

Paediatric Intensive Care Audit Network State of the Nation Report 2022



Summary Report

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January 2019 – December 2021

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Online resources

We have a range of resources to accompany this report online.

The [Infographic](#) highlights some of the report's key findings in relation to paediatric critical care activity between 2019 and 2021.

A set of tables and figures document transport, referrals and admissions activity within paediatric critical care between 2019 and 2021.

The [Appendices](#) contain acknowledgements to the paediatric critical care community, background information and methodology about the audit.

New for 2022, we have introduced a dedicated [Quality Improvement webpage](#) with resources for participating organisations.

Introduction

This is the nineteenth PICANet annual clinical audit report describing paediatric critical care activity which occurred within paediatric intensive care units in the United Kingdom (UK) and Republic of Ireland (ROI) between 2019 and 2021. This year we present the first PICANet 'State of the Nation' Report, cataloguing comprehensive information on referral, transport and admission events to monitor the delivery and quality of care in relation to agreed standards and evaluate clinical outcomes to inform national policy in paediatric critical care.

We report on five key metrics relevant to Paediatric Intensive Care services: case ascertainment including timeliness of data submission, retrieval mobilisation times, emergency readmissions within 48 hours of discharge, unplanned extubation in PICU and mortality in PICU. Unplanned extubation in PICU is introduced as a new metric this year.

We also plan more regular and focused outputs, moving towards quarterly updates of the 'PICANet Metrics online' from quarter four 2023 onwards as well as enhancements to the PICANet web platform in the form of online dashboards.

The PICANet National Paediatric Critical Care Audit is commissioned by the Healthcare Quality Improvement Partnership (HQIP) as part of the National Clinical Audit and Patient Outcomes Programme (NCAPOP), the Welsh Health Specialised Services, NHS Lothian/NHS Greater Glasgow and Clyde, the Royal Belfast Hospital for Sick Children, The National Office of Clinical Audit (NOCA) for the Republic of Ireland and HCA Healthcare UK.

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Key messages

- The number of admissions to paediatric intensive care across the UK and Republic of Ireland (ROI) increased by 11% from 16,540 in 2020 (following the start of the COVID-19 pandemic) to 18,320 in 2021. This increase was reflected across all countries of the UK and ROI, although remained 10% below pre-pandemic levels in 2019.
- The rise in admissions in 2021 was also reflected by a similar increase in the number of bed days delivered across the UK and ROI, which increased by 10% in 2021 compared to 2020 (from 63,271 to 69,570 bed days).
- Two-thirds of admissions to PICUs occurred in those aged under 5 years, with just over two in five admissions aged under 1 year. These proportions remained similar between 2019 and 2021.
- The proportion of admissions which were of 'Asian', 'Black' or 'Other' ethnic minority origin increased from 17% to 25% between 2019 and 2021 with the proportion classified as 'White' also increasing from 62% to 63% over this period.
- Completeness of known data on ethnic group improved from 82% in 2019 to 88% in 2021.
- Children from the most deprived areas were over-represented in admissions to PICU: 30% of all children from England and Wales came from the most deprived group of the population when split into five equal groups. However, only 14% of admissions came from the least deprived group. This pattern remained the same between 2019 and 2021.

- The proportion of admissions where children died in PICUs remained low, with 96.6% of admissions discharged alive in 2021. There was a fall in mortality from 3.6% of admissions in 2020 to 3.3% in 2021. The proportion of all deaths within PICU remained steady at around 15% in 2021, although this increased from 24% in 2020 to 27% in 2021 for PICU admissions in the ROI.
- Units across the UK and ROI provided complete and timely admissions data to PICANet within three months of discharge for 88% of all admissions in 2021. Twenty-four units achieved completeness within three months for at least 90% of their admissions in 2021, a slight increase from twenty-two units in 2020. Five units completed fewer than 60% of their admission records within this timescale compared to four units in 2020.
- The number of children requiring urgent transport to a PICU in 2021 increased from 3,073 in 2020 to 4,324 in 2021, a similar number to 2019 (n=4,262). Of those journeys carried out in 2021, 65% were started within 30 minutes vs 64% in 2020 and 58% in 2019, whilst over 80% started within one hour of the clinical decision being made. Just over 4% of journeys in 2021 started more than three hours after the decision compared to 3% in 2020 and 6% in 2019.
- The proportion of emergency readmissions within 48 hours of discharge for the UK and ROI combined remained stable throughout 2019-2021 at around 1.6%. Rates varied by country in 2021, from 1.4% in Wales to 2.1% in Scotland.
- Reported rates of unplanned extubations for the UK and ROI combined fell from 4.6 per 1,000 days in 2019 to 4.2 in 2021. There was some variation in these figures with Northern Ireland reporting lower rates (2.4 per 1,000 days) and Scotland reporting higher rates (5.4 per 1,000 days).
- There were no units identified as statistical outliers with higher than predicted mortality rates between 2019 and 2021. However, two units were identified as positive outliers for mortality, with substantially lower numbers of deaths than would be predicted.

National Recommendations

1. Ensure PICANet data submissions are completed within the PCCS Quality Standard; as soon as possible or within two months of discharge from PICU.
Action: PCC Providers, PCC Operational Delivery Networks, Paediatric Critical Care Society, Specialised Commissioning NHSE
2. Maintain high levels of recording of ethnicity, ensuring appropriate resource, for admissions to all PICUs and work towards a UK wide standardised recording of ethnicity, to enable PICANet to investigate health inequalities.
Action: PCC Providers, NHS England, national data handlers in the other participating countries that support the improvement of data collection
3. Investigate the reasons for the disproportionate numbers of admissions from the most deprived areas of the country.
Action: Integrated Care Boards, Department of Health and Social Care, Department for Levelling Up, Housing and Communities, ROI equivalent government departments
4. Develop a standard for comparing and evaluating rates of unplanned extubation.
Action: Specialised Commissioning NHSE, Paediatric Critical Care Society, clinical community

5. Review the barriers and facilitators of timely mobilisation of centralised transport teams to provide appropriate transport services for critically ill children.

Action: PCC Operational Delivery Networks, Paediatric Critical Care Society Acute Transport Group, clinical community

Improvement resources

PICANet provide a variety of improvement resources for participating organisations. The dedicated Quality Improvement page on our website (<https://www.picanet.org.uk/>) signposts to these and the page is updated regularly. Some of the key quality improvement (QI) resources are:

Risk-adjusted resetting sequential probability ratio test (RSPRT) plots

PICANet conduct an annual formal outlier analysis for in PICU mortality and the outcome of this is included in the 'mortality in PICU' key metric section of our annual reports. We also continue to provide real-time 'RSPRT' plots to enable PICUs to monitor their mortality outcomes on a much more timely and regular basis. To support this, [RSPRT Guidance for Units](#) is available to assist PICUs in identifying and responding to potential issues with quality of care in a time-sensitive fashion. The guidance includes a case study from a PICU team that responded to a RSPRT reset which was a cause for concern requiring internal review. Further to the case study in the guidance, the [PICANet Annual Meeting 2022 discussion session, PICANet RSPRT in PICU](#), is available on our website. This features two PICU clinicians talking about their experience of using RSPRT plots to monitor mortality in their units.

Ethnicity data collection resources

Guidance and resources for asking about ethnicity, collecting and recording it are available from [Ethnicity - NHS Digital](#), which signposts to [Improving ethnicity data collection for health statistics in the UK](#) (IQBAL, Gulnaz, GUMBER, Anil, JOHNSON, Mark R.D, SZCZEPURA, Ala, WILSON, Sue and DUNN, Janet A (2009). Improving ethnicity data collection for health statistics in the UK. Diversity and Equality in Health and Care, 6 (4), 267-285).

Tables and figures

Tables and figures are provided with each annual State of the Nation Report. These are provided here <https://www.picanet.org.uk/annual-reporting-and-publications/> in an accessible Excel Workbook format and enable participating organisations to assess and monitor their performance against other PICUs or centralised transport services to inform local and regional quality improvement initiatives. They document the following activity and outcomes within paediatric critical care for the reporting period.

- Admissions to PICU
- Retrieval and transfer information collected from the PICU admission data
- Interventions received by children admitted to PICU
- Bed activity (bed days) and length of stay in PICU
- Outcomes of children admitted to PICU and Standardised mortality ratios (SMRs)
- Number of children admitted by diagnostic group
- Prevalence of admission to PICU
- Daily activity data, known as the Paediatric Critical Care Minimum Dataset (PCCMDS)
- Data quality
- Referral information for both transport to PICU and PICU admission
- Information on transports to PICU

Admissions to Paediatric Intensive Care Units

Table 1a: Admissions to PICU across UK & Republic of Ireland by socio-demographic characteristics and year of admission

		2019		2020		2021		2019-2021	
		n	%	n	%	n	%	n	%
Sex	Male	11,571	56.7	9,405	56.9	10,301	56.3	31,277	56.6
	Female	8,829	43.3	7,122	43.1	8,005	43.7	23,956	43.4
	Total	20,400	36.9	16,527	29.9	18,306	33.1	55,234	
Age group (years)	<1	8,652	42.4	7,026	42.5	7,463	40.8	23,141	41.9
	1-4	5,405	26.5	3,977	24.1	4,625	25.3	14,007	25.4
	5-10	3,346	16.4	2,747	16.6	3,014	16.5	9,107	16.5
	11-15	2,997	14.7	2,777	16.8	3,205	17.5	8,979	16.3
	Total	20,400	36.9	16,527	29.9	18,307	33.1	55,234	
Ethnicity	White	12,654	62.0	10,308	62.4	11,565	63.2	34,527	62.5
	Mixed/Multiple ethnic groups	597	2.9	558	3.4	668	3.6	1,823	3.3
	Asian/Asian British	2,141	10.5	1,865	11.3	2,167	11.8	6,173	11.2
	Black/African/Caribbean/Black British	834	4.1	858	5.2	1,019	5.6	2,711	4.9
	Other	488	2.4	565	3.4	736	4.0	1,789	3.2
	Unknown	1,082	5.3	605	3.7	474	2.6	2,161	3.9
	Not stated	2,604	12.8	1,768	10.7	1,678	9.2	6,050	11.0
Total	20,400	36.9	16,527	29.9	18,307	33.1	55,234		
Deprivation	1 (Most deprived areas)	4,630	30.3	3,798	30.4	4,104	30.2	12,532	30.3
	2	3,522	23.0	2,898	23.2	3,024	22.2	9,444	22.8
	3	2,726	17.8	2,303	18.4	2,533	18.6	7,562	18.3
	4	2,286	15.0	1,800	14.4	1,993	14.6	6,079	14.7
	5 (Least deprived areas)	2,117	13.9	1,710	13.7	1,955	14.4	5,782	14.0
	Total	15,281	36.9	12,509	30.2	13,609	32.9	41,399	
Country	England (NHS)	15,904	78.0	13,025	78.8	14,260	77.9	43,189	78.2
	England (Non-NHS)	304	1.5	231	1.4	240	1.3	775	1.4
	Wales	489	2.4	363	2.2	372	2.0	1,224	2.2
	Scotland	1,697	8.3	1,178	7.1	1,375	7.5	4,250	7.7
	Northern Ireland	492	2.4	353	2.1	443	2.4	1,288	2.3
	Republic of Ireland	1,514	7.4	1,377	8.3	1,617	8.8	4,508	8.2
	Total	20,400	36.9	16,527	29.9	18,307	33.1	55,234	

Children recorded as ambiguous sex are excluded from yearly totals within the sex category.

Percentages are calculated within category by column, except for totals which are calculated across rows.

Deprivation is calculated for residents of England and Wales admitted to PICU in those nations. Deprivation score is based on the location of residence of the child using the Children in low income measure (HMRC, 2014). Categories are equivalised to contain equal populations. Where an address was unknown or score unavailable, the admission was excluded.

Ethnicity categories are defined using Office for National Statistics definitions (Ethnic group, national identity and religion).

'Country' refers to country of admission rather than residence of the child.

Table 1a shows the number of admissions recorded in paediatric intensive care units (PICUs) across the UK and Republic of Ireland (ROI) according to socio-demographic factors by year of admission. Admissions to PICUs increased by 11% in 2021 compared to 2020, following the reduction in admission numbers resulting from the COVID-19 pandemic. The rise in admissions in 2021 was mirrored across all UK nations and ROI. However, overall admission numbers in 2021 remained lower than those recorded in 2019 before the COVID-19 pandemic, with a breakdown provided according to diagnostic group summarised in Table 2. The proportion of admissions for PIC was higher for males (57%) than females (43%). Around 40% of all admissions were for children aged under 1 year with two-thirds of the total for those under 5 years of age. These proportions have remained constant over the reporting period. The proportion of all admissions aged 11-15 years increased from 15% in 2019 to 18% in 2021. There was a disproportionate number of admissions from the most deprived areas of England and Wales: 30% of admissions were from the most deprived fifth of the population whereas only 14% of admissions came from the least deprived fifth of the population. Although completeness of known ethnic group recorded on PICANet improved throughout the three-year reporting period from 82% in 2019 to 88% in 2021, there is still work to be done by PICUs to ensure that ethnicity data is provided for all admissions. There was an increase in the proportion of admissions recorded as 'Asian', 'Black' or 'Other' over time, from 17% in 2019 to 25% in 2021. However, changes in proportions of different ethnic groups of children admitted to PICU may be accounted for by the improved completeness of ethnic group.

Table 1b shows that 69% of admissions to English units were of 'White' ethnic group compared to 78% in the overall childhood population (ages 0-15 years).

Table 1b: Admission rate per 10,000 population by ethnicity (England only)

England	Avg annual admissions		Child population 2020		Admissions/ 10,000 pop
	n	%	n	%	
White	8,454	69.0	8,475,599	78.1	10.0
Mixed/Multiple ethnic groups	531	4.3	586,021	5.4	9.1
Asian/Asian British	1,909	15.6	1,106,928	10.2	17.2
Black/African/Caribbean/Black British	835	6.8	542,612	5.0	15.4
Other	516	4.2	141,079	1.3	36.6
Total	12,245		10,852,239		11.3

Admissions are for an average year in the 3 year reporting period, and exclude admissions that had ethnicity recorded as 'unknown' or 'not stated'.

Population is based upon 2020 mid-year population estimates (ONS, 2021). Population within each ethnic group is calculated using data from the 2011 census (table LC2109EWIs).

Table 2: Admissions by primary diagnostic group and year

Primary Diagnosis	2019	2020	2021	Total
Respiratory	6,176	3,575	4,891	14,642
Cardiovascular	5,278	4,858	4,739	14,875
Neurological	2,401	1,906	2,101	6,408
Gastrointestinal	1,214	1,190	1,140	3,544
Infection	1,042	803	817	2,662
Musculoskeletal	928	715	778	2,421
Oncology	807	784	775	2,366
Endocrine / metabolic	677	808	1,035	2,520
Other	1,871	1,883	2,016	5,770
Unknown	6	5	15	26
Total	20,400	16,527	18,307	55,234

Although the general pattern of an increase in admissions in 2021 following the pandemic of 2020 is reflected in most of the diagnosis groups, there was a consistent increase in admissions with endocrine / metabolic diagnoses. In 2021 following the pandemic, numbers of admissions for infection and oncology have remained in a steady state since 2020.

Mortality within PICUs

Table 3: Proportion of deaths in PICU of all PICU admissions, by country and year of admission

Country of admission	2019		2020		2021		2019-2021	
	%	n	%	n	%	n	%	n
England	3.5	576	3.7	491	3.4	494	3.6	1,561
Wales	2.0	10	3.3	12	4.0	15	3.0	37
Scotland	1.9	33	2.3	27	1.7	23	2.0	83
Northern Ireland	2.2	11	2.0	7	2.5	11	2.3	29
Republic of Ireland	4.0	60	3.9	54	4.0	65	4.0	179
Total	3.4	690	3.6	591	3.3	608	3.4	1,889

Table 4: Proportion of deaths in PICUs of all children's deaths in the population: UK and Republic of Ireland, 2019–2021

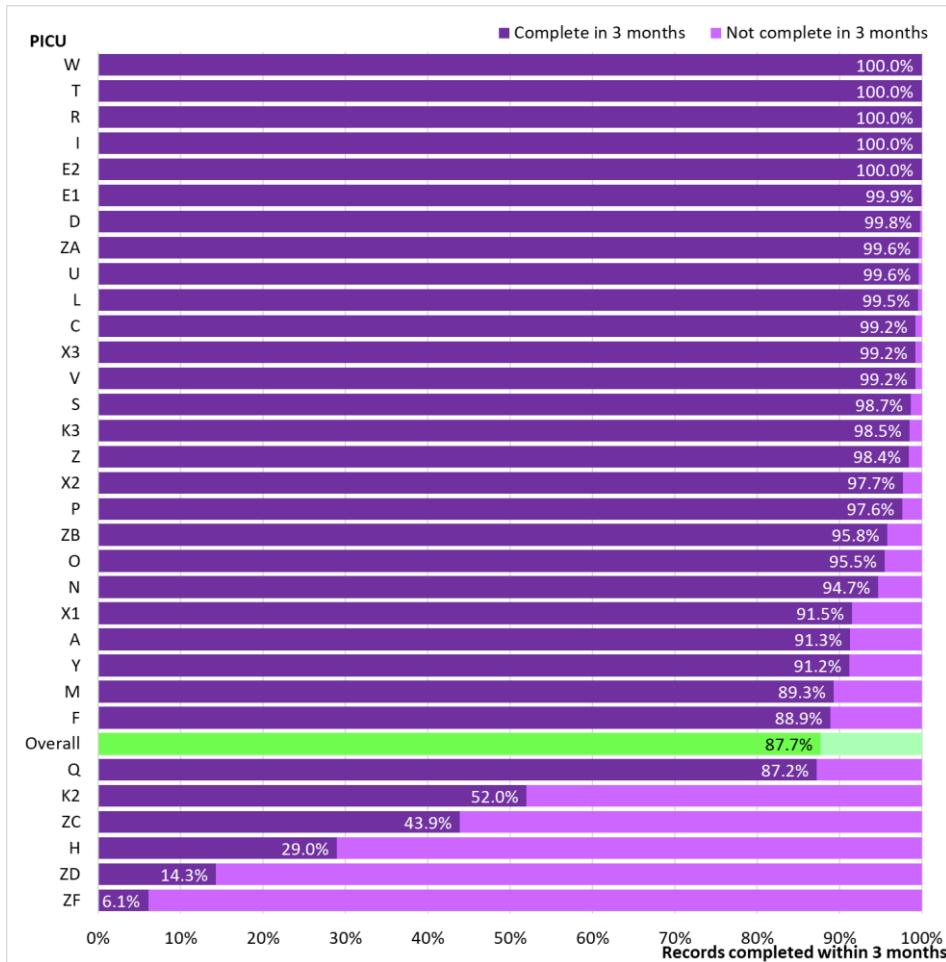
Country of admission	2019		2020		2021		2019-2021	
	%	n	%	n	%	n	%	n
UK	15.9	630	14.7	537	14.2	543	15.0	1,710
Republic Of Ireland	24.2	60	23.8	54	27.5	65	25.2	179
UK and Republic of Ireland	16.4	690	15.2	591	15.0	608	15.5	1,889

Numbers of children who die when admitted to a PICU remain extremely low, with almost 97 in every 100 admissions surviving and being discharged alive (Table 3). The proportion of admissions which resulted in death whilst being treated in paediatric intensive care decreased from 3.6% in 2020 to 3.3% in 2021. Around 15% of all childhood deaths in the UK occurred within a PICU although this figure was higher in the ROI (25%) and increased from 24% in 2019-2020 to 27% in 2021 (Table 4).

Key metrics

Metric 1: Case ascertainment and timeliness of data submission

Figure 1: Proportion of admission records completed within 3 months of discharge by PICU, 2021



88% of admissions were completed within three months of discharge in 2021 (Figure 1). This was similar in 2020 (89%) and 2019 (88%). Twenty-four units achieved completeness within three months for at least 90% of their admissions in 2021, compared to twenty-two units in 2020. Five units had a much lower level of data completion in 2021, all of which were below 60%, an increase from four units in 2020.

[Organisation key](#)

Metric 2: Retrieval mobilisation times

Figure 2: Number of non-elective transports to PICU by time to mobilisation: UK and Republic Of Ireland 2019-2021

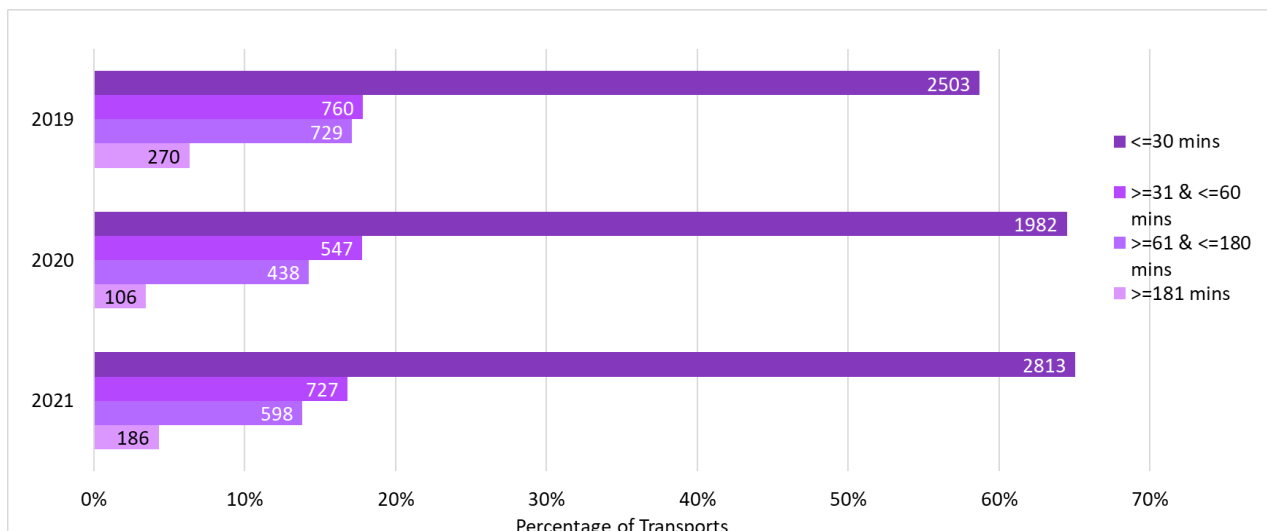


Figure 2 shows that there was an increase of just over 40% in the number of children who needed an urgent transportation to a PICU in 2021 (n=4,324) compared to 2020 (n=3,073) and similar to 2019 (n=4,262) prior to the COVID-19 pandemic. 65% of journeys in 2021 began within 30 minutes of being requested, a small increase from 2020 (64%) and 2019 (58%). 80% of journeys in 2021 were started within one hour of the clinical decision being made, compared to 82% and 76% in 2020 and 2019, respectively. Just over 4% of journeys in 2021 started more than three hours after the decision compared to 3% in 2020 and 6% in 2019.

Metric 3: Emergency readmissions within 48 hours

Table 5: Emergency readmission within 48 hours of discharge by country of admission, 2019–2021

Country of admission	2019		2020		2021		2019-2021	
	n	%	n	%	n	%	n	%
England	257	1.6	223	1.7	228	1.6	708	1.6
Wales	9	1.8	4	1.1	4	1.1	17	1.4
Scotland	32	1.9	25	2.1	33	2.4	90	2.1
Northern Ireland	8	1.6	4	1.1	7	1.6	19	1.5
Republic of Ireland	26	1.7	24	1.7	28	1.7	78	1.7
Total	332	1.6	280	1.7	300	1.6	912	1.7

Figure 3: Relative rate of emergency readmission within 48 hours of discharge by PICU, 2019–2021



[Organisation key](#)

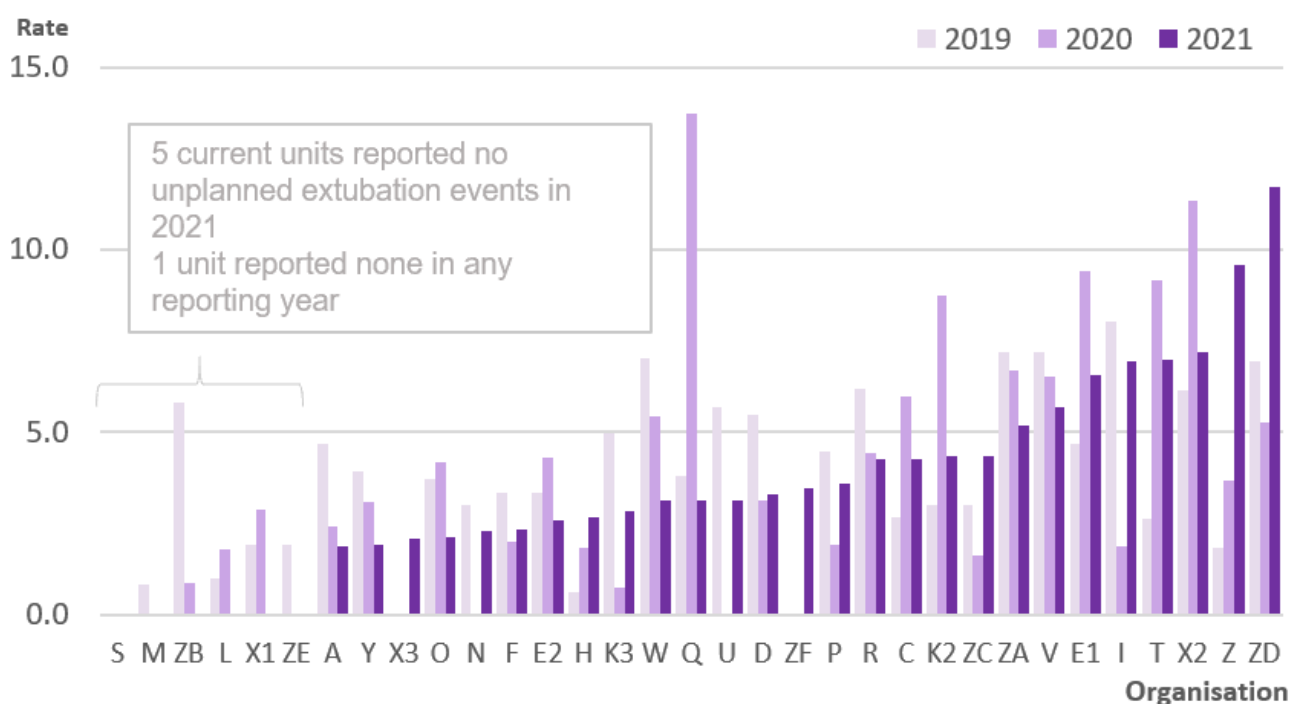
The percentage of emergency readmissions within 48 hours of discharge remained unchanged in 2021 across the UK and ROI combined compared to the two preceding years, at 1.6% (Table 5). However, this masked some variation at the country level with slightly higher emergency readmission rates occurring in Scotland (2.1%) and lower rates seen in Wales (1.4%). There were also noticeable differences in emergency readmission rates by unit with this varying between 0.2 to 1.6 times the overall UK and ROI rate (Figure 3).

Metric 4: Unplanned extubation in PICU

Table 6: Unplanned extubation rates per 1,000 days of invasive ventilation by country and year, 2019–2021

Country of admission	2019		2020		2021		2019-2021	
	n	rate	n	rate	n	rate	n	rate
England	249	4.6	182	4.5	197	4.1	628	4.4
Wales	3	2.7	4	6.0	3	4.4	10	4.0
Scotland	25	6.0	16	5.7	15	4.4	56	5.4
Northern Ireland	8	5.8	< 3	< 2.7	0	0.0	9	2.4
Republic of Ireland	23	4.0	12	2.5	30	6.0	65	4.2
Total	308	4.6	215	4.3	245	4.2	768	4.4

Figure 4: Unplanned extubation rates per 1,000 days of invasive ventilation by health organisation, all admissions, 2019-2021

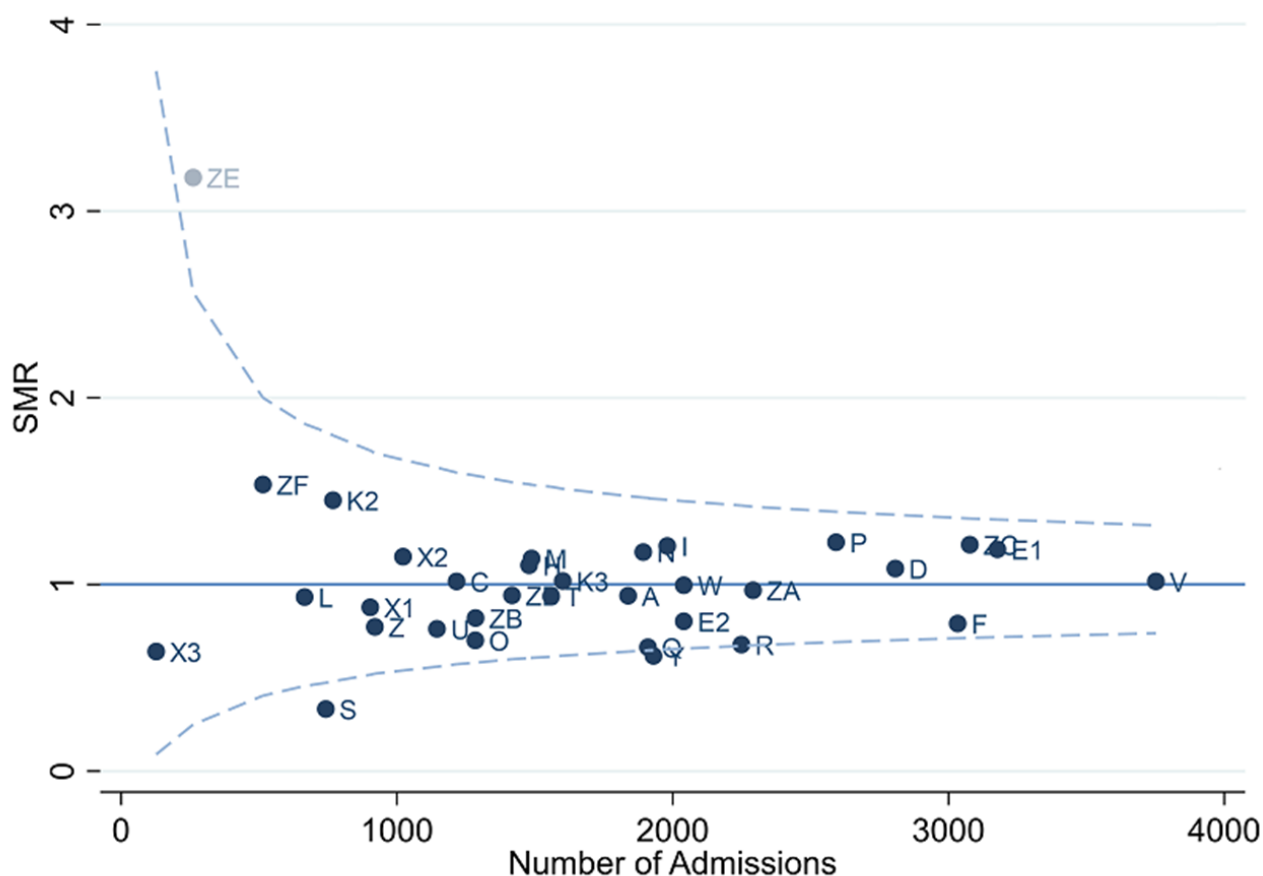


[Organisation key](#)

There was a decline in the overall reported rates of unplanned extubations across the UK and ROI from 4.6 per 1,000 days in 2019 to 4.2 per 1,000 days in 2021 (Table 6). Higher rates of unplanned extubations were reported in Scotland (5.4 per 1,000 days) and lower rates in Northern Ireland (2.4 per 1,000 days). Five units reported no unplanned extubation events in 2021 compared to two units with a null return in 2020 (Figure 4). Thirteen PICUs demonstrated a decrease in their unplanned extubation rate in 2021 compared to 2020, with 10 units reporting an increase in their rate (Figure 4).

Metric 5: Mortality in PICU

Figure 5: Risk-adjusted Standardised Mortality Ratio (SMR) by health organisation for under 16 year olds, 2019–2021



[Organisation key](#)

ZE (Harley Street) will not be flagged as an outlier as the unit closed in 2020 and an investigation previously took place
Unit X3 (Leicester CICU) was opened in 2021 and therefore has a low number of admissions

There was no evidence that any PICU had an excess mortality rate compared to what would be expected based on the level of sickness at the time of admission across the three-year reporting period. This is illustrated in Figure 5 based on inclusion of all SMR estimates being contained within the control chart limits. Two units (Royal Hospital for Children and Young People PICU, Edinburgh and The James Cook University Hospital PCCU, Middlesbrough) had lower mortality rates than would be expected and were therefore classified as positive outliers.

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Organisation key

A	Addenbrooke's Hospital, Cambridge
C	Noah's Ark Children's Hospital for Wales, Cardiff
D	Royal Manchester Children's Hospital
E1	Great Ormond Street Hospital, London (PICU/NICU)
E2	Great Ormond Street Hospital, London (CICU)
F	Evelina London Children's Hospital
H	King's College Hospital, London
I	Leeds General Infirmary
K2	Freeman Hospital, Newcastle upon Tyne
K3	Great North Children's Hospital, Newcastle upon Tyne
L	Royal Stoke University Hospital
M	Nottingham Children's Hospital, Queens Medical Centre, Nottingham
N	John Radcliffe Hospital, Oxford
O	Royal Brompton Hospital, London
P	Alder Hey Children's Hospital, Liverpool
Q	Sheffield Children's Hospital
R	Southampton Children's Hospital
S	James Cook University Hospital, Middlesbrough
T	St George's Hospital, London
U	St Mary's Hospital, London
V	Birmingham Children's Hospital
W	Bristol Royal Hospital for Children
X1	Glenfield Hospital, Leicester
X2	Leicester Royal Infirmary
X3	Leicester Royal Infirmary CICU
Y	Royal Hospital for Children and Young People, Edinburgh
Z	The Royal London Hospital
ZA	Royal Hospital for Children, Glasgow
ZB	Royal Belfast Hospital for Sick Children
ZC	Children's Health, Ireland, Crumlin formerly Our Lady's Children's Hospital, Crumlin, Dublin
ZD	Children's Health, Ireland, Temple Street, formerly Temple Street Children's University Hospital, Dublin
ZE	Harley Street Clinic, London
ZF	The Portland Hospital, London
T001	Children's Acute Transport Service (CATS)
T002	Embrace: Yorkshire & Humber Infant & Children's Transport Service
T003	North West and North Wales Paediatric Transport Service (NWTS)
T004	South Thames Retrieval Service (STRS)
T005	KIDS Intensive Care and Decision Support
T008	Southampton Oxford Retrieval Team (SORT)
T010	Northern Ireland Specialist Transport and Retrieval (NISTAR) Paediatric
T020	Scotland Specialist Transport and Retrieval (ScotSTAR)
T022	Irish Paediatric Acute Transport Service (IPATS)
T024	Wales and West Acute Transport for Children (WATCh)
T026	North East Children's Transport and Retrieval Service (NECTAR)
T027	Children's Medical Emergency Transport Service (CoMET)
T028	<i>Heart Link ECMO Children's Service (Inc. in Tables & Figures only)</i>
T032	Paediatric and Neonatal Decision Support and Retrieval Service (PaNDR)