: Health and Social Care Board

In the Republic of Ireland, Our Lady's Children's Hospital, Crumlin is governed by a Board of Directors and is a company limited by guarantee. Temple Street Children's University Hospital (TSCUH) is incorporated as a private limited company. Both receive funding from the Health Services Executive, charitable and private sources.

METHODS

Basic methodology

Most critically ill children who need complex clinical care and life support are treated in Paediatric Intensive Care Units (PICUs). These children may have had complex surgery, an accident or a severe infection and may arrive in the PICU from an operating theatre, accident and emergency or from a hospital ward. In some cases they may have been transferred from another hospital and, rarely, admitted directly from home.

PICANet is an audit that collects personal, organisational and clinical data on all children with a clinically determined need for paediatric intensive care in the UK and Ireland, to compare outcomes and activity between PICUs and specialist transport organisations and also between health regions and nations.

Data are stored on a secure database. Each organisation is able to view and download their own data and reports on their data quality and activity as well as comparative national data. An annual report is produced each autumn that includes a summary of what has happened to children admitted to PICU including why they were admitted, where they were admitted from, how long they stayed, what treatments they received and their outcome at the time of discharge. Comparisons between PICUs are made to assess how well they perform against established clinical standards and guidelines.

In addition to the annual report, PICANet provides technical and statistical support for the use of its data for local audit and research, regional and national commissioning, national and international research and to provide baseline information for clinical intervention trials.

Participating organisations and data submission

PICANet has collected data from all PICUs in England and Wales since 2002. The two PICUs in Scotland, one from Northern Ireland and two from the Republic of Ireland along with two non-NHS units based in London have joined PICANet at different times so that coverage is now for the whole of the UK and the Republic of Ireland. There are 34 PICUs and 6 specialist transport organisations currently submitting data to PICANet.

Data are submitted by individual PICUs prospectively, using our secure web-based data collection application with real-time online validation reporting, systematic monthly validation review by our research nurse and regular on-site validation visits. Data submission can involve direct entry of patient data or an upload of a data file from an existing clinical information system. PICANet provides full documentation on data definitions which have been developed in collaboration with our Clinical Advisory Group as well as technical specifications for IT and database professionals. In addition, standardised data collection forms are supplied to all organisations where there is no in-house provision for data collection.

Data collected

PICANet collects three core datasets:

Admission data contains personal details of each child including their name, age, date of birth, NHS number, address and ethnic group; it also records where children are admitted from, their clinical diagnoses, some physiological parameters on admission including blood gases, blood pressure, medical history and ventilation status. Data on outcome and discharge details are included. The medical interventions received on each day by each child are recorded as part of the audit and to help NHS organisations in England to supply information on the cost of their activity.

Referral data for all children where clinicians agree a paediatric intensive care bed and/or paediatric intensive care transport is required includes details of the referring hospital, demographic details of the child, grade of the referring doctor or nurse, the outcome of the referral, the transport team involved and the destination PICU.

Transport data for all children transported to a PICU from their original admitting hospital or who are transported but are not admitted to a PICU includes patient details as well as information about their presenting physiology. Details about the composition of the transport team, journey times, any interventions carried out and critical incidents are also recorded.

Additional data collection takes place to understand more about staffing on PICU and patient and family experiences:

Staffing data is collected each year in November to monitor staffing levels within PICUs as well as the PICS standards relating to staffing requirements.

Parent/Carer satisfaction data is collected on an ad hoc basis as part of the work programme of the PICU families group. During 2015 this data was collected using the EMPATHIC 30 questionnaire developed by colleagues in the Netherlands to facilitate international comparisons and the results of this work are presented in this year's annual report.

Case ascertainment, data quality and validation

We estimate that ascertainment is 99.9% complete for PICU admissions: PICANet Web allows PICU staff to obtain reports on their own data to check monthly admissions totals. In addition during validation visits by the PICANet research nurse a cross check is carried out against records held on PICU (such as admission books, or in–house data collection systems) and PICANet Web. These on-site validation visits are a core element of our data quality assurance process.

Data is validated on-line via PICANet Web using logic and range checks as well as flagging missing data items. The Modulus 11 algorithm is used to validate the NHS number based on a check digit – this is a standard method of ensuring the NHS number is a true NHS number and improves our ability to trace patients through the PICANet database and in linked healthcare data.

Collaborative working supporting policy, commissioning, research and clinical trials

PICANet has become established as the definitive source of data on paediatric intensive care activity in the UK and Ireland. Its data has been used to plan PIC services, model demand, assess interventions and outcomes and provide data to underpin research to facilitate the development of new standards

for critical care provision for children. We have provided baseline data for the two largest clinical trials in paediatric intensive care (CHiP (Control of Hyperglycaemia in Paediatric Intensive Care) and CATCH (CATheter infections in Children)), PICANet has provided baseline data for the development of the I-KID, SANDWICH and FEVER trials discussed in this report by Dr Heather Lambert, Dr Bronagh Blackwood and Professor Mark Peters respectively in this report. PICUs participating in these trials will be able to reduce the data collection burden by using the PICANet custom data download facility.

Professional and Quality standards audited by PICANet

The Paediatric Intensive Care Society (PICS) has developed a set of professional standards to make sure the quality of care provided by organisations involved in every aspect of intensive care is high. These standards are used in practice in all NHS organisations across the UK. The present standards [1] cover the whole patient pathway from the initial referral to paediatric intensive care, specialist transport and then inpatient care. PICANet has been an integrated part of the revisions of the PICS standards since their inception. Currently we audit 27 PICS Standards for the care of critically ill children using both the core PICANet data-set, retrievals data and the data collected via the staffing and PIC families surveys (Table 1).

Table 1: Paediatric Intensive Care Society Standards audited by PICANet in the 2016 Annual Report

PICS Standards	
101	There should be a nominated lead consultant for the Retrieval Service responsible with the lead nurse (standard 105) for ensuring training, protocols and audit are in place, and for sustaining regular links with referring hospitals.
103	24 hour consultant advice should be available to the Retrieval Service and this consultant should be able to join the retrieval team if necessary. This consultant should not be providing cover for PICU at the same time as for the Retrieval Service.
104	A doctor appropriately trained and experienced to carry out retrieval should be available at all times.
105	There should be a nominated lead nurse for the Retrieval Service responsible, with the lead consultant (standard 101) for ensuring training, protocols and audit are in place and for sustaining links with referring hospitals.
107	A nurse or other non-medical member of staff trained and experienced to carry out retrievals should be available at all times.
118	The Retrieval Service should have written guidelines covering arrangements for transfer of parents. Wherever possible and appropriate, parents should be given the option to accompany their child during the transfer. Where this is not possible or appropriate, other arrangements should be made to transfer parents.
122	The Retrieval Service should audit and monitor requests for retrieval to which it is not able to respond.
123	The retrieval team should arrive at the referring unit within three hours of the decision to

	retrieve the child.
124	Wherever possible, a child should undergo one retrieval journey only.
126	The Retrieval Service should be collecting data on, at least: Referrals, including those that do not result in transfer, Referral information completeness, Advice to referring hospitals, Pre-transfer patient condition and management, Retrievals, Ambulance response times, Untoward clinical incidents, Mortality and morbidity. These data should be collected all children for whom retrieval was requested, including those not retrieved by the Service.
127	The Retrieval Service should be submitting the required dataset to the Paediatric Intensive Care Audit Network (PICANet) within three months of the retrieval.
129	The Retrieval Service should produce an annual report summarising activity, compliance with quality standards, and clinical outcomes. This report should identify actions required to meet expected quality standards and progress since the previous year's annual report. This report should be shared with referring hospitals.
144	The following support services should be available; Interfaith support, Social workers, Interpreters, Bereavement support, Patient advice & advocacy, Family Psychological support, Staff psychological support. (Availability is not defined but should be appropriate to the case mix and needs of the patient)
149	Appropriately qualified play specialists should be available 7 days a week.
156	All paediatric intensive care consultants should have regular day time commitments on the paediatric intensive care unit.
157	For every 8 to 10 beds there should be at least one consultant available to the unit at all times.
158	During normal working hours one medical trainee (or equivalent grade doctor) should not normally be allocated more than five patients.
159	Outside normal working hours, for every eight PICU beds there should be at least one ST4 or above grade doctor available to the unit at all times.
164	The unit's nursing establishment and nursing rosters should be appropriate to the anticipated number and dependency of patients. Staffing levels should be based on the ratios in Appendix 13. Appendix 13:- the minimum number of qualified nurses required to staff 1 critical care bed is, at least 7.01 (WTE).
167	All nurses should have up to date paediatric resuscitation training. Senior nurses should have up to date advanced paediatric resuscitation training.
168	The unit should provide training for nursing staff in paediatric care in collaboration with local universities.
169	Each unit should have a discharge coordinator responsible for managing the discharge of children with complex care needs.
170	Daily sessional support should be available to the Paediatric Intensive Care Unit from pharmacy, physiotherapy and dietetic staff with competences in the care of critically ill

	children who have time in their job plans allocated for their work on the unit.
179	The unit should be collecting data on all requests for admissions, including those who were not admitted. The unit should obtain data from the Retrieval Service on the eventual destination and clinical outcome of children for whom admission was refused.
180	Average occupancy on the unit should not exceed 80%. The unit should be monitoring occupancy and there should be evidence of escalation within the Hospital and involvement of Health Boards/Commissioners if occupancy exceeds 80% for more than two successive months.
181	The unit should be submitting the required dataset to the Paediatric Intensive Care Audit Network (PICANet) within three months of discharge.
Appendix 13	Levels of Care & Patient Dependency, Paediatric Intensive Care Society (Clinically Based). Level 1 requires nurse to patient Ratio of 0.5:1. Level 2 requires 1:1. Level 3 requires 1.5:1. Level 4 requires 2:1.

NHS England has developed a Quality Dashboard programme for specialised services to provide assurance on the quality of care by collecting new information about outcomes from healthcare providers [2]. One of the dashboards is specifically for paediatric intensive care and PICANet provides data which can be used to calculate several of the indicators required (Table 2). Discussions are currently underway concerning the revision of the core PICANet dataset to allow collection of all paediatric intensive care data dashboard measures. Decisions as to how this will be addressed will be made following the award of the next contract to run the national PIC audit.

Table 2: NHS Specialised Services Quality Dashboard Measures audited by PICANet

Dashboard Measure		Description & Provenance
PIC01	Risk adjusted mortality	PICANet is a clinical data base used by most / all PICU providers. PICANet produce a risk adjusted SMR that is accepted by Trusts.
PIC02	Refusal rate for emergency admissions	Number of emergency admissions refused from within the defined catchment population served
PIC04	Emergency readmissions to PICU within 48 hours	Emergency readmissions to PICU within 48 hours of a previous discharge / transfer from PICU
PIC05a	Bed occupancy	PICU bed occupancy rates
PIC08	Unplanned extubation	Rate of unplanned extubation of patients/100 ventilated days
PIC10	% of data submissions to PICANet within 3 months of discharge	PICANet expects provider information to be complete and accurate 3 months after patient discharge
PIC13	% of refused requests for retrieval of a patient within defined catchment	Ability to deliver a comprehensive retrieval service
PIC14	Mobilisation of PIC retrieval team	Number of retrievals performed within the agreed mobilisation time

The NHS England Commissioning for Quality and Innovation (CQUIN) payment framework links a proportion of English healthcare providers' income to the achievement of local quality improvement goals, and both of the proposed National Paediatric Critical Care (PCC) CQUINs (prevention of unplanned readmissions to PIC within 48 hours and transfers out of normal catchment/network to PICU) are collected by PICANet [3].

Analytical techniques

Statistical techniques used include simple cross tabulations, the use of logistic regression to recalibrate the mortality risk adjustment model based on a rolling 3-year data window; the calculation of crude and risk-adjusted SMRs and 95% confidence intervals; the construction of crude and risk-adjusted funnel plots of SMRs; and local provision of Risk Adjusted Resetting Sequential Probability Ratio Test (RA-RSPRT) plots to assess real-time performance related to in-PICU mortality. Cox-proportional hazards models and Kaplan-Meir graphs are used to assess survival trends using the mortality data obtained from the NHS Health and Social Care Information Centre to assess longer term survival. More sophisticated statistical techniques such as random effects logistic regression, propensity score matching and latent class analysis have been proposed to enable this rich dataset to be explored with greater subtlety.

Small number policy

Publication of PICANet data is subject to scrutiny for small numbers. When small numbers of admissions are involved other data items may become identifiable i.e. a living individual may be identified from the data. This is still the case in aggregated data where small groups of individuals are presented, these are reviewed and in some cases categories are combined or cells anonymised where necessary.

Outlier Policy

When unusual performance is detected following routine or bespoke analysis which suggests that a PICU is an outlier, PICANet follow the established procedure outlined in our outlier policy (http://www.picanet.org.uk/Documentation/Policies/PICANet_Policy_on_Units_lying_outside_the_control_limits%205_oct2015.pdf), which relates specifically to assessment of risk-adjusted mortality. We also follow the more detailed guidance on outliers subsequently developed by HQIP published in 2011. On two specific occasions, PICUs have been identified as outliers with excess risk-adjusted mortality. In each case this was attributable to data quality issues and when corrected, the outliers fell within normal limits. Both PICUs contributed an article in a previous PICANet annual report detailing their experiences and lessons learnt from the process. In this report, we outline how we dealt with an outlier that was not attributable to data quality and include a response from the PICU detailing their internal findings and the result of an external review.

Links with the clinical community, patients and their families

The PICANet PICU Families Group currently has four Lay Representatives who are the parents of children who are currently or have previously received paediatric intensive care. In addition we have a standing Lay Representative on our Steering Group and work closely with the charity Well Child. Our Lay Representatives have worked closely with PICANet to develop the Annual Lay Report. To date all communications we have had from patients/parents have been to support PICANet and its work and to request further information.

PICANet has the support of the Paediatric Intensive Care Society and the associated PICS Study Group, the PICANet Clinical Advisory Group and as well as the Clinical Reference group which oversees Paediatric Critical Care and PCC transport.

DATA ANALYSIS: FINDINGS AND COMMENTARY

In this year's summary report we describe our findings for the four proposed metrics (mobilisation time, nurse establishment, emergency readmissions and SMR), together with a measure of case ascertainment as an indicator of audit quality, identified in collaboration with the Care Quality Commission (CQC) and selected to answer three of the five CQC Key Questions relating to Responsiveness, Safety and Efficacy in the Paediatric Intensive Care Service. We also report on unplanned extubation rates, children in adult ICUs, an assessment of the proportion of bed days used by individual children, staffing levels including preliminary analysis from the new medical establishment data collection forms and the results of our parents and carers survey, as well as presenting the investigation of a mortality outlier. The PICANet annual report comprises three sections and this summary report should be read in conjunction with the Tables and Figures and the Appendices for reference purposes.

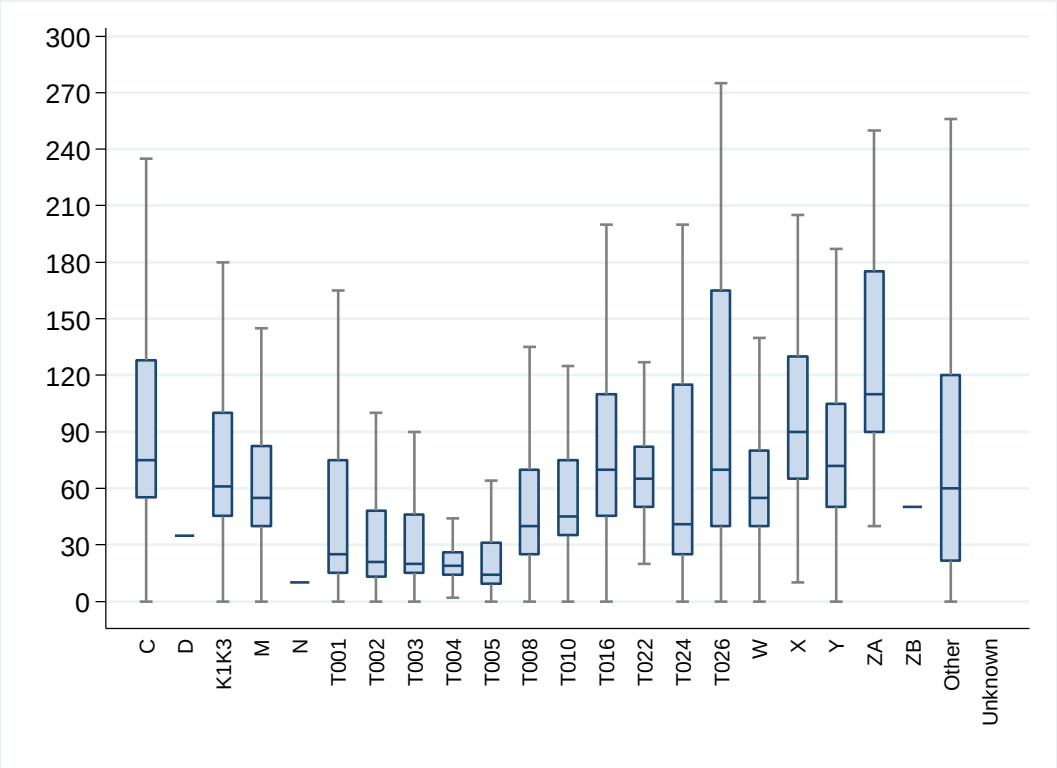
Case ascertainment

Case ascertainment levels for the PICANet audit are 99.9%.

Metric 1: Crude proportion of retrievals with mobilisation time <1 hour

In this year's report, the transport tables have changed to show information by transport organisation, instead of organisation that submitted the record. The transport tables focus on non-elective transports and over the three year reporting period 2013-2015 the majority (68.5%) of the non-elective mobilisation times have taken less than one hour (Figure 1). In 24.9% of cases the mobilisation time took more than 1 hour. In 6.7% of cases data on mobilisation times were not recorded.

Figure 1: Non- elective transports by year, by transport organisation & mobilisation time (minutes), 2013-2015



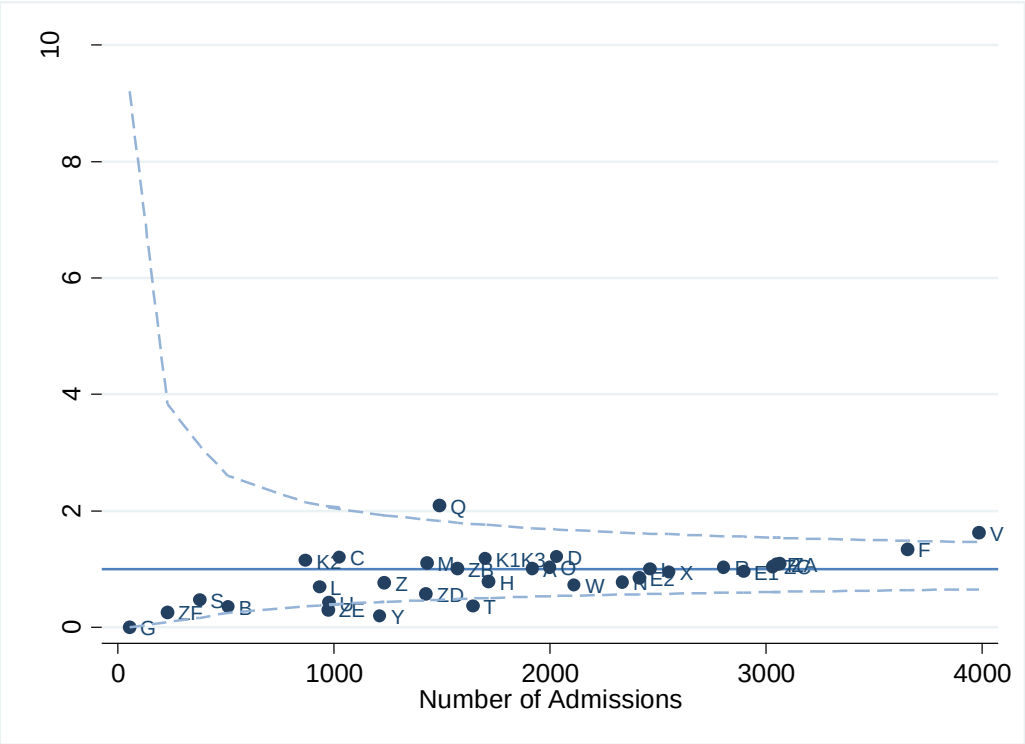
Metric 2: Nursing establishment

In 2015, 12 (34%) PICUs have met the nursing establishment levels and increase from just 5 PICUs in 2014. Details on the staffing levels in PICUs are included in the Staffing Section.

Metric 3: Crude 48 hour emergency readmission ratio

Crude rates of emergency readmissions to the same PICU within 48 hours are calculated by health organisation. A funnel plot is used to compare the average readmission rate between organisations, for the three years reporting period (Figure 2).

Figure 2: Relative rates of emergency readmissions with 48 hours of discharge, 2013-2015

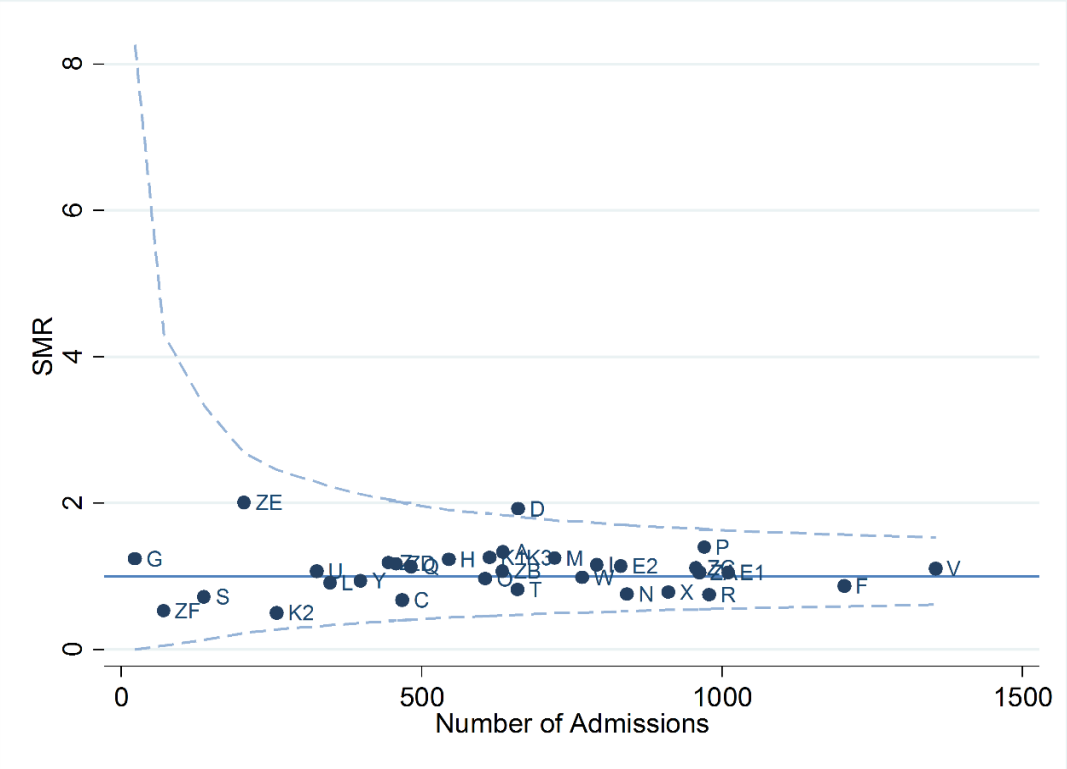


All organisations, other than Q and V fall within the control limits. Organisation Q reports PICU bed data only but is a combined PICU/HDU which may lead to an overestimate of their emergency readmission rate and organisation V falls on the upper limit. In 2013-2015 the average emergency readmission rate was 1.7%, varying between 0% and 5% between organisations. In 2015, the highest readmission rate was 3%.

Metric 4: Standardized mortality ratio (SMR)

Each year PIM2 is re-calibrated to be up-to-date with the latest dataset used in the annual report. Crude and standardised mortality ratios (SMRs) are then calculated, to show the performance of each unit. The SMR uses the risk adjusted data to compare the number of deaths in a specific time period with the number predicted by the PIM2 score. Crude mortality for the three year reporting period 2013-2015 was 3.7%, varying between 0.7% and 6.1% across the different PICUs, predominately due to variations in case mix. Funnel plots are used to compare mortality ratios between units (Figure 3).

Figure 3: Standardized mortality rates (SMR), by health organisation, 2015

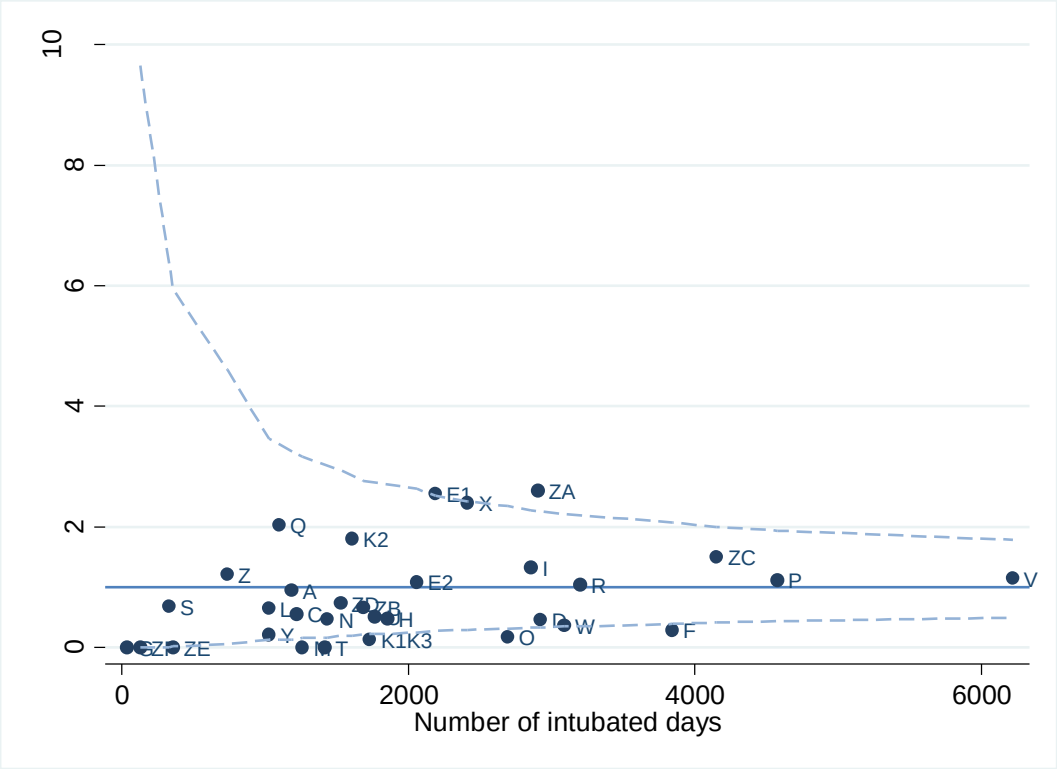


In 2015 the risk-adjusted performance of one PICU fell outside acceptable limits triggering the established procedure for the investigation of an outlier. Details on the outlier can be found in the "Detection of a mortality outlier in the PICANet annual report data" section (see page 44).

Unplanned extubation

Unplanned extubation is a quality indicator that shows how well PICUs perform. The rate of unplanned extubation of patients per 100 intubated days is one of the measures included in the Quality Dashboard Programme for NHS England (PIC08). Unplanned extubation was introduced to the PICANet dataset in mid-2014, by the 1st January 2015 all units had started collecting this data. A new table and a figure have been introduced to this year's Annual Report. Figure 4 shows unplanned extubation ratios by health organisation.

Figure 4: Unplanned extubation ratio by health organisation, 2015



An intubated day was defined if invasive ventilation via endotracheal tube was performed on that day. Results show that overall rates are very low, ranging between 0 and 1.1 unplanned extubation events per 100 intubated days. As this is the first year we report on unplanned extubations, these numbers will be used as a baseline measure for future reference.

High flow nasal cannula therapy

In mid-2014 high flow nasal cannula therapy was added to the PICANet admission collection form in the daily interventions section. By the start of 2015 all units were reporting on high flow nasal cannula therapy. Preliminary results from this data collection are shown in table 3 which provides the number of high flow admissions by organisation with the number of days in which high flow nasal cannula therapy was administered and details of the median, minimum and maximum days of therapy.

Table 3: High flow nasal cannula therapy, by organisation, 2015

Organisation	Total admissions	HIGH FLOW NASAL CANNULA THERAPY					
		High flow admissions		Days	Median	Minimum	Maximum
		n	(%)				
A	**616**	82	(13.3)	269	8	1	40
C	**466**	17	(3.6)	75	7	1	20
D	**643**	17	(2.6)	38	7	1	40
E1	**997**	0	(0.0)	0	0	0	0
E2	**816**	0	(0.0)	0	0	0	0
F	**1190**	0	(0.0)	0	0	0	0
G	**22**	0	(0.0)	0	0	0	0
H	**533**	67	(12.6)	250	10	1	25
I	**793**	187	(23.6)	436	12	4	40
K1K3	**597**	112	(18.8)	373	6	2	15
K2	**255**	79	(31.0)	468	8	3	35
L	**323**	9	(2.8)	20	8	3	50
M	**684**	1	(0.1)	4	20	10	20
N	**826**	234	(28.3)	732	10	3	35
O	**670**	75	(11.2)	228	15	2	63
P	**966**	178	(18.4)	453	7	2	30
Q	**477**	44	(9.2)	110	13	4	60
R	**957**	152	(15.9)	379	14	2	40
S	**123**	11	(8.9)	33	8	5	30
T	**639**	89	(13.9)	239	15	2	45
U	**317**	1	(0.3)	5	20	4	20
V	**1340**	240	(17.9)	665	15	5	40
W	**761**	188	(24.7)	580	10	3	44
X	**898**	61	(6.8)	190	6	1	20
Y	**381**	47	(12.3)	133	15	3	50
Z	**441**	37	(8.4)	88	8	1	30
ZA	**941**	245	(26.0)	1096	9	2	30
ZB	**630**	62	(9.8)	194	8	3	30
ZC	**942**	214	(22.7)	772	9	1	40
ZD	**456**	149	(32.7)	386	7	3	50
ZE	**199**	5	(2.5)	10	12.5	2	24
ZF	**68**	2	(2.9)	6	6	2	15
Total	**19967**	**2605**	**(13.0)**	**8232**	**10**	**0**	**63**

In 2015, 13% of admissions of children aged between 0-15 years were given high flow nasal cannula therapy, with the median value administered across all units being 10 l/min (range 1-63 l/min). The total number of days that high flow nasal cannula therapy was performed was 8,232, which represents 6.2% of all bed days for children aged 0-15 years.

Children in adult ICUs

In some cases children are admitted to adult ICUs, for example if the nearest PICU is a long distance away or so the child can be stabilised before transfer to a PICU. Data on children cared for in adult ICUs is presented and was provided by the Intensive Care Audit and National Research Centre

(ICNARC). Nearly 1,700 admissions of children to adult ICUs were recorded during the reporting period, slightly more males than females were admitted (54% vs. 46%) and over one third of child admissions (36%) were in the 11-15 years age group. When examining the primary diagnosis the highest proportions of children admitted to adult ICUs were in the respiratory (39%) and neurological (29%) groups.

Proportion of bed days used by individual patients

PICANet reports on bed activity (the number of bed days delivered) and this is a function of the number of admissions and length of stay. Here we present two figures: figure 5 gives the number of admissions by length of stay (excluding those stays over 100 days) and illustrates the small numbers of children who stay more than 30 days.

Figure 5: PICU length of stay in the UK and Republic of Ireland, 2013-2015.

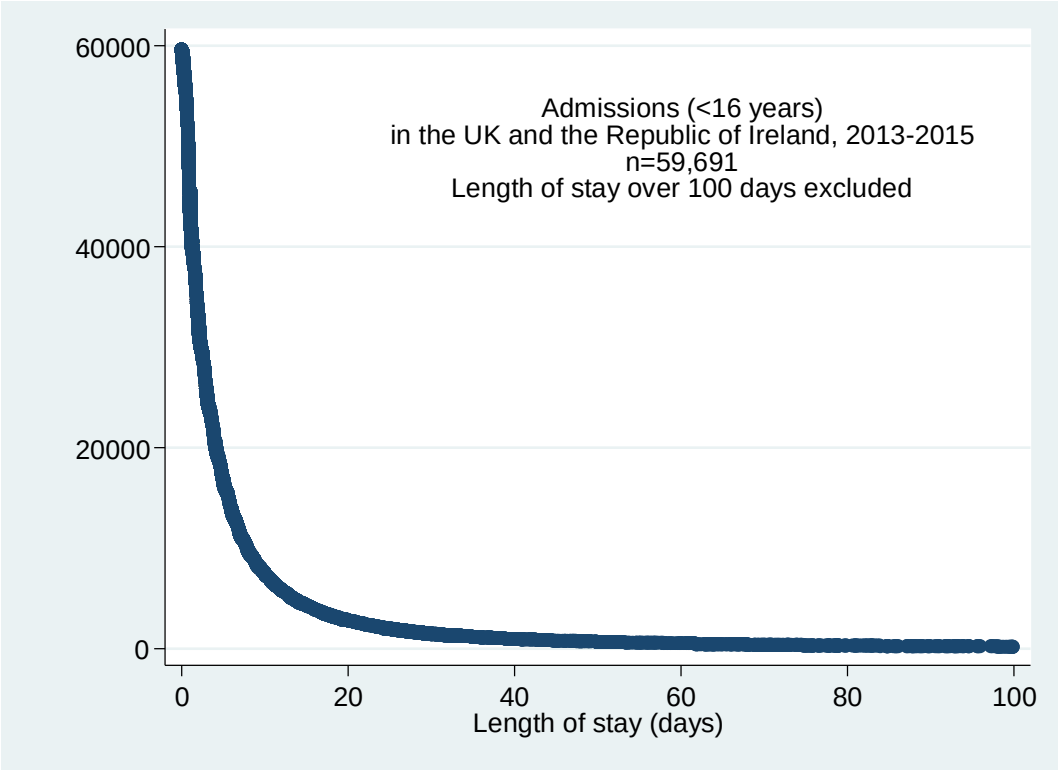
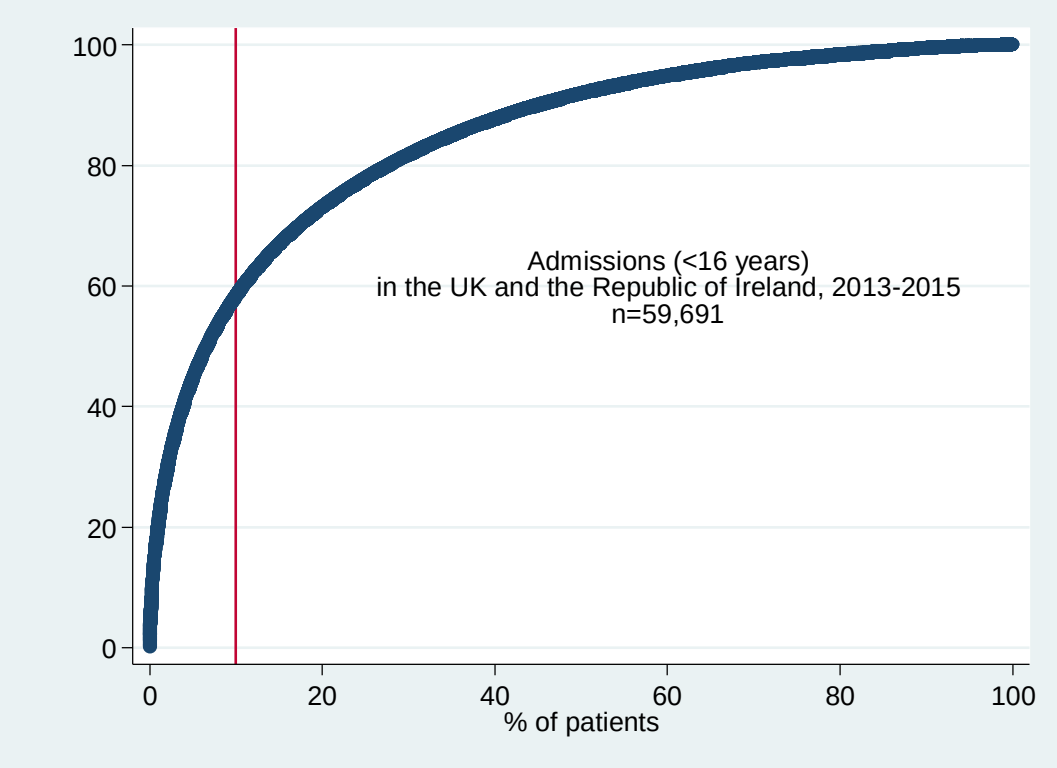


Figure 6 makes it clear that nearly 60% of bed days delivered by PICUs in the UK and Republic of Ireland are used by 10% of the patients. These figures suggest that there is a small group of children who use a high level of resource and it may be appropriate to investigate whether their care could be provided in a different setting, away from the high-turnover activity associated with acute admissions and post-operative care.

Figure 6: Percentage of PICU bed days used by percentage of patients in the UK and Republic of Ireland, 2013-2015.



Referral and transport

PICANet referral and transport data collection was introduced in 2011. This has created two separate datasets which are complementary to the admissions data; one relating to referrals to PICUs and the other transports to PICU and other journeys carried out by paediatric intensive care specialist teams and PICU based teams. In this annual report twelve tables are presented; two relating to referrals and ten providing detailed information about the transport data collected. This year rather than the tables focusing on the organisation who submitted the data we have re-focused the analysis on the organisation conducting the transport or referral. However, in the case of Table R2 (Tables & Figures) the focus is on admitting organisation as this table illustrates admission outcome.

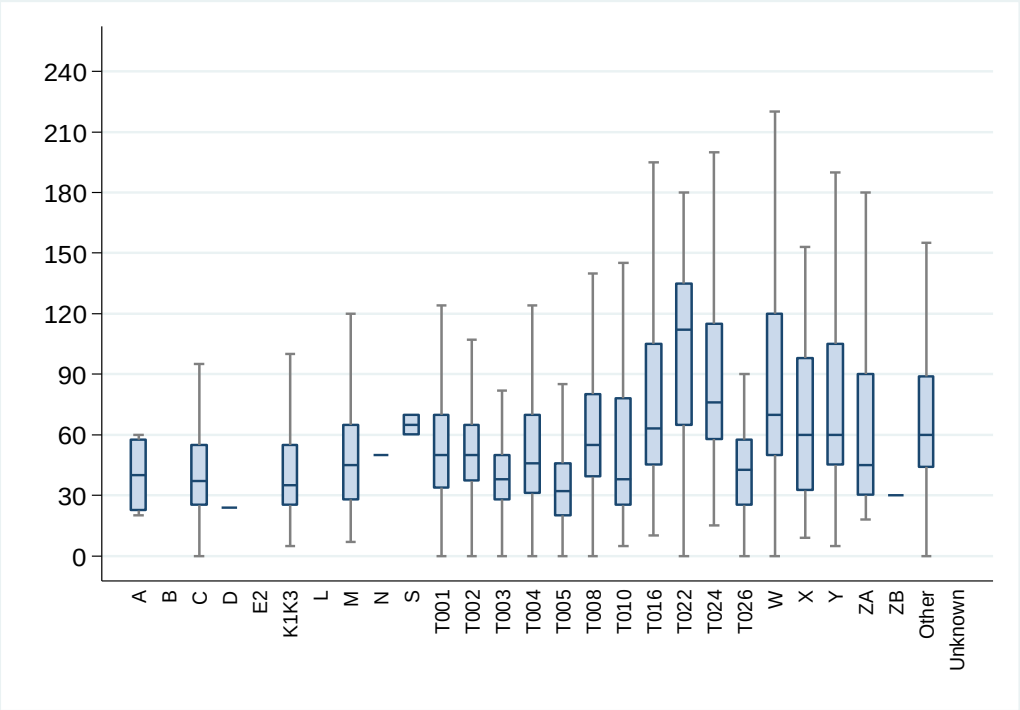
In mid-2014 significant changes were made to the referral dataset, now using two outcome measures, Transport Outcome and Admission Outcome, to replace the previous measure, Referral Decision and as such related tables are restricted to the 2015 data alone. This analysis will be used as a baseline for future reports.

In 2015 PICANet received data for 7,460 referrals, of which 6,577 (88%) were transported and 5,901 (79%) were accepted for PICU admission. In the period 2013 to 2015 we received data for 15,844 transports of which 13,278 (83.8%) records were non-elective transports to PICU. A number of PICS Standards (Standards 118, 122, 123 and 124) and Data Dashboard items (PIC02, PIC13, PIC14) are linked to transport and referral related data. During 2015 11.6% of referral cases were rejected due to a transport related issue and 20.7% were rejected due to an issue at the admitting PICU. Over the three years 2013 to 2015 the vast majority (97.7%) of transport events recorded that the patient was

transported (transport of a child may not take place or journeys may not be completed if their clinical condition changes or if they die before or during a journey). Journey time data is now available and will be developed as more information on catchment areas and agreed mobilisation time is elicited.

The majority of non-elective patient journeys to PICU (61.2%) were completed in under 1 hour, whereas only 1.4% took longer than 3 hours (Figure 7).

Figure 7: Patient journey (mins) by transport organisation, 2013-2015



Data quality and completeness

The completeness of the PICANet dataset is a major strength and monitoring data quality and the evaluation of the timeliness of data collection are important aspects of the role of PICANet; measures are quantified within the PIC Data Dashboard (Item PIC10) and the PICS standards (127, 181). PICS Standard 181 states data must be submitted to PICANet within 3 months of discharge for each admission. The 2015 data shows that whilst there is still a wide variation between organisations in the percentage of records where this is attained (mean: 77%, range: 45%-100%), there has been a substantial improvement compared to 2014 (mean: 56%, range: 0% to 99%).

Staffing

The annual staffing survey was carried out during a specified week in November 2015 with details recorded at four specific 'snapshot' time periods (a weekday and a weekend at noon and midnight) as well as information about other professionals working on PICU. Complete data was returned by all PICANet units.

The units reported a total of 382 funded intensive care beds and 73 funded high dependency in the 2015 survey. High dependency care beds are included in those critical care units where PICANet data is submitted for both intensive care and high dependency patients and staffing is provided by the same paediatric intensive care nursing and medical establishment.

Staffing forms

The forms used to collect the medical staffing data were changed this year to reflect the way that consultant contracts are calculated using Direct Clinical Care Programmed Activities, equivalent to sessions of activity defined as follows: 1 DCC PA =4 hours during daytime hours (approximately 7am to 7pm) and 1 DCC PA=3 hours for nights and weekends. New tables have been developed to reflect this change focussed at the DCC PA's allocated to PICU care provision. A copy of these forms can be found in Appendix M.

New PIC standards were introduced in December 2015 (after the PICANet annual staffing data collection) and so, with the exception of Figure 11 which uses the new PICs standard for the numbers of consultant staff required in PICU, all other data refers to the previous PICs standards (2010) allowing for direct comparison to our previous years' results.

Nursing staff

Staff per bed

PICS standard 164 (2010) details the qualified nursing establishment levels required. Figure 8 shows that in November 2015 29.4% (n = 10) of the UK PICUs met the standard of at least 7.01 WTE qualified nurses required to staff one critical care bed an increase from just five PICUs in 2014. A similar increase is seen for the previously defined PICS standard (2001) of 6.4 WTE per bed with a total of 47.1% (n =16) units meeting this target (an increase from 10 in 2014). This is a statistically significant increase in the number of UK PICUs that meet the nurse staffing standard over the period 2013 to 2015 (Test for trend p=0.03) shown in Figure 9 and is reflected in the total number of qualified nursing staff in post which has shown a 13% increase from 2462.5 whole time equivalents (wte) in 2014 to 2795.1 wte in 2015.

Figure 8: Number of clinically qualified nursing staff in post (WTE) per bed, by health organisation, Nov 2013-2015 against the PICS 2001 and PICS 2010 standards

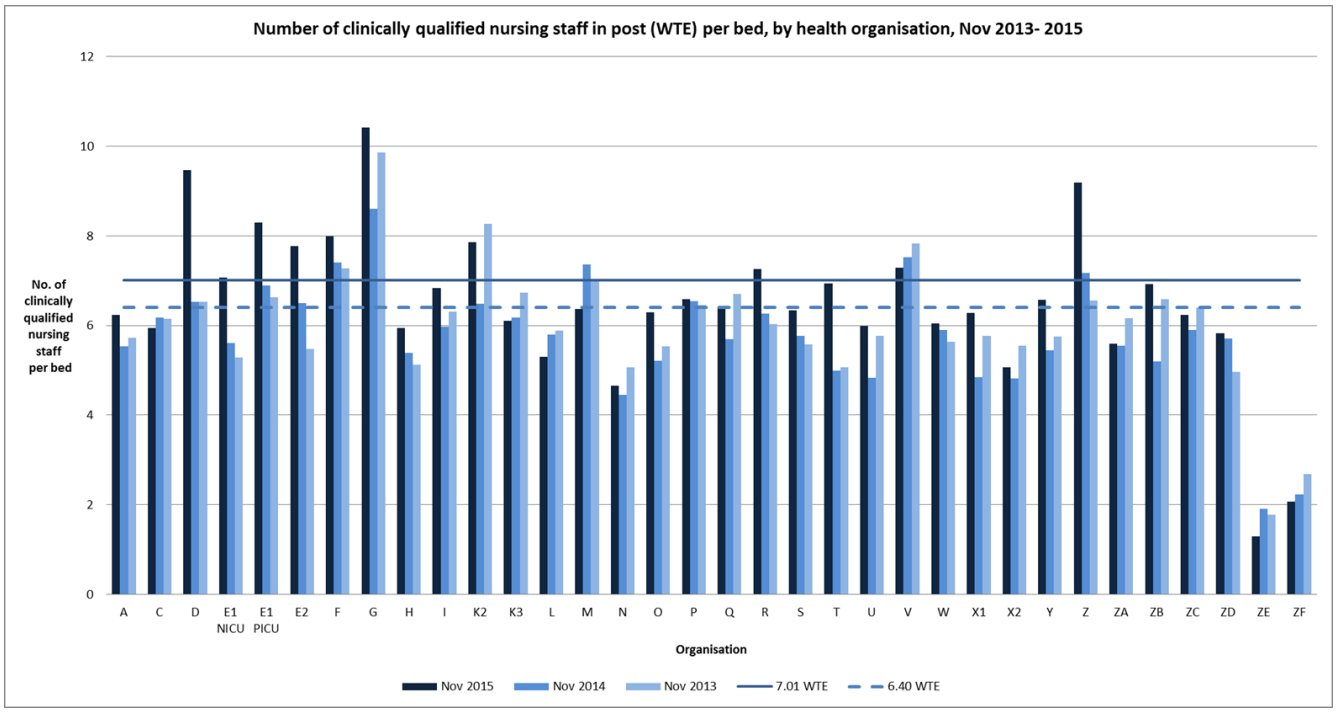
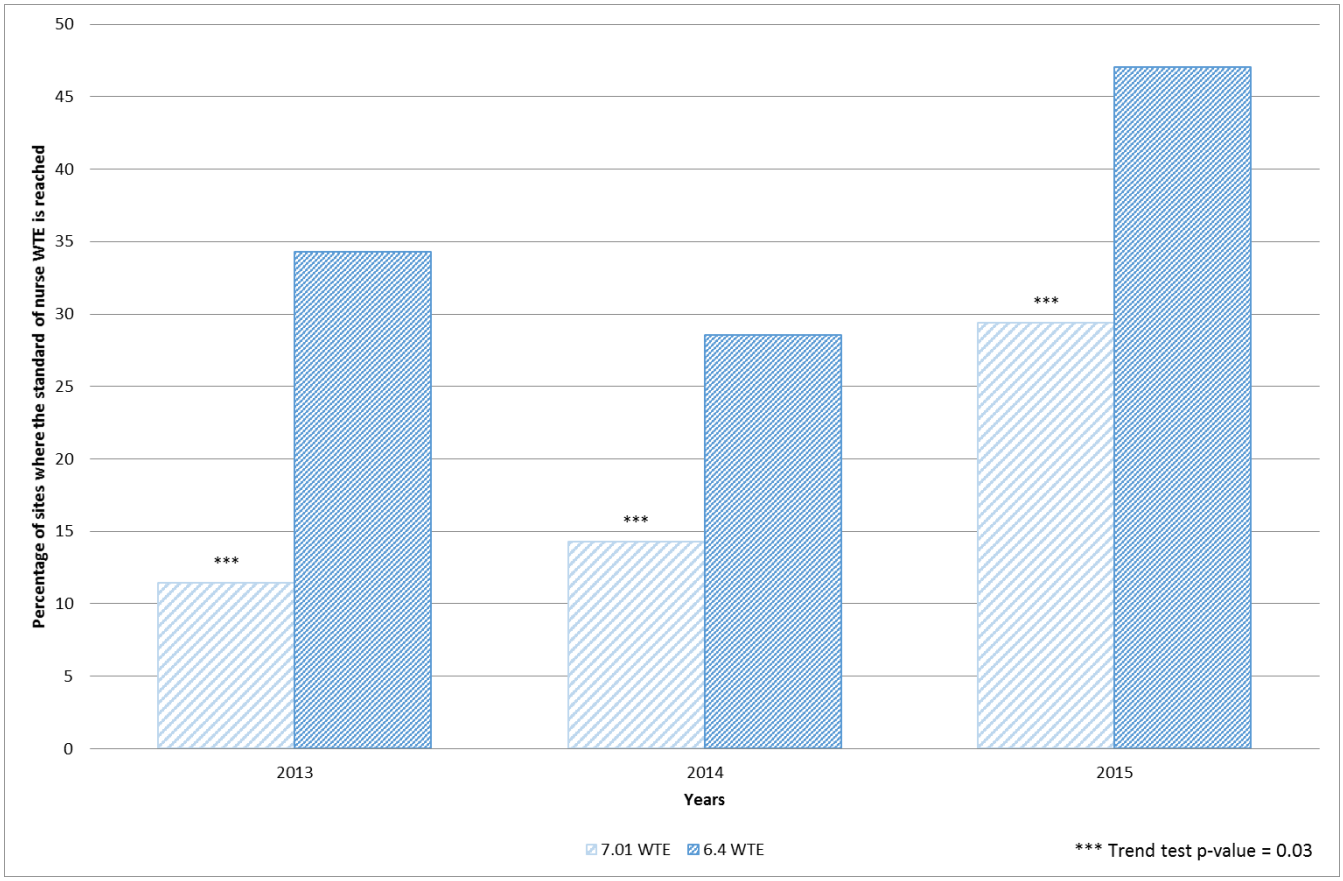


Figure 9: Proportion of health organisations meeting the PICs 2001 and 2010 standards for the number of clinically qualified nursing staff in post (WTE) per bed 2013-2015



Nurses on duty

Table 4: Proportion of units meeting the PICS Standard 164 (2010) defined levels of care and patient dependency.

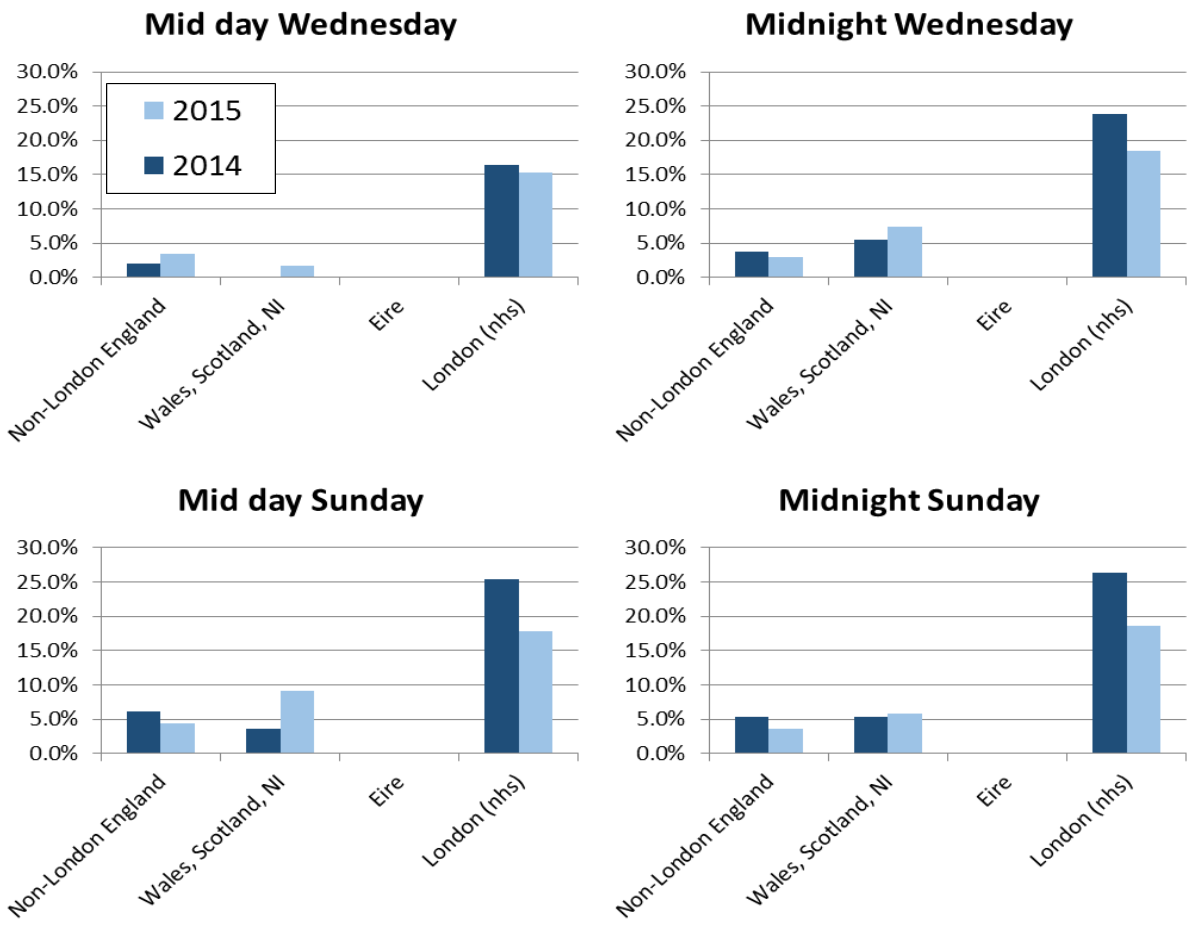
Snapshot time period		% Meeting Standard
Wednesday	Noon	66.7
	Midnight	45.5
Sunday	Noon	45.5
	Midnight	51.5

For each snapshot time period Table 4 shows the proportion of units meeting PICS standard 164 with respect to the levels of care and patient dependency levels of the children being cared for on PICUs as defined in Appendix M; where Level 1 requires nurse to patient Ratio of 0.5:1. Level 2 requires 1:1. Level 3 requires 1.5:1 and Level 4 requires 2:1.

Two thirds of units met the nurse to patient ratio at 12 noon on a weekday (66.7%). As in previous years around half of units met this standard at midnight on a weekday and at 12 noon and midnight on the Sunday of the snapshot week in November 2015.

Figure 10 shows the proportion of nursing staff that were agency and bank staff on duty during the four different snapshots recorded as part of the staffing survey in 2015 compared to the snapshot period for 2014. Whilst the largest proportion of bank and agency staff are once again in London, 15% on a weekday at noon and around 17-18% on the other three 'out of hours' time periods there has been a substantial reduction in the proportion of these staff being used (reduced from 27% in 2014 12 midnight Sunday). It should be noted that this data was collected prior to the Government introducing caps for agency costs.

Figure 10: Percentage of bank and agency staff working on PICU for the four snapshot time periods in 2015 (noon and midnight Wednesday and Sunday, week commencing 16th November 2015)



Medical staff

Consultant staff

PICANet has worked with their Clinical Advisory Group to develop a new data collection tool in order to collect the number of direct clinical care (DCC) programmed activities attributable to paediatric intensive care to match the method used for consultant contracts for England, Scotland, Wales and Northern Ireland (29 health organisations). Eire and the private PICUs have been excluded from this consultant analysis as their contracts are calculated differently. Data was collected in November 2015 with the refined questionnaire and is presented in this section here in a modified format to previous reports to allow for the more detailed results.

Table 5: Medical establishment: number of consultants DCC PAs in post and vacant posts by consultant type

	Paediatricians		Anaesthetists		Non-PICM consultants		Associate specialists/staff grade		TOTAL by grade
Consultant area of work	n	(%)	n	(%)	n	(%)	n	(%)	n
ICU									
Number of staff in post	168.8	(73.3)	41.5	(18.0)	16.0	(6.9)	4.0	(1.7)	230.3
Number of vacant posts	13.0	(89.7)	1.5	(10.3)	0.0	(0.0)	0.0	(0.0)	14.5
TOTAL ICU establishment posts	**181.8**		**43.0**		**16.0**		**4.0**		244.8
Combined total DCC PAs of funded staff in post	1410.7	(82.4)	243.3	(14.2)	29.6	(1.7)	28.0	(1.6)	1711.6
Combined total DCC PAs of vacant posts	109.0	(93.7)	7.4	(6.3)	0.0	(0.0)	0.0	(0.0)	116.3
Total DCC PAs for ICU medical establishment	**1519.7**		**250.7**		**29.6**		**28.0**		1827.9
Transport									
Number of staff in post	7.0	(70.0)	2.0	(20.0)	0.0	(0.0)	1.0	(10.0)	10.0
Number of vacant posts	7.0	(100.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	7.0
Total transport establishment posts	**14.0**		**2.0**		**0.0**		**1.0**		17.0
Combined total DCC PAs of funded staff in post	98.5	(92.5)	8.0	(7.5)	0.0	(0.0)	0.0	(0.0)	106.5
Combined total DCC PAs of vacant posts	61.0	(100.0)	0.0	(0.0)	0.0	(0.0)	0.0	(0.0)	61.0
Total DCC PAs for transport medical establishment	**159.5**		**8.0**		**0.0**		**0.0**		167.5

Table 5 provides the medical establishment figures (with vacant posts) for all PICUs across England, Scotland, Wales and Northern Ireland by type of consultant and area of work. Overall 116.3 (6.4%) DCC PAs are vacant out of 1827.9 DCC PAs required for medical establishment to cover PICU beds. Of the filled consultant posts 57.6 (3.4%) DCC PAs are non-PICM consultants or Associate specialists/staff grade doctors and 243.3 (14.2%) DCC PAs are PIC anaesthetists.

Of the 29 health organisations presented 21 are standalone PICUs with 1297.6 DCC PAs consultants in post and the remaining 8 are combined PICU and retrieval services using approximately one quarter (414.1) of the DCC PAs in post. Data concerning the staffing of the standalone retrieval services have not, to date, been included in the PICANet annual staffing study.

Locum consultants currently fill around 10% of DCC PAs (157.8 (9.2%)).

In PICS standard L3-202 (Dec 2015) consultant staffing requirements state that:
The following consultant staffing should be available:

'Normal working hours': At least one consultant for up to 12 beds for children needing Level 3 critical care and for each subsequent 12 beds.

Outside 'normal working hours': At least one consultant for up to 20 critical care beds and for each subsequent 20 beds. All consultants should have regular day-time commitments on the unit.

The definition of working hours in the PICS standards is that it 'should take into account times of peak activity' and the difference in the requirement between 'normal working hours' and 'outside normal working hours' is not fully explained and may vary from PICU to PICU. In this analysis the same definition has been used for all PICUs with 'normal working hours' being defined as 7am to 7pm Monday to Friday.

Figure 11: Combined total DCC PAs of funded staff in post for Consultant Paediatric Intensivists, by organisation, November 2015 against PICS standard L3-202 (December 2015)

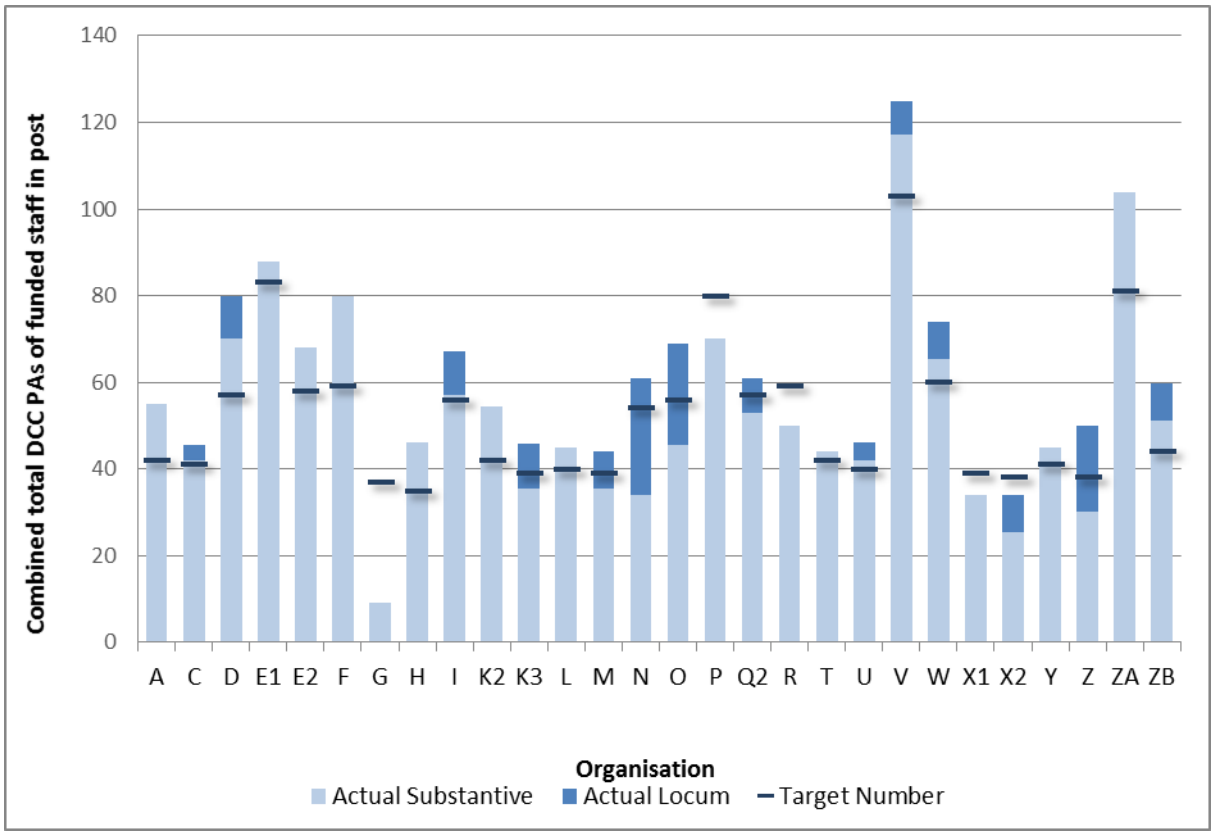


Figure 11 presents data for PICS standard L3-202 (Dec 2015) consultant staffing by individual health organisation by type of post. Most organisations meet the specified target (23/28, 82%); six units (21%) meet the target by using locum consultant staff. PICS standards are seen as 'minimum target' figures and depending on the availability of junior and middle grade staff (advanced nurse practitioners and nursing staff) other models may have been developed locally to ensure safe practice for the population served by any particular PICU. In calculating the "minimum target" figures we have made a number of assumptions based on assumed levels of activity: an expectation of actual consultant immediate availability or presence on units from 8am to midnight every day, and that there is consultant availability within 30 minutes and no responsibility for other hospital sites between midnight and 8am. However, models for individual PICUs will vary.

Junior and middle grade staff

Table 6: Medical establishment: number of junior and middle grade staff (WTE) in post and vacant posts by training grade

	In post		Vacant		Total
Junior staff by training grade	n	(%)	n	(%)	n
Overall					
ICU - Number of staff	379.0	(93.1)	27.9	(6.9)	**406.9**
ICU - Combined total WTE	318.5	(92.8)	24.8	(7.2)	**343.3**
Transport - Number of staff	15.0	(88.2)	2.0	(11.8)	**17.0**
Transport - Combined total WTE	14.0	(82.4)	3.0	(17.6)	**17.0**
Junior (FY1-2, ST 1-3)					
ICU - Number of staff	86.0	(97.3)	2.4	(2.7)	**88.4**
ICU - Combined total WTE	39.8	(93.4)	2.8	(6.6)	**42.6**
Transport - Number of staff	0.0	(0.0)	0.0	(0.0)	**0.0**
Transport - Combined total WTE	0.0	(0.0)	0.0	(0.0)	**0.0**
Middle Grade (ST 4-8)					
ICU - Number of staff	293.0	(92.0)	25.5	(8.0)	**318.5**
ICU - Combined total WTE	278.7	(92.7)	22.0	(7.3)	**300.7**
Transport - Number of staff	15.0	(88.2)	2.0	(11.8)	**17.0**
Transport - Combined total WTE	14.0	(82.4)	3.0	(17.6)	**17.0**

Table 6 presents the medical establishment for junior and middle grade medical staff for all UK PICUs. Overall 92.8% of junior and middle grades were filled in November 2015 and of the filled posts 278.7 out of 318.5 whole time equivalents (wte) (87.5%) were middle grade (ST 4-8). However, given the potential scheduling difficulties for these mainly full shift rota staff some shifts may run on reduced levels of junior and middle grade medical staffing that do not always comply with PICS standards (see Table 7). The vast majority of junior and middle grade posts (77.3%) were UK trainee posts. Across the UK there were 17 wte posts allocated to PIC transport and not based in a separate transport team all of which were middle grade medical staff (ST 4-8).

Other professionals

The number of hours allocated to the medical rota by Advanced Nurse Practitioners / Physician Associates (APP) is presented in Table 7 for England, Scotland and Wales where they are an essential part of the medical establishment. There are no such posts in Northern Ireland, Eire and the private PICUs. Nearly one third of all APP hours on the medical rota occur in one of the two PICUs in Scotland.

Table 7: Other staff (ANPs/Physician associates) information by regions

Other staff (ANPs/Physician associates) by UK country	England		Wales		Scotland		TOTAL by country
	n	(%)	n	(%)	n	(%)	n
ICU							
Number of staff in post	33.0	(78.6)	2.0	(4.8)	7.0	(16.7)	42.0
Number of vacant posts	3.0	(100.0)	0.0	(0.0)	0.0	(0.0)	3.0
Total hours per week on medical rota	698.0	(64.6)	75.0	(6.9)	307.5	(28.5)	1080.5
Transport							
Number of staff in post	12.0	(100.0)	0.0	(0.0)	0.0	(0.0)	12.0
Number of vacant posts	1.9	(100.0)	0.0	(0.0)	0.0	(0.0)	1.9
Total hours per week on medical rota	168.0	(100.0)	0.0	(0.0)	0.0	(0.0)	168.0

Medical standards

Table 8 shows the proportion of units meeting the recommended PICS standards (2010) for the defined levels of care and dependency levels of the children receiving care during the four snapshot periods in November 2015.

Table 8: Proportion of units meeting the PICS standards (2010) at specified times

Standard		Snapshot time period	% of units meeting standard
157: Consultant availability at all times	Wednesday	Noon	93.8
		Midnight	75.0
	Sunday	Noon	68.8
		Midnight	65.6
158: Medical trainee allocation during normal working hours	Wednesday	Noon	65.6
159: ST4 or above availability outside normal working hours	Wednesday	Midnight	53.1
	Sunday	Noon	71.9
		Midnight	56.3

Data collected for the four snapshot time periods in November 2015 showed that in 95% of units a consultant was available at noon on Wednesday (one consultant for every 8-10 beds); PICS standard 157. Over two thirds of units met this standard during the snapshot periods representing nights and weekends. Medical trainees were appropriately allocated for up to five patients for nearly two thirds

of units at the snapshot period representing normal working hours, thus meeting PICS standard 158 (2010). PICS standard 159 (2010) requires that outside normal working hours, for every eight PICU beds there should be at least one ST4 or above grade doctor available at all times was met by just over half of the units at midnight on Wednesday and Sunday and by almost three quarters of units at noon on Sunday.

Conclusion

This year the PICANet staffing survey has shown a significant increase in whole time equivalent qualified nurses and in the proportion of health organisations meeting the PICS standards for the number of clinically qualified nursing staff in post. We have also shown that the use of bank and agency staff in PIC has reduced. New medical establishment data collection forms have been designed and preliminary data have been presented. We welcome any feedback from PIC staff and others regarding any additional analysis or alternative presentation of the data that they require.

Parent Experience of PICU – EMPATHIC-30

"Your Experience Counts" – the EMpowerment of PArents in THe Intensive Care (EMPATHIC-30) survey was developed in the Netherlands (ref) to collect information about the experiences of parents and carers during the admission of their child to a paediatric intensive care unit (PICU). PICANet have worked closely with Jos Latour, who developed the tool, to produce an English translation for use in the UK to monitor levels of parent satisfaction with the service.

In this summary, the term "parents" is used to include mothers, fathers, carers, guardians and other adults with responsibility for caring for a child or young person. Individual reports have been produced and circulated to participating units. Here we present an overall summary of the quantitative study findings.

In 2015 PICANet collected data during two time periods (the months of February and July) from parents of children who received paediatric intensive care across the UK. During each month of the data collection units were asked to distribute the EMPATHIC-30 questionnaire to the parents and carers of all children being discharged from the service asking them to complete the questionnaire and return it in the freepost envelope provided, via the designated box on each unit or the post to the PICANet office.

The main section of the EMPATHIC-30 questionnaire comprises 30 questions about the parent experience and can be sub-divided into five sections relating to different areas of domains relating to parent experience of the care provided for their child: professional attitude, care and treatment, organisation, parental participation, and information. Answers to each question are recorded on a six point scale assessing their level of agreement with each statement from 1= definitely NO to 6=definitely YES. Broadly scores of 1 of 2 indicate that parents were not satisfied with the subject of the statement, scores of 3 or 4 indicate that parents felt the care was 'OK' and scores of 5 to 6 indicate that they were satisfied. In addition the final section of the questionnaire asks parents to rate the overall performance of the PIC staff using a ten point scale from extremely poor (1) to excellent (10) and provides space for additional comments.

Distribution of the questionnaires was controlled by each individual PICU and therefore we were unable to ascertain the total number of questionnaires given out by each unit. The response rate for the study has therefore been estimated using the total number of discharges from each unit during the specified months and is presented in Table 9. Due to the fact that staff may have missed some parents, excluded distribution to parents unable to read English or those whose child died or was discharged in specific circumstances (eg. for palliative care) the estimated denominator may be over inflated and therefore the presented response rate will be an underestimate of the true rate.

PICUs have been provided with a summary of the responses for their unit compared to all PICUs. Here we present an overview of the findings for the UK and Ireland as a whole.

Study findings

In total 31 out of 34 PICUs participated in the study at each time point and 30 units participated in both time points. Just over one fifth of the parents of children who were discharged from care during the periods of data collection completed and returned the EMPATHIC-30 questionnaire (Table 9).

Table 9: Estimated response rate - EMPATHIC-30 questionnaire for PICUs in the UK & Ireland, 2015.

For participating units	February	July	Total
Completed questionnaires	347	345	692
Children discharged during time period	1596	1665	3261
Percentage returned	21.7%	20.7%	21.2%

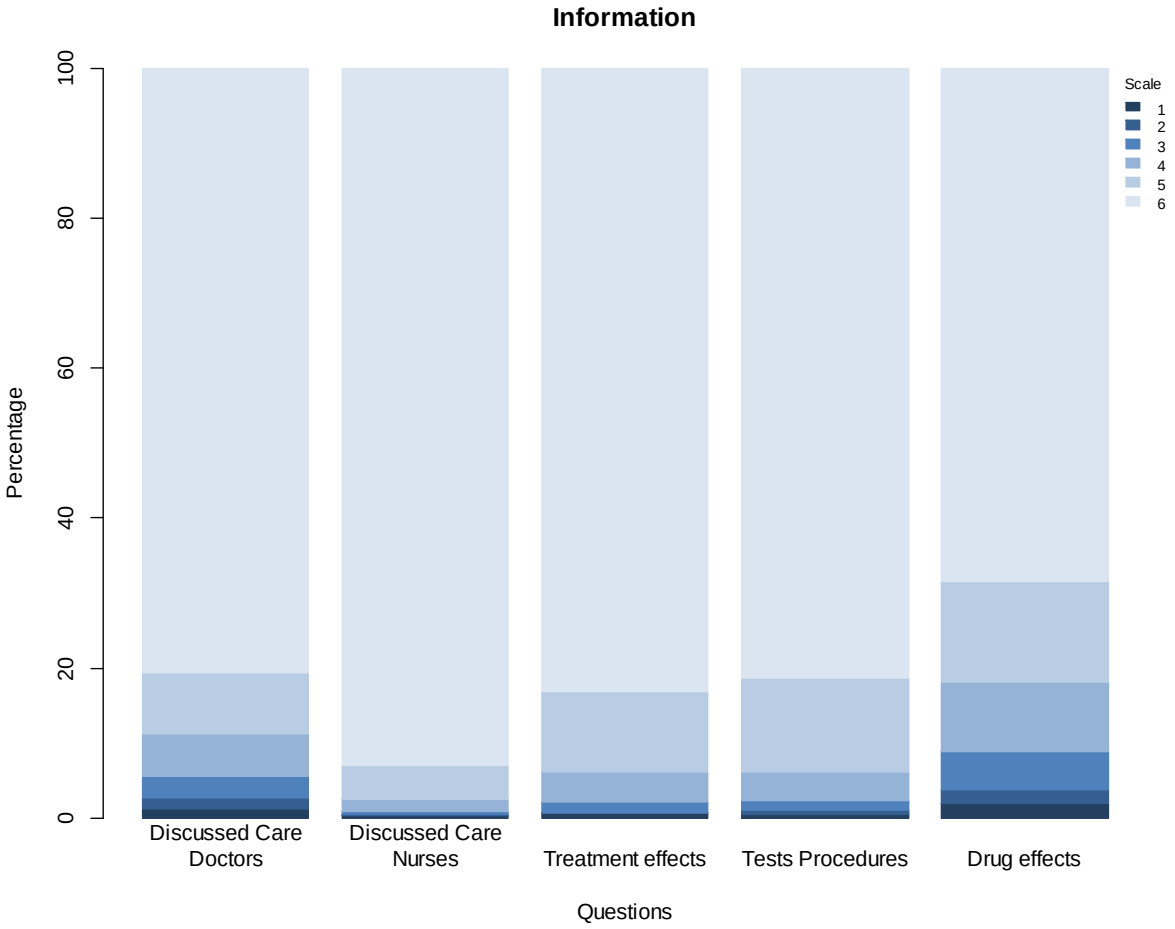
The results for the two time periods of the study have been combined for this report and are presented for the five separate domains identified earlier. For each domain a graph of the frequency distribution is presented for the level of agreement with each question. The vast majority of parents were very happy with their child's stay on the PICU. Analysis by unit size (less than 10 beds vs 10 or more beds) and by length of stay (less than or equal to 2 days vs more than 2 days) produced similar results with no significant differences between the groups.

Information

There are five questions included in EMPATHIC-30 that cover the provision of information to parents. These questions are listed below in the order they are presented on the bar chart:

- *Every day we discussed our child's care and treatment with the Doctors*
- *Every day we discussed our child's care and treatment with the Nurses*
- *The doctor clearly informed us about the possible effects of our child's treatment*
- *We received clear information about the tests and procedures*
- *We were given clear information about the possible effects of the drugs used to treat our child*

Figure 12: Level of satisfaction with information for parents - PICUs in the UK & Ireland 2015



Overall parents were very satisfied with the information they received about their child's care on PICU with over 80% of parents providing the highest score for the questions regarding discussions with the Doctors, effect of treatments and information regarding procedures and over 90% of parents providing the highest score for discussions with the nurses (Figure 12). Highest scores were recorded for a lower proportion of parents, around 70%, concerning the information provision about the effects of drugs with a small proportion of parents (around 5%) indicating that they were not satisfied with the information they received.

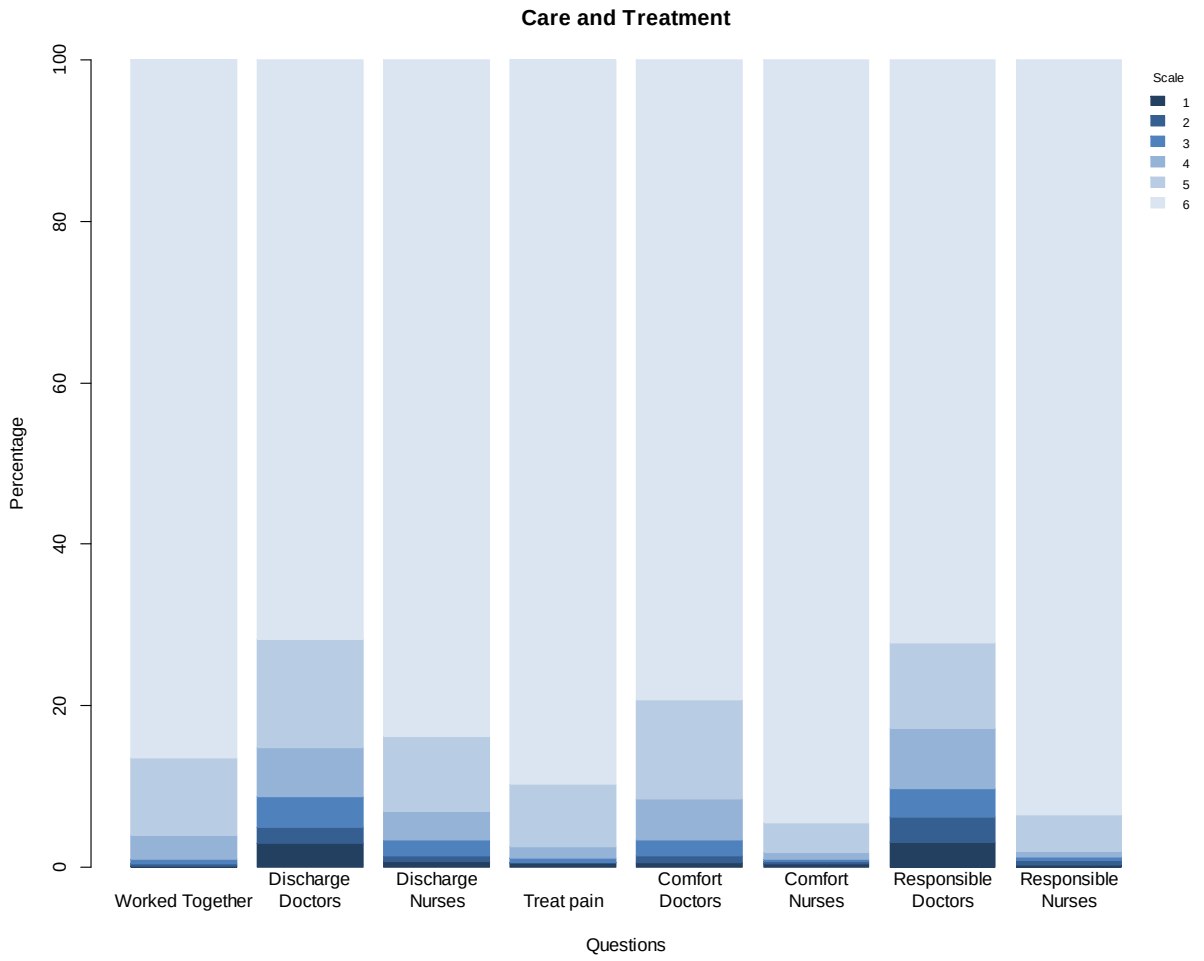
Care and treatment

EMPATHIC-30 includes eight questions that cover the physical care and treatment of children in PICU once again listed below in the order they are presented on the bar chart:

- *The doctors and nurses worked closely together*
- *We were well prepared for our child's discharge from paediatric intensive care by the Doctors*
- *We were well prepared for our child's discharge from paediatric intensive care by the Nurses*
- *The team closely observed our child to prevent and treat pain*
- *The comfort and wellbeing of our child was taken care of by the Doctors*
- *The comfort and wellbeing of our child was taken care of by the Nurses*

- *Each day we knew which member of the staff was responsible for our child regarding the Doctors*
- *Each day we knew which member of the staff was responsible for our child regarding the Nurses*

Figure 13: Level of satisfaction with care and treatment - PICUs in the UK & Ireland 2015



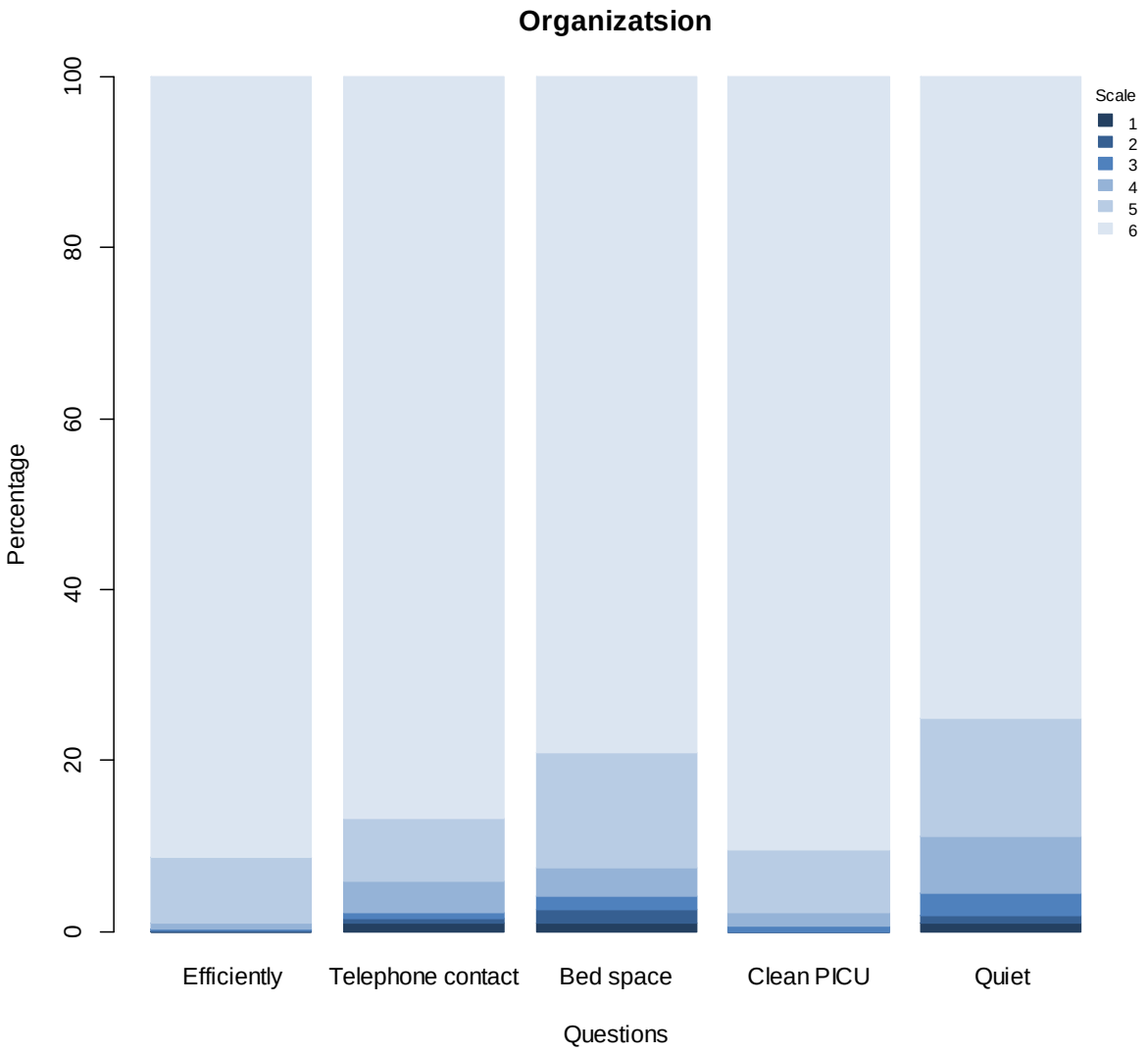
Highest levels of agreement (between 85% and 95%) with statements were seen for all aspects of care provision by nurses and for team working (Figure 13). The levels of agreement with statements regarding aspects of care provision by the doctors were somewhat lower at 70% to 80% possibly reflecting the perception of parents that 'care' is part of the nursing role.

Organisation

Five of the EMPATHIC-30 questions cover organisational issues.

- *The staff worked efficiently*
- *It was easy to contact the paediatric intensive care unit by telephone*
- *There was enough space around our child's bed*
- *The paediatric intensive care unit was clean*
- *The paediatric intensive care unit was kept as quiet as possible*

Figure 14: Level of satisfaction with organisation - PICUs in the UK & Ireland 2015



The vast majority of parents scored the questions concerning organisational issues with the highest levels of agreement in terms of the efficiency of staff, ease of PICU contact by telephone and cleanliness (around 90%) (Figure 14). However adequacy of space around the child's bed and noise levels on the unit scored somewhat lower with around 5% parents indicated that these were problem issues and provided written comments at the end of the questionnaire highlighting these areas of concern, in particular noise levels on the PICU. Some did, however, acknowledge that equipment noise was inevitable on an intensive care unit.

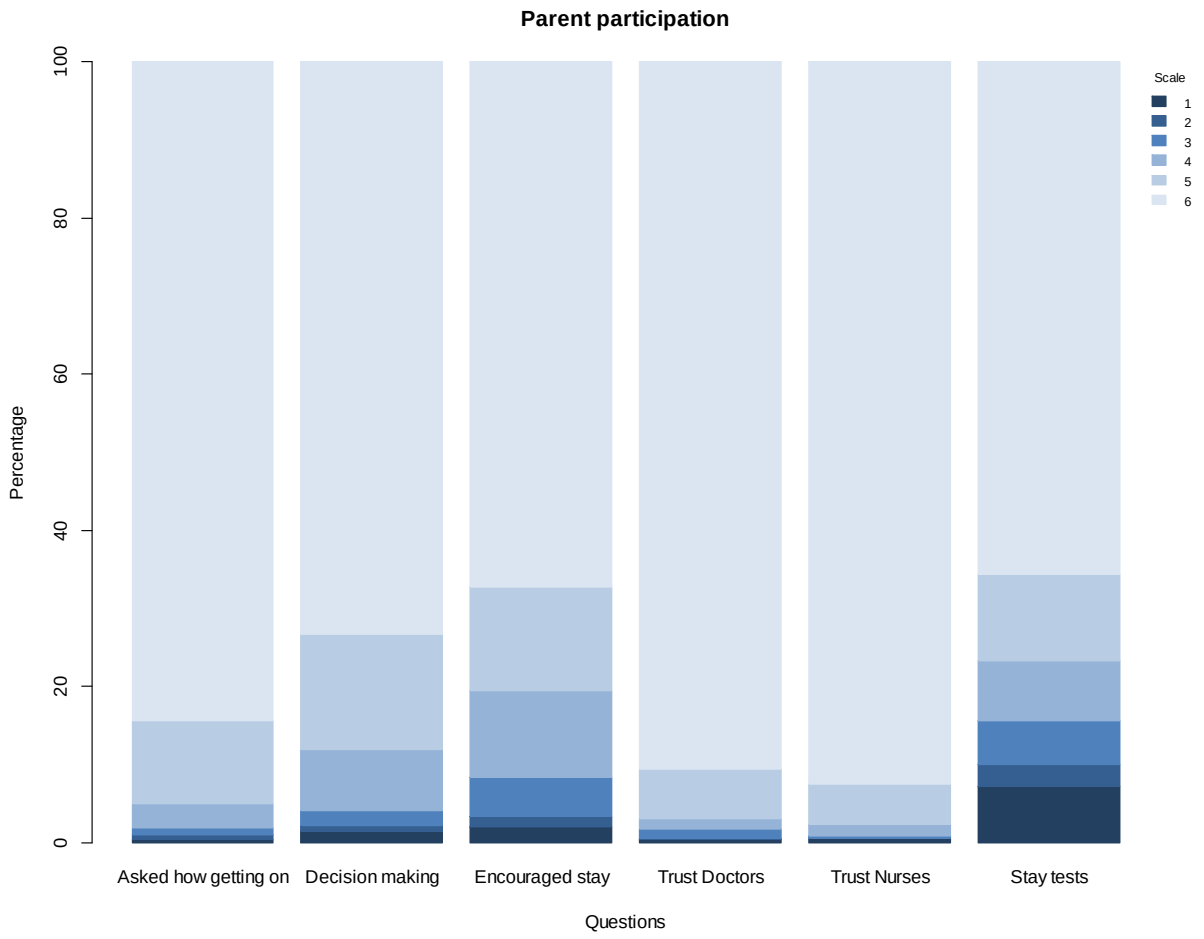
Parent participation

Six questions in the EMPATHIC-30 questionnaire cover parent participation in the care of their child on PICU.

- *During our stay the paediatric intensive care staff regularly asked us how we were getting on*
- *We were actively involved in decision-making about the care and treatment of our child*
- *We were encouraged to stay with our child*
- *We trusted the Doctors*

- *We trusted the Nurses*
- *We could always stay with our child even during intensive care procedures and tests*

Figure 15: Level of satisfaction with parent participation - PICUs in the UK & Ireland 2015



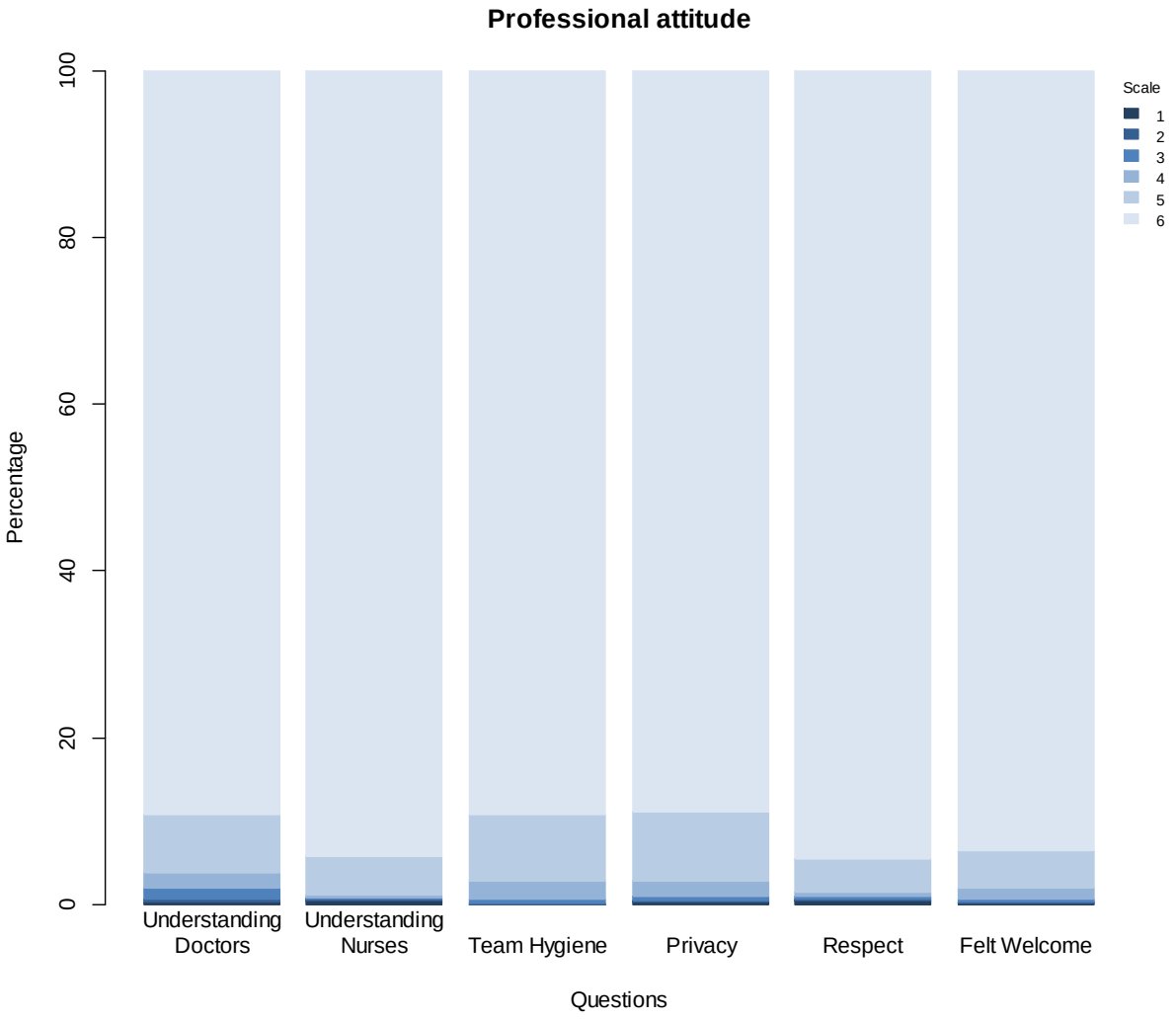
Parents indicated that they had very high levels of trust in both the doctors and the nurses with highest scores in around 95% responders (Figure 15). Between 5% and 10% of parents felt that they were not actively involved in the decision making for their child and reported that they were not encouraged to stay with their child during tests and procedures or to be around at all times as there was an expectation that they leave the unit at night. Provision of accommodation for parents varies widely across the PICUs in the UK and Ireland and this is reflected in the response to this question.

Professional attitude

EMPATHIC-30 has six questions covering the topic of professional attitude.

- We were treated with care and understanding by the Doctors
- We were treated with care and understanding by the Nurses
- Standards of cleanliness and hygiene were maintained by the team
- The staff respected the privacy of our child and ourselves
- Our child and our family were treated with respect by the staff
- When we arrived at the paediatric intensive care unit the staff made us feel welcome

Figure 16: Level of satisfaction with professional attitude - PICUs in the UK & Ireland 2015

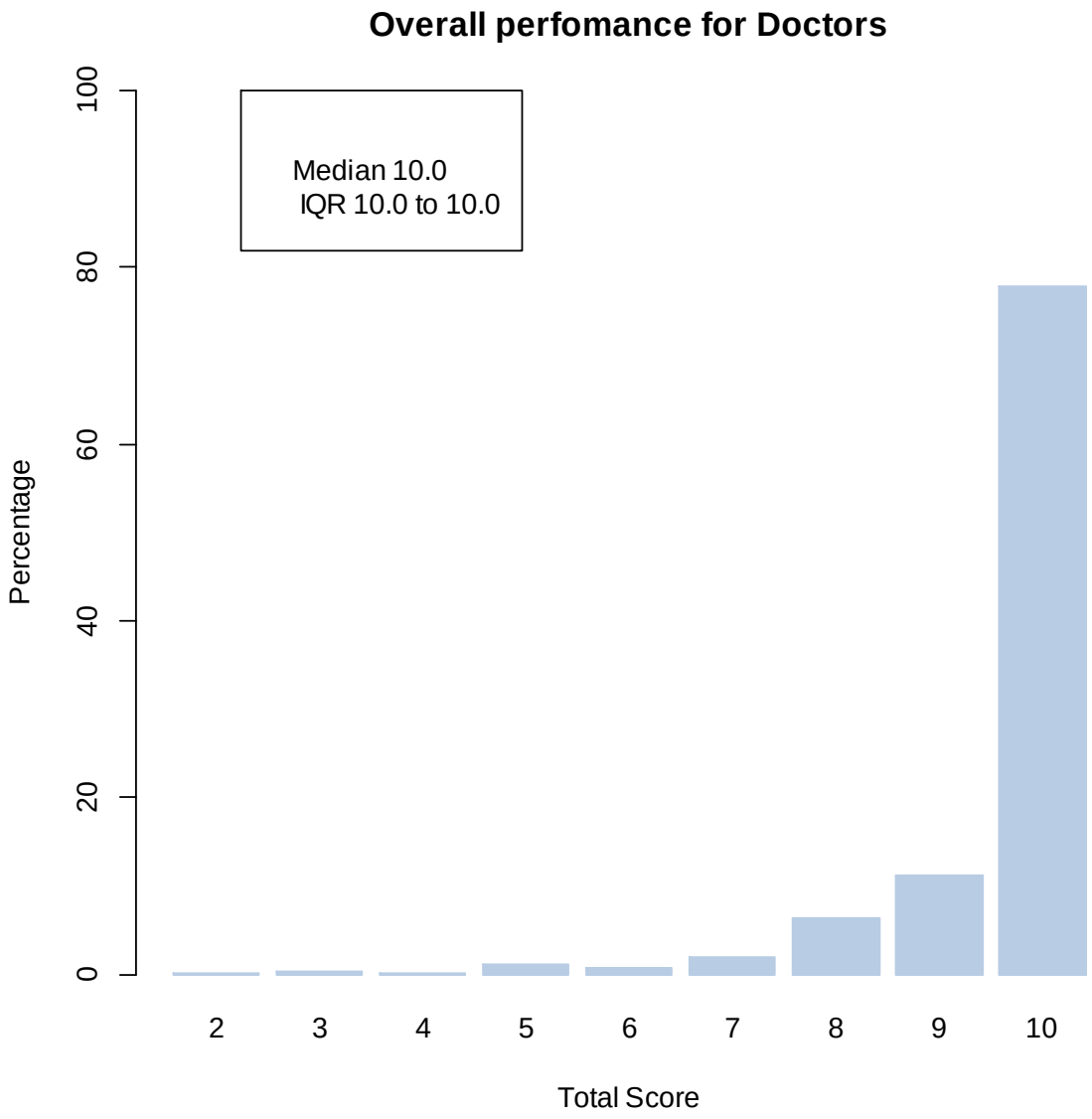


All questions concerning the professional attitude of the PIC staff were scored very highly with few negative scores or comments (Figure 16).

Doctors and nurses

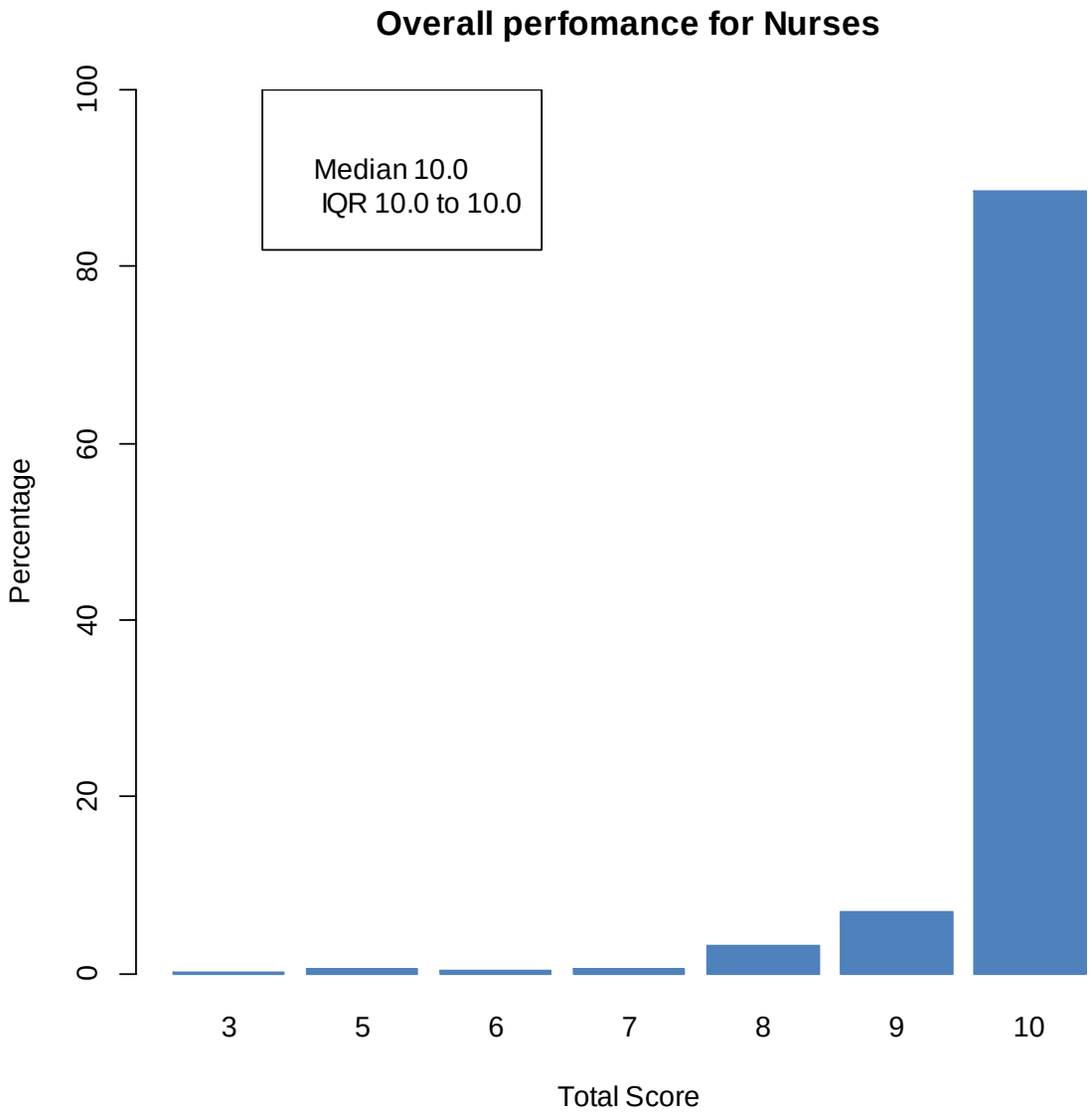
Parents were finally asked to rate the performance of the paediatric intensive care staff separately for the doctors and nurses on a 10 point scale: extremely poor (1) to excellent (10)

Figure 17: Parent rating of the overall performance of the doctors in PICU - 2015



The performance of both the doctors and nurses was rated very highly by almost all parents. Doctors' performance was rated as 9 or 10 for round 90% of responders with less than 5% of parents rating their performance as less than 8 (Figure 17). Similarly nurses' performance was rated as 9 or 10 for over 95% responders and less than 2% of parent rated their performance as less than 8 (Figure 18).

Figure 18: Parent rating of the overall performance of the nurses in PICU - 2015



Conclusion

In 2015 the vast majority of parents who completed the EMPATHIC-30 questionnaire were very happy with the care provided for their child in PICU and they rated the performance of both the doctors and nurses very highly.

DETECTION OF A MORTALITY OUTLIER IN THE PICANET ANNUAL REPORT DATA

Introduction

Each year, following closure of the annual report dataset, PICANet runs preliminary analyses on data submitted by all PICUs to check data quality and consistency and to identify any outliers for specific outcome measures including risk-adjusted mortality. This year the PICU at Royal Manchester Children's Hospital had a risk-adjusted SMR of 2.23 in 2015, falling above the upper control limit in the 2015 funnel plot. In accordance with PICANet policy, the excess mortality in this unit was investigated.

This section of the report is divided into two parts: firstly, an account of the data analysis and findings together with a set of recommendations from PICANet; secondly, a report from the PICU at RMCH on their findings from an internal review and a summary of the findings from an independent panel commissioned by Central Manchester University Hospitals NHS Foundation Trust.

Investigation and methods

Mortality risk adjustment and SMRs

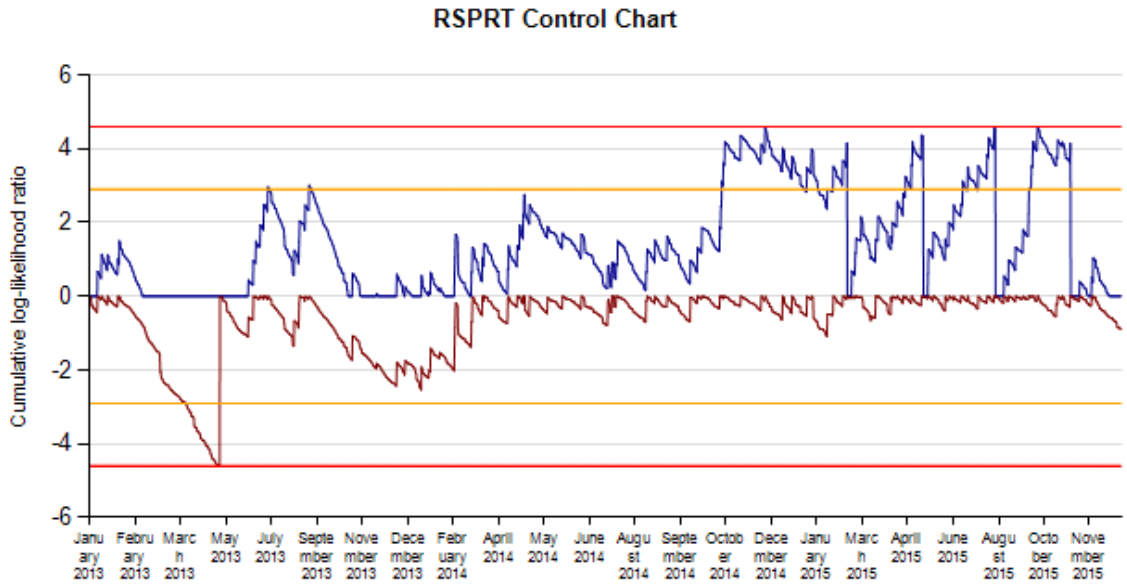
PICANet uses a recalibrated version of the Paediatric Index of Mortality 2 (PIM2) to calculate the expected probability of mortality for each admission to PICU. These expected probabilities of mortality are summed for the year to calculate the total number of expected deaths for the PICU. The risk-adjusted Standardised Mortality Ratio (SMR) is calculated as a ratio of the observed number of deaths to expected number of deaths. An SMR of 1 indicates expected performance, lower than 1 better performance and greater than 1 worse performance. As there is natural random variation in outcomes, statistical confidence limits (95% Confidence Intervals) are calculated to estimate the reliability of the SMR: if the intervals do include 1 the SMR is not considered statistically significantly different from 1. Note that mortality is measured for the year of admission: a child admitted in 2014 who died in 2015 would be counted as a 2014 death for the purposes of calculating SMRs. This does mean that the SMR for 2015 may not include children admitted in 2015 but who die in 2016 after the analysis has been carried out. They would get picked up in subsequent years.

PICANet recalibrates PIM2 each year to take into account changing patient case mix and improvements in survival. To do this, the variables used in PIM2 were entered into a logistic regression model using current (2013-2015) data to provide revised PIM2 coefficients. For the 2016 annual report this is denoted as pim2r2016. Earlier years have had a similar recalibration applied and use the same naming convention with just the year changing.

We firstly calculated SMRs and associated funnel plots for the individual years 2013, 2014 and 2015. The methods of producing funnel plots and their interpretation are described in the outcomes section of the PICANet annual report. For 2015, the PICU at RMCH fell above the upper control limit of the funnel plot indicating significant excess mortality in this year.

To investigate the timing of the excess mortality we used an RSPRT (Risk-adjusted resetting probability ratio test) plot, a statistical graphical method of detecting outliers over time. Between the orange 'tramlines' on the plot is a 'safe zone' with the variability you might expect day to day. Between the orange and red tramlines at the top of the plot can be regarded as a 'warning zone' for excess mortality; between the orange and red tramlines at the bottom of the plot performance is better than expected. Until there is a death, the top line on the plot stays flat and the bottom line gradually drops. When a death occurs the top line moves up and the bottom line moves closer to zero. When either line touches the red tramline (at the bottom or the top), the graph resets to zero. This method showed four significant 'spikes' in mortality in 2015 in the upper zone that caused the plot to reset, an indicator of excess mortality at those time-points (see figure 19).

Figure 19: RSPRT plot for RMCH PICU, 2013-2015



An examination of the crude number of deaths in the three year reporting period revealed an increase in the percentage of deaths from 3.7% (24/648) in 2013 to 8.4% (56/664) in 2015 (see table 10 below)

Table 10: Number of admissions and vital status at discharge with predicted deaths based on pim2r2016

Year	Alive (%)	Died (%)	Total admissions	Predicted deaths
2013	624 (96.3)	24 (3.7)	648	30.0
2014	727 (94.3)	44 (5.7)	771	31.6
2015	608 (91.6)	56 (8.4)	664	25.5

Investigation into data quality and patient characteristics that may affect the SMR

In accordance with the PICANet outlier policy, we investigated the elements of the mortality risk adjustment model (PIM2) for any unusual patterns in missing data or other changes in the frequency of the data items returned to PICANet. We also looked at the patient characteristics including ethnicity, age, sex and diagnostic group to determine if there were any substantial differences in 2015 compared with other years.

Our findings suggested little in the way of data-driven reasons for the increased mortality in 2015. There was an indication that diagnoses categorised as 'low risk' in PIM2 were not recorded in 2013 as the majority of these were returned as 'other'. This may have reduced the overall SMR in 2013 but would have had no effect on the 2015 risk-adjusted mortality. There was also a small reduction in the percentage of valid blood gases recorded in 2015 which may have contributed to an increase in SMR if valid values had been available but not recorded.

We did identify a marked increase in the length of stay for those children who died in 2015 (see table 11 below). This suggests that the characteristics of the children who died in 2015 were different to those who died in 2013 and 2014. It is not possible to ascertain what these differences are from the data available to PICANet. It does suggest closer scrutiny of their patient journey is warranted.

Table 11: Length of stay in days for all admissions and non-survivors at RMCH PICU, 2013-2015

Length of stay (days)	2013	2014	2015
All admissions			
Number	648	771	664
Mean	6.30	6.50	6.65
Min	0.05	0.02	0.02
Max	203	113	187
Non-survivors			
Number	24	44	56
Mean	12.58	10.86	19.05
Min	0.24	0.34	0.16
Max	84	113	187

Results following dataset revision

Re-analysis following data quality review by the PICU

Following the initial report on an elevated SMR in 2015 for the PICU at RMCH, the PICU reviewed the data submitted for 297 out of 664 (45%) admission records (including all 54 deaths on the PICU) in 2015, concentrating on those elements of the data that are used in the calculation of the mortality prediction model, PIM2. The revised data was submitted to PICANet. The final version of the PICANet annual report dataset was frozen on the 6th June 2016 and PIM2 was recalibrated using this final dataset. This is designated pim2r2016. This dataset included updated data from RMCH as well as from other units following validation and completeness queries. It ensures that our recalibration of PIM2 is based on the latest data for the reporting period. In this second analysis, we have used the final recalibrated version of pim2r2016 to look at both the initial data submitted to PICANet by RMCH as well as the revised data submitted after the initial report.

The effect of recalibrating PIM2 using a more complete dataset

Using the latest version of pim2r2016 that incorporates the updated dataset from 6th June, 2016, the expected number of deaths in 2015 from the initial dataset rose from 25.5 to 26.95 and the adjusted SMR decreased from 2.23 (95% CI 1.70,2.85) to 2.15 (95% CI 1.64, 2.75). *This meant that our recalibration of PIM2 using additional and corrected data from all units including RMCH has resulted in a small decrease in SMR for RMCH based on their original data submission*.

The effect of review and correction of data submitted by RMCH PICU for children who died in 2015

Following review, revised PIM2 data for 24 out of the 297 admission records reviewed were resubmitted to PICANet. Using the latest version of pim2r2016 and this revised data, the expected number of deaths increased from 25.5 in the original report to 29.45 resulting in an SMR of 1.92 (95% CI 1.46, 2.46). *This meant that the recalibration of PIM2 combined with the changes to PIM2 data for those 297 admission records reviewed and resubmitted to PICANet, have resulted in increase in the expected number of deaths and decrease in the SMR. However, this decreased SMR still falls above the upper control limits*.

Conclusions

The review of admissions records revealed a number of errors in the initial data submission. Correction of this data has resulted in 20 of those children having a higher expected probability of mortality. As the SMR is calculated as the observed over the expected number of deaths this has resulted in a lower SMR. This SMR still falls above the upper control limit and is therefore still regarded as an outlier.

It should be noted that all admissions to PICU contribute to the expected number of deaths as each admission has some risk. The PICU has reviewed data submitted for 45% of all admissions, a substantial amount of work. It is still possible that there may have been only a partial correction of the overall expected probability of mortality and hence the calculated SMR, but this level of review is not conducted in most PICUs. It is also not possible to predict whether this would have a significant effect on the SMR.

The recalibration of PIM2 on a rolling 3 year basis is carried out to ensure that the model is based on the most recent data available. It does reveal a sensitivity of the model to changes in data that clearly have an effect on SMR. This is not satisfactory and PICANet will investigate how mortality prediction can be improved. The newly established HQIP Methodology Advisory Group will be an ideal forum to debate this issue more widely and share experiences and expertise.

Response from RMCH

The outcome of the independent review of deaths on PICU is confidential to the RMCH but some of their comments have been included in the article below from Dr Stephen Playfor which details the RMCH PICU's response to the process of outlier identification and reporting. Dr Playfor notes that their internal review identified a significant number of children who had life-limiting syndromes or comorbidities that are not accounted for in PIM2 and this fact was picked up by the independent review panels. For PICANet the potential failure of the mortality risk adjustment model used to monitor quality of care should be addressed urgently.

PICANet report summaries and recommendations to RMCH PICU

The summary and recommendations given below were contained in two reports sent to the PICU lead, Medical Director and Trust CEO. The first of these was sent on 3rd May 2016, the second on 4th July 2016. These are reproduced in full here to allow readers a better understanding of the processes involved in dealing with an outlier.

Summary from report dated 3rd May 2016

- Data submitted to PICANet for 2015 indicate that the risk-adjusted Standardised Mortality Ratio (SMR) for the Royal Manchester Children's Hospital (RMCH) PICU falls outside the control limits of funnel plots designed to detect mortality outliers.
- The SMR was 2.23 (95% CI 1.7-2.85) in 2015 vs. 1.39 (95% CI 1.02-1.85) in 2014 and 0.81 (95% CI 0.52-1.19) in 2013.
- There were 56 deaths (8.4% of admissions) in 2015 compared to 24 (3.7%) in 2013 and 44 (5.7%) in 2014. The overall crude in-PICU mortality rate for the UK and Ireland in the period 2013-2015 was 3.8%.
- Further evidence of excess risk-adjusted mortality for 2015 has been confirmed by the use of resetting sequential probability ratio test (RSPRT) plots, a statistical graphical method of detecting outliers over time. This method showed 4 significant 'spikes' in mortality in 2015 that caused the plot to reset, an indicator of excess mortality at those time-points.
- In accordance with our policy on outliers, PICANet has investigated the nature of this elevated SMR in relation to data quality, demographics and case-mix using the standard PICANet dataset.
- There has been a small reduction in the percentage of valid blood gases recorded and an increase in the number of 'low-risk' reasons for admission used in the calculation of the mortality risk-adjustment model that may have had some minor effect of increasing the overall SMR if incorrect.
- Our investigations did not however, identify any marked data quality/data driven issues that may account for the magnitude of increase in the SMR.

- We noted that the mean length of stay on PICU of those children who died was approximately 65% higher in 2015 than 2013. Mean length of stay for survivors remained similar across the years.
- The increased length of stay of those children who died suggests that they were different in some way to the earlier cohorts.

Recommendations from report dated 3rd May 2016

1. A review of the variables that are used in the mortality risk adjustment model should be carried out by the PICU staff for all admissions in 2015, not just for children who died.
2. Any revised data values should be uploaded to the PICANet database and a description of the reasons for any changes should be given for each data item for each patient.
3. Following any revision of data, PICANet should re-run the analyses described in this report and send an updated report to RMCH.
4. An independent review of the deaths that occurred in PICU in 2015 should be carried out by a suitable qualified PICU consultant.
5. Any changes to the data notified to PICANet should be scrutinised and verified as correct by the same PICU consultant.
6. The Clinical Lead at RMCH PICU should be given the opportunity to respond to the discovery of an outlier in their data in an article published in the PICANet Annual Report (due September 2016).
7. If the outlier SMR persists after review and revision of the data, the RMCH, HQIP and the Universities of Leeds and Leicester should ensure that appropriate media releases are prepared in advance of the publication of the PICANet Annual Report with due regard to the sensitivity of this topic.

Summary from report dated 4th July, 2016

- Initial data submitted to PICANet for 2015 indicated that the risk-adjusted Standardised Mortality Ratio (SMR) for the Royal Manchester Children's Hospital (RMCH) PICU fell outside the control limits of funnel plots designed to detect mortality outliers.
- The SMR was 2.23 (95% CI 1.7-2.85) in 2015 vs. 1.39 (95% CI 1.02-1.85) in 2014 and 0.81 (95% CI 0.52-1.19) in 2013.
- The PICANet policy on outliers was followed and the PICU lead was informed of this finding.
- A report detailing our findings was sent to the PICU lead, Medical Director and Trust CEO on 3rd May 2016 and was copied to HQIP, who manage the National Clinical Audit Outcome Programme.
- The PICU lead initiated a review of the data submitted to PICANet and clinical notes for 297/664 (45%) admissions were examined, including all 54 deaths.
- An updated dataset with changes to 24 admission records (8% of those reviewed) was resubmitted for further analysis.
- An independent review of all deaths on the PICU in 2015 has been commissioned.

- Out of the 24 resubmitted admission records, 4 had changes that reduced, and 20 had changes that increased, the expected probability of mortality.
- Reanalysis of the data included two elements: firstly, the mortality prediction model was recalibrated using a finalised dataset that included additional and validated data from all contributing PICUS and this was used to reanalyse the initial dataset submitted by RMCH; secondly, an analysis was performed on the updated data submitted by the RMCH after their review of 297 admissions records for 2015.
- Recalibration of the mortality prediction model using additional data resulted in a reduction in SMR from 2.23 to 2.15 but the PICU at RMCH remained an outlier, falling above the upper control limit of the funnel plot.
- Analysis of the updated data from RMCH produced an SMR of 1.92 (95% CI 1.46, 2.46) which, although lower, still remained above the upper control limit, indicating excess mortality persists in the data

Recommendations from report dated 4th July 2016

1. The RMCH should be given the opportunity to comment on and respond to the findings from PICANet, and this should be in the form of an article to be published in the PICANet Annual Report.
2. The outcome of the independent review of deaths in the PICU at RMCH in 2015 should be used to provide the necessary context for interpreting the excess mortality indicated by the SMR outlier.
3. A review of the suitability of the mortality prediction models used by PICANet to compare SMRs should be conducted in light of the sensitivity of the PIM2 model calibration to changes in the data and data quality.

DEALING WITH A MORTALITY OUTLIER – THE EXPERIENCE FROM ROYAL MANCHESTER CHILDREN'S HOSPITAL

In April 2016 we were contacted by the Principal Investigator for the Paediatric Intensive Care Audit Network (PICANet) regarding the Standardised Mortality Ratio (SMR) for our unit in 2015. The data demonstrated a risk-adjusted SMR of 2.23, falling above the upper control limit in the 2015 funnel plot. The Paediatric Index of Mortality (PIM) scores predicted that we would see 26 deaths in 2015, whereas we actually saw 56; an 'excess' of 30 deaths.

In keeping with standard procedures PICANet, as a member of the National Clinical Audit programme, made HQIP aware of our outlier status, who in turn informed the Deputy Chief Inspector of Hospitals.

In response to the elevated SMR we initiated a review of the data submitted to PICANet and clinical notes for 297/664 (45%) admissions were examined, including all deaths. Recalibration of the mortality prediction model using additional corrected data resulted in a reduction in SMR from 2.23 to 2.15 but we remained an outlier.

An internal review of clinical records for all of the deaths was undertaken and an independent external panel was commissioned to review the data and provide a report.

Prompt investigation of outlier status is important to ensure that high quality care is being delivered and throughout the process PICANet staff, and indeed all parties involved, were supportive and helpful.

The internal review demonstrated patterns in the diagnoses and co-morbidities of the deaths which were unpredicted by PIM2; only 4 children could have been considered to have been well prior to PICU admission. A significant number of the children who died had suffered from life-limiting syndromes or co-morbidities which do not appear in the range of conditions which are recognised and 'weighted' in the PIM2 scoring system. As our independent external panel stated:

'*the number of individuals admitted with any specific condition may be so small that each individual diagnosis cannot be included within the risk adjustment, but for any PICU admitting a larger proportion of patients with a range of life-limiting conditions as part of its case-mix, there may be an unfavourable effect on the risk-adjusted SMR*'.

As with most other PICUs we have seen an increase in the proportion of children admitted with complex chronic conditions; in several cases in 2015 life-sustaining therapies were withdrawn or withheld with the agreement of families following admission to PICU when this was thought to be in the child's best interests. In these circumstances the degree of physiological derangement on admission often did not reflect the outcome.

The report of the independent external panel did not identify any specific breaches in the standard of care delivered in PICU, but did recommend a more detailed evaluation of the PICU care delivered to one child who died there. The report made several valuable observations regarding the delivery of care prior to admission to PICU and related to the organisational processes which occur following the death of a child.

The National Clinical Audit Advisory Group has stated that performance indicators must provide a valid measure of a provider's quality of care in that there is a clear relationship between the indicator and quality of care. It may be that the SMR can no longer be relied upon as a valid measure of a PICU's quality of care given the changing population of critically ill children who we care for. As our patient population has evolved so our performance indicators must evolve to account for factors other than physiological derangement and a small number of pre-defined co-morbidities apparent at the time of admission.

It has previously been suggested that there may be more valid indicators of quality of care than mortality given that more than 95% of children are discharged alive from PICU. In the future it may be that composite performance indicators which include both SMR and an assessment of clinical incidents such as drug errors, hospital-acquired infections and inadvertent extubations may provide a more valid indication of the overwhelmingly high quality care that is delivered in UK PICUs.

Stephen Playfor, Consultant Paediatric Intensivist, PICU, Royal Manchester Children's Hospital.

NEW DEVELOPMENTS & FUTURE WORK

Updating and improving the data collected

The information PICANet collects has changed over time and updates are needed to collect the most relevant information to patient care.

One recent change has been to collect more information on ventilation of children in intensive care:

- High flow oxygen is now being used with increasing frequency in PICU but little is known about actual flow rates and how it is used in practice. Changes to the PICANet admission dataset allows recording of maximum daily flow in l/min to provide the necessary benchmark data to inform the use of this new technology. This will be reported in our next annual report.
- In August 2014 the PICANet dataset was updated allowing the collection of a new outcome: unplanned extubation to support the collection of Data Dashboard item PIC08.

Customised data collection

In the last twelve months customised data collection has been developed by PICANet and this is currently being utilised by two audit projects:

PICANet renal replacement therapy audit

A customised data collection tool is being piloted for a new renal replacement therapy dataset relating to paediatric patients who receive Continuous Renal Replacement Therapy (CRRT) in PICUs in the UK and Ireland. Clinical support for this audit is being provided by Dr Claire Westrope (Consultant PICU/ECMO, University Hospitals of Leicester NHS Trust) and the Paediatric Intensive Care Society Study Group (PICS SG) Renal Group. While it is clear that the use of CRRT in critically ill children is increasing, very little is known about outcomes, modality, timing of initiation and a host of other parameters. This pilot audit will provide baseline information on current practice that has not been available up until now.

Supporting the development of new and updated standards

The Paediatric Intensive Care Society is currently updating their Standards to ensure they are relevant and up to date; PICANet has collaborated in the development of updated PICS standards.

Through the NHS England Clinical Reference Group PICANet is involved in the refinement of the Data Dashboard (http://www.england.nhs.uk/commissioning/spec-services/npc-crg/group-e/e07/). Online reporting is being developed for units to allow them to be able to report as many dashboard items as possible from the PICANet dataset, including the referral and transport data. Additional data items are being gathered and new methods of displaying the metrics are being developed to support units and make sure the latest figures are available to be reported to commissioners. We have now added a new table to the annual report to quantify the timely completeness of data submitted to PICANet which is required for both PICS Standard 181 (Table 1) and Data Dashboard item PIC10 (Table 2).

Providing units with reporting tools to improve access to information and reporting of activity

PICANet provides reporting tools to PICUs so they can access their data and create online reports, this helps them measure the levels of care they are delivering and identify areas where additional capacity might be needed as well as carry out routine reporting on a day to day basis. This information can be used to report PICU activity to others including hospital managers, commissioning groups and other stakeholders. Ongoing work is being carried out to extend the available reports and provide additional reports for the referral and transport datasets.

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INVITED PAPERS

This year we have concentrated on the role that PICANet has played in supporting clinical trials to drive improvement in the quality of care delivered by the paediatric intensive care service.

The invited articles that follow include a trial that has been successfully completed as well as those that have been funded and are in the start-up phase

We are very grateful to the authors for their contributions.

GENERALISING THE FINDINGS FROM THE CATCH TRIAL (CATHETER INFECTIONS IN CHILDREN) TO PAEDIATRIC INTENSIVE CARE ACROSS THE NHS: THE VALUE OF LINKING PICANET AND INFECTION SURVEILLANCE DATA.

The CATCH trial was a 3-arm trial in which children receiving intensive care who required a central venous catheter (CVC) were randomised to antibiotic (minocycline and rifampicin) impregnated, heparin bonded, and standard CVCs [1, 2]. The primary outcome was time to bloodstream infection (BSI). 1485 children treated in 14 PICUs across England between 2010 and 2012 were included in the analyses. Results published earlier this year reported that BSI was recorded for 42 children, with higher rates in the standard group 18/502 (3.59%) and heparin group 17/497 (3.42%) than the antibiotic group 7/486 (1.44%).[1, 2] There was no significant difference in the primary outcome of time to first BSI comparing any impregnated CVC with the standard CVC [hazard ratio (HR) 0.71, 95% confidence interval (CI) 0.37 to 1.34; p = 0.29]. However, BSI risk was reduced for antibiotic compared with standard CVCs (HR 0.43, 95% CI 0.20 to 0.96; p = 0.04) and for antibiotic compared with heparin CVCs (HR 0.42, 95% CI 0.19 to 0.93; p = 0.03) but not for heparin compared with standard CVCs (HR 1.04, 95% CI 0.53 to 2.03; p = 0.90). The risk difference in BSI comparing antibiotic versus standard CVCs was –2.15% (95% CI –4.09% to –0.20%). The number needed to treat with antibiotic instead of standard CVC to avoid one additional BSI was 47. There were no differences in the risks of adverse events, including antibiotic resistance [1-3].

CATCH was a large, pragmatic randomised trial designed to inform practice across the NHS. Before considering whether to adopt antibiotic CVCs, clinicians need to know i) whether this clinically effective intervention is also cost effective, and ii) the cost impact of bulk purchasing antibiotic CVCs for all children who need a CVC in their paediatric intensive care unit (PICU). Antibiotic CVCs cost twice as much as standard CVCs but managing BSI in PICU is also extremely costly. The cost effectiveness analysis compared costs of care and outcomes in the three trial arms and showed no overall difference in cost at 6 months after randomisation (the primary analysis). However, sensitivity analyses showed that antibiotic CVCs were cost saving up to 120 days after randomisation **[**1**].**

We used PICANet data linked to national BSI surveillance data to help us determine the generalisability and cost impact of the trial findings across all PICUs in the NHS. Prior to the CATCH trial, standard CVCs were used for the majority of children in UK PICUs [4]. We reasoned that if antibiotic-impregnated CVCs were adopted for children, it is likely that they would be bulk-purchased and used for all children requiring CVCs in PICU, not just children like those in the trial. Decisions on whether to purchase antibiotic impregnated CVCs therefore need to take into account the absolute rate of BSI for all children requiring CVCs across all PICUs and how much this rate would be reduced by adopting antibiotic CVCs. We estimated BSI rates using standard CVCs through linkage of national PICANet data with laboratory surveillance data for England and Wales, held by Public Health England. We also surveyed PICUs to determine the type of CVCs used in routine practice [4-6]. We reported declining trends in BSI rates across PICUs [5, 7], and used local audit data to estimate the proportion of children requiring CVCs, as this variable is not yet collected in PICANet data [8]. We estimated that the additional cost of purchasing antibiotic CVCs would be less than the costs of managing BSI with

standard CVCs for PICUs with BSI rates above 1.2 per 1000 CVC-days [1, 8]. This cut-off is much lower than the estimated average for PICUs using standard CVCs of 4.6/1000 CVC days. The results from the CATCH trial on the effectiveness, cost effectiveness and cost impact of antibiotic versus standard CVCs are consistent with trials in adults [9, 10].

CATCH was the first trial in the UK to use deferred consent for children [11]. Two-thirds of randomised patients were recruited during emergency insertion of a CVC, usually as part of resuscitation. The type of CVC was randomised at the bedside and parents were approached after CVC insertion for consent to have data collected for the trial. A qualitative study showed that once the trial was explained, parents were content with the use of deferred consent [12]. However, obtaining consent from parents after a child died was challenging, and resulted in under recruitment of children who died [11]. We therefore recommend that in future low-risk intervention trials using deferred consent, ethics committees should waive the need for consent after a patient dies provided reasonable efforts have been made to obtain consent [11].

The CATCH trial was funded by the NIHR (project number 08/13/47).

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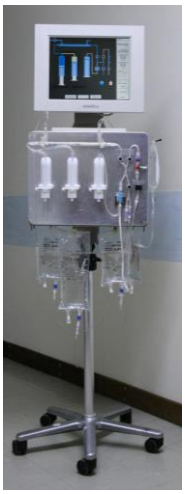
I-KID Study: Evaluation of efficacy, outcomes & safety of a new infant haemodialysis and ultrafiltration machine in clinical use

Background

There is a need for improved technology to provide renal replacement therapy (RRT) effectively and safely for small babies. Two main groups of babies are currently treated with RRT. Firstly those with intrinsic renal disease, which is often congenital, who are normally treated with peritoneal dialysis (PD), which frequently works well in the chronic situation. However some babies fail treatment with PD because of problems like catheter leakage, peritonitis; or cannot be treated with PD because of abdominal wall problems like gastroschisis or abdominal surgery. Alternative options for treating very small babies with standard intermittent haemodialysis are limited.

The other group needing RRT are sick infants in paediatric intensive care units (PICU). Most of these babies do not have intrinsic renal disease and therefore have good potential for renal recovery, however they are reported to have higher mortality, longer length of stay and although most survivors are independent of RRT at discharge from PICU up to 30% may have long term renal sequelae. Babies treated with continuous RRT in PICU include i) those who have multisystem disease which includes acute kidney injury – for example babies with severe sepsis, ii) post operative babies – especially after cardiac surgery whose major problem is fluid overload and poor urine output and iii) babies with an inborn error of metabolism for example urea cycle defects causing hyperammonaemia. In these three groups of patients mortality and morbidity are different and related to the underlying diagnosis. PD often used in smaller babies in PICU but problems with catheter malfunction, leakage, infection (peritonitis) may limit its use. PD is often poorly effective in fluid removal and it is very poor at clearing toxic metabolites in babies with inborn errors of metabolism.



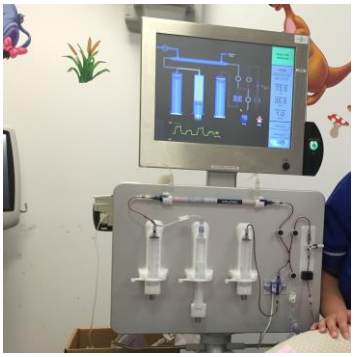
Conventional haemofiltration (CVVH) machines are not licensed for use in babies weighing <8 kg because their technology for controlling ultrafiltration is inherently imprecise and presents a relatively large potential error with risk of dehydration or fluid overload for small babies. For small babies under 5kg, the large CVVH circuit volume exceeds the 10-15% of total blood volume removal considered safe and therefore the circuit is frequently primed with blood, or the infant has a simultaneous blood transfusion. The circuits may clot early when CVVH is used for the smallest babies related to poor blood flow. Hypotension requiring intervention is quite commonly reported on starting CVVH. However because of lack of alternatives the machines, designed for adults and older children, are frequently used outside recommendations. Recurrent themes emerge from published case series of babies who received RRT in PICU, indicating similar problems faced by clinicians world-wide and proposing the need to provide solutions. The need to improve technology has been recognised as an important target by research groups in Europe and the US. From PICANet reports we know that in UK PICUs approximately 300 infants under 8kg receive RRT each year split approximately equally between peritoneal dialysis (PD) and continuous haemofiltration (CVVH).

Nidus

The Newcastle infant dialysis and ultrafiltration system (Nidus) is a new device developed within the NHS. It is the first device designed for babies 0.8 to 8kg, and has been shown to be efficacious in a pilot study in the development centre. Further data on efficacy and safety in clinical use outside the development centre are urgently needed.

I-KID study

The aim of the I-KID study is to compare Nidus with conventional RRT in PICU. The study is a randomised, stepped wedge cluster design: a one-way cross over with each unit acting as their own control. This was chosen over individual patient randomisation because of the strong views of parents, public and professionals regarding feasibility. Factors taken into account included recruitment, equipoise, ethics, training and safety in this specific urgent PICU situation with vulnerable patients. Parent and public involvement has been high from the early stages of the study design. The study population is babies under 8kg needing continuous RRT for renal impairment or fluid overload in PICU.



The study intervention is Nidus, compared to current RRT either PD or CVVH (control). The primary outcome is precision of fluid removal. Secondary outcomes include survival, ventilator-free days, renal recovery, biochemical clearances, haemodynamic status (drop in BP requiring intervention) and adverse events such as transfusions, unplanned loss of circuits and access line changes. Views of staff on acceptability and usability and experience of parents will be sought by questionnaire and a safety profile of the Nidus will be produced. Assessments include accurate fluid measurements, routine biochemical analyses and clinical observations. In a 24 month recruitment period, we plan to recruit 100 babies from 5 UK centres. For the study duration and for 1 year post study, Nidus will be loaned by the manufacturers Allmed Group and consumables cost is comparable to current therapies.

This study is designed to determine the clinical efficacy and feasibility of the novel infant haemodialysis machine, Nidus, compared to currently available therapy. Because Nidus is specifically designed for use in small babies (0.8 - 8kg), we predict using it may avoid many of the adverse effects associated with current therapy. Nidus offers the possibility of RRT for the smallest babies when peritoneal dialysis is not possible or is inadequate. Nidus is not simply a miniaturisation of existing machine systems but uses novel technology and an entirely different pump method which allows greater precision, a smaller circuit which avoids blood priming and smaller access lines.

The proposed study, driven by clinical need and with considerable input from parents, has been developed by collaboration between front line clinicians, scientists, academics and manufacturers. The proposed study demonstrates a collaborative and committed UK effort to determine whether Nidus offers a significant improvement over conventional RRTs for babies in PICU.

There is, however, sufficient evidence from the pilot study to anticipate Nidus has the potential to contribute significant benefits to the health of small babies needing RRT in the short and long term. Increasing success and breakthroughs in neonatal surgery including cardiac, will continue to produce a need for safe and effective post-operative management of fluid overload, acidosis and biochemical disturbance. The results will be applicable not just in the UK but worldwide and changes in clinical practice could take place rapidly. The study is due to start recruiting later in 2016, once the regulatory process of CE marking the Nidus device (currently underway) is complete. The I-Kid Study would not

have been possible to develop without the data provided by PICANet. Close collaboration with PICANet staff has been invaluable to all aspects of study design and will continue to be for the duration of the study

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THE SANDWICH TRIAL (SEDATION AND WEANING IN CHILDREN): WHAT IS IT ABOUT AND WHAT ARE THE POTENTIAL IMPLICATIONS FOR CARE IN THE PICU?

Background

Currently there is no UK consensus on weaning from invasive mechanical ventilation (IMV) in PICUs. Weaning from ventilation is a complex process involving a number of stages: recognition that the child is ready to begin the weaning process; steps to reduce ventilation while optimising sedation in order not to induce distress; and removing the endotracheal tube [1]. Delay at any stage can prolong the duration of IMV, therefore an intervention targeted at assisting clinicians to safely expedite this process will minimise the risks associated with IMV. The judgement and experience of clinicians is critical in guiding weaning from ventilation, however, as data from our feasibility study on paediatric usual practice show, there is wide variation both in sedation and ventilator weaning practices and junior staff are rarely involved in the process [2]. Various ICU studies have reported associations between rates of high inter-professional collaboration and patient mortality [3, 4]; and improved clinician-to-clinician communication with reductions in ICU length of stay [5]. A team-led approach that maximises engagement of all staff in early recognition of readiness and preparation for weaning ventilation could potentially reduce duration of IMV and PICU length of stay and relieve pressures for beds. As 67% of nurses employed in UK PICUs are Band 5 (junior) nurses, this would greatly maximise nursing contribution to the weaning process PICANet [6]. Our feasibility study findings yielded very few policies that specifically addressed sedation and weaning guidelines and staff interviews confirmed that a strategy for weaning sedation and ventilation was an important priority in most PICUs [2]. Staff also disclosed continuing uncertainty about readiness to wean, the benefits of an extubation readiness test and its potential impact on duration of IMV in the UK. Importantly the overwhelming majority of PICUs (83%) were willing to take part in a trial that tested an intervention to address these issues.

Aims

The SANDWICH trial will evaluate a coordinated approach using guidelines with greater involvement of nurses in weaning children from the ventilator. The trial will determine if this intervention:

(1) reduces duration of time spent on the ventilator;

(2) reduces length of stay in the PICU and the hospital;

(3) does not cause additional harm;

(4) is cost effective in the NHS;

(5) is acceptable to staff delivering care and can be sustained.

METHODS

The intervention will involve greater collaboration among doctors and nurses in coordinating patient-relevant sedation plans linked to regular assessment using the COMFORT sedation tool; regular daily assessment of ventilation parameters; and a spontaneous breathing trial when extubation readiness

criteria are met. This will be a multicentre stepped wedge trial cluster randomised trial conducted in at least 15 PICUs over a period of 20 months. The trial will begin in all PICUs at the same time when data will be collected while usual practice is conducted. The intervention will commence, following a training period, in one PICU each month with the order of commencement determined by computer randomisation. The stepped wedge design allows delivery of the intervention at an organisational level with evaluation of outcome measures at a patient level. One of the main strengths of the stepped wedge design is that we can offer the intervention to every PICU that takes part.

Alongside the trial, we will explore the process of delivering the intervention to answer the question 'does it work?' in a way that will help us distinguish between intervention failure and implementation failure. Additionally, this evaluation will deliver important evidence concerning the barriers and facilitators to adoption. This can not only help to explain trial outcomes, but also determine factors requiring attention if, post-trial, the intervention is to be further disseminated to other PICUs and sustained in practice.

Potential implications

This is an intervention that engages front line staff to maximise ward round opportunities to improve outcomes. It offers potential for greater engagement of the nursing workforce at all stages in the weaning process with a focus on optimal sedation to assist weaning and extubation. The trial has the capacity to generate new knowledge on the intervention, its cost - effectiveness and the implementation process. First, it will be large enough to provide reliable evidence for or against a combined ventilator/sedation weaning protocol allowing clear, strong recommendations to be made on the use of this potentially low cost intervention. Second, it will determine the main organisational and process factors considered important for ensuring the intervention is optimally implemented in PICUs.

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FEVER: A FEASIBILITY STUDY OF A FORMAL RANDOMISED TRIAL OF A MORE LIBERAL APPROACH TO FEVER IN CRITICALLY ILL CHILDREN WITH SUSPECTED INFECTION

Fever has survived billions of years of evolution as accelerant of the immune response. Even plants raise their temperature during an infection. All warm-blooded animals raise a 'central thermostat' (a hypothalamic set-point) in response to infection. The resultant fever is currently often viewed as an unwanted by-product of increased metabolic activity involved in fighting an infection. This, at least the pre-antibiotic era, was incorrect; fever itself increased the chance of clearing an infection. Thomas Sydenham called fever 'Nature's Engine; which she brings to the battlefield'.

The power of fever is illustrated by classic studies in the 1970's. Kluger and colleagues showed that the desert iguana (Dipsosaurus dorsalis) preferentially sits in the sun when infected; and if this environmental warming is not available, the iguanas die.

In humans understanding of the curative potential of fever has waxed and waned. In 1927 Julius Wagner-Juaregg won the Nobel Prize for curing neurosyphilis by inoculating patients with malaria to induce a fever. The advent of antibiotics (and his Nazi sympathies) mean that this insight was rapidly forgotten. Observational evidence support a benefit of fever in humans: antipyretics increase the length of virus shedding in chicken pox, rhinovirus and the parasite load in malaria. Despite this, and no evidence to support the treatment of fever, anti-pyretics are used routinely in children and adults.

What of critically ill patients? Fever requires an increase in metabolism (approximately 10-12% for each degree centigrade rise), causes an increase in heart rate, and may affect blood pressure. These physiological changes may be detrimental in critical illness. A large-scale observational study of over 600000 adults suggested that patients with a maximum temperature of 38.5-39.5^{o}C on the first day of admission had the lowest adjusted odds of death. In particular, this was evident in patients with infection. This finding prompted the HEAT trial: the largest randomised controlled trial of treatment of fever with paracetamol in ICU patients to date. The results showed no difference in ICU length of stay or mortality. However three important points need to be borne in mind when interpreting the trial results: (a) the trial protocol allowed paracetamol use after the initial resolution of fever: consequently a third of patients in both paracetamol and placebo arms received paracetamol, (b) prospective consent was mostly required, which meant that on average patients were enrolled 32 hours after admission to ICU, and (c) there was a no significant difference in temperature in the paracetamol and placebo arms (there was mean drop in temperature was 0.29^{o}C with paracetamol and 0.28^{o}C with placebo).

What about children in PICU? In 2012 a Paediatric Intensive Care Society Study Group (PICS-SG) prioritisation exercise identified the need to answer the question 'Should fever be treated on PICU?' A survey of 462 members of PICS suggested there was equipoise to conduct this trial in UK PICUs. There is no consensus threshold for the treatment of fever. This has led to the design and planning of a trial from PICS-SG with PICANet as essential co-investigators. The National Institute of Heath Research Health Technology Assessment has recently confirmed support for FEVER: a feasibility study of a

formal randomised trial of a more liberal approach to fever (compared to our current aggressive approach to fever control) in critical-ill children with suspected infection.

FEVER consists of

(a) Qualitative work with parents and guardians and healthcare workers to assess the acceptability of the trial design and the proposed interventions

(b) Observational work to better understand the current treatment and impact of fever treatment, and

(c) A 125 patient multiple centre pilot trial to assess trial design, inform on suitable outcomes, power calculations and clinician acceptability.

This now sets us on the exciting journey towards a definitive answer to the question 'Should we treat children with fever in PICU?'

Gratifyingly, this study is only one of a number of peer-reviewed and funded ambitious interventional studies led by members of PICS-SG. These include: Fluids in Shock (FiSh), Sedation and Weaning in Children (SANDWiCh), a novel infant dialysis system (I-KID) and Oxygenation Targets in ventilated children (Oxy-PICU). Much of this recent success arises from PICANet's contribution by providing high quality baseline data demonstrating both need and feasibility. This dawning era of generating evidence puts the UK in the forefront of research in PIC worldwide. We look forward to the data….

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GLOSSARY

A		
	APP	Advanced Practice Practitioner
	AR	Annual Report
B		
	BSI	Blood Stream Infection
C		
	CAG	Clinical Advisory Group
	Cardiovascular	Relating to, or involving the heart and the blood vessels
	Cardiac Arrest	A cardiac arrest happens when your heart stops pumping blood around the body due to failure of the heart to contract effectively. If you have a cardiac arrest, you lose consciousness almost at once. A cardiac arrest is different from a heart attack, where blood flow to the muscle of the heart is impaired
	Case Mix	The term case mix refers to the type or mix of patients treated by a hospital
	Clinical Trial	Clinical trials are research studies that compare different treatments and treatment strategies
	CTS	Centralised Transport Service
D		
	Data Validation	The process of ensuring the quality and reliability of data for a study or audit by checking against dataset rules and definitions
	Dataset	A set of standardised data fields collected for an audit or trial, allowing comparisons between sites to be made
	DGH	District General Hospital
	DH	Department of Health
E		
	EMR	Electronic Medical Record
	Event	A single instance of paediatric intensive care (PIC) activity, such as a referral, transport or admission
F		
	Funnel plots	Scatterplots of an outcome ratio (observed outcome divided by predicted outcome) against the number of eligible individuals. Used when observations for different critical care units/hospitals are based on varying sample sizes
H		
	Health Organisation	Any unit or transport service involved in the provision of paediatric intensive care

	HFNCT	High Flow Nasal Cannula Therapy
	HQIP	Healthcare Quality Improvement Partnership
	HRG	Healthcare Resource Group
	HSCIC	Health & Social Care Information Centre
	Hyperglycaemia	The presence of an abnormally high concentration of glucose in the blood
I		
	ICNARC	Intensive Care National Audit & Research Centre
	IV	Invasive ventilation
L		
	LOS	Length of stay
M		
	Mean	The 'average' value (obtained by summing all values and dividing by the number of values)
	Median	The middle number in a given sequence of numbers
	Mortality	Death rate
	Musculoskeletal	Relating to or involving the muscles and the skeleton
N		
	NHS	National Health Service
	NIHR	National Institute for Health Research
	NOCA	National Office of Clinical Audit Ireland
O		
	Outcome	Outcomes are measures of health, e.g. response to treatment, occurrence or recurrence of disease, a measure of well-being
P		
	Patient identifiable data	Patient identifiable data, such as NHS Number, are confidential.
	PbR	Payment by Results
	PCCMDS	Paediatric Critical Care Minimum Data Set
	PICANet	Paediatric Intensive Care Audit Network
	PICS	Paediatric Intensive Care Society
	PICU	Paediatric Intensive Care Unit
	PIM	Paediatric Index of Mortality
	Poisson distribution	Probability distribution that characterises discrete events occurring independently of one another in time
	Principal Investigator	The lead person at a single site designated as taking responsibility within the research team for the conduct of the study

R		
	RCT	Randomised Controlled Trial
	Respiratory	Of, relating to, used in, or affecting respiration
S		
	Sepsis	The poisoned condition resulting from the presence of pathogens or their toxins
	SG	Steering Group
	SMR	Standardised Mortality Ratio
	Status Epilepticus	A condition in which repeated epileptic seizures occur without the patient gaining consciousness between them
T		
	TBI	Traumatic Brain Injury
W		
	WTE	Whole Time Equivalent

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PICS Paediatric Intensive Care Society