

Irish Paediatric Critical Care Audit National Report 2020: including a special chapter on COVID-19 and Paediatric Inflammatory Multisystem Syndrome (PIMS-TS) 2020–2022

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IRISH PAEDIATRIC CRITICAL CARE AUDIT

NATIONAL REPORT 2020

*Including a special chapter on COVID-19 and Paediatric
Inflammatory Multisystem Syndrome (PIMS-TS) 2020–2022*



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NATIONAL OFFICE OF CLINICAL AUDIT (NOCA)

The National Office of Clinical Audit (NOCA) was established in 2012 to create sustainable clinical audit programmes at national level. NOCA is funded by the Health Service Executive Office of the Chief Clinical Officer and operationally supported by the Royal College of Surgeons in Ireland. The National Clinical Effectiveness Committee (NCEC) defines national clinical audit as "a cyclical process that aims to improve patient care and outcomes by systematic, structured review and evaluation of clinical care against explicit clinical standards on a national basis" (NCEC, 2015, p. 2). NOCA supports hospitals to learn from their audit cycles.

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We would also like to thank Professor Liz Draper, Co-Principal Investigator, Hannah Lever, Senior Project Manager, and Christopher Leahy, Senior Research Statistician, from the Paediatric Intensive Care Audit Network (PICANet). NOCA works with PICANet in the United Kingdom for data validation, data analysis, and the generation of reports on activity in paediatric intensive care units.



Irish Paediatric Critical Care Audit

National Report 2020

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25th November, 2022

Dear Dr Healy,

I wish to acknowledge receipt of the *Irish Paediatric Critical Care Audit National Report 2020*.

Following your presentation to the NOCA Governance Board on the 24th November 2022 and feedback garnered from our membership, we are delighted to endorse this report.

I wish to congratulate you, Audit Manager Karina Hamilton and your governance committee in the development of this report which is a valuable quality improvement initiative.

In future reports, the Board looks forward to seeing further progress on the audit recommendation for further expansion of the Irish Paediatric Transport Service.

Please accept this as formal endorsement from the NOCA Governance Board of the *Irish Paediatric Critical Care Audit National Report 2020* and we wish you every success in your ongoing commitment to improving the care of paediatric critical care patients.

Yours sincerely,



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PREFACE

This publication is the second Paediatric Critical Care Unit (PCCU) national report produced under the governance of the National Office of Clinical Audit (NOCA). It has come about as a result of a collaborative effort across both sites providing paediatric critical care in Children's Health Ireland (CHI) at Crumlin and CHI at Temple Street. It entails the collection of detailed Paediatric Intensive Care Audit Network (PICANet) datasets by dedicated audit nurses and data managers.



The report presents data from 2020, while aggregate data from 2018 to 2020 have been included to allow for trend analysis and comparison. These specific, validated benchmarked data allow for quality assurance of paediatric critical care services in the Republic of Ireland.

As our PCCUs care for complex, critically ill children, a key recommendation in this report recommends additional detailed data collection, including subspecialty classification of rare diagnoses, and advocates for the establishment of a national PCCU database to collect and validate additional data not currently captured by PICANet. We differ from most units in the United Kingdom, in the Republic of Ireland we look after complex neonates requiring congenital cardiac and general surgery; hence, sub-analysis of this group would be useful from a staffing and planning perspective. This would allow comprehensive audit and analysis of validated data from both Units. In order to achieve both collection and further validation of additional data, we require additional funded data managers and audit coordinators. Our aim is to build a useful tool to describe our acute, complex patient population for detailed workforce planning and service development.

The team involved in collecting data and writing this report are as follows:

CHI at Crumlin: Erika Brereton, Mong Hoi Tan, Malena McLoone, Luiza Dsouza and Andrea Joan Sequeira
CHI at Temple Street: Dr Aisling Walsh and Marie Lawlor

I would like to thank them and the NOCA Irish Paediatric Critical Care Audit team who collaborated and produced this report with us. I look forward to the production of a more detailed in-depth report in the coming years.

Associate Professor Martina Healy

Clinical Lead Irish Paediatric Critical Care Audit, NOCA

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GLOSSARY OF TERMS AND DEFINITIONS

NAME	DEFINITION
bed days	This is calculated as the sum of children receiving intensive care in a Paediatric Critical Care Unit (PCCU) each day and is counted if a child is in a bed for any part of the day.
bed occupancy	This is expressed as the percentage of bed days used out of total bed days available each year.
CDH	congenital diaphragmatic hernia
CHI	Children's Health Ireland
CIDR	Computerised Infectious Disease Reporting
CIS	clinical information system
COVID-19	coronavirus disease: an infectious disease caused by the SARS-CoV-2 virus
CVVH	continuous venovenous haemodialysis
ECLS	extracorporeal life support
ECMO	extracorporeal membrane oxygenation
ECPR	extracorporeal cardiopulmonary resuscitation
ELSO	Extracorporeal Life Support Organisation
GDPR	General Data Protection Regulation
HIPE	Hospital In-Patient Enquiry
HPSC	Health Protection Surveillance Centre
HRG	Healthcare Resource Group
HSE	Health Service Executive
ICU	Intensive Care Unit
ICNARC	Intensive Care National Audit and Research Centre
ICP	Intracranial pressure
INICUA	Irish National Intensive Care Unit Audit
IPATS	Irish Paediatric Acute Transport Service
IPCCA	Irish Paediatric Critical Care Audit
IQR	interquartile range
LOS	Length of stay
NHDU	Neonatal High Dependency Unit
NHS	National Health Service
NI	Northern Ireland
NICU	Neonatal Intensive Care Unit

NAME	DEFINITION
NOCA	National Office of Clinical Audit
PCCS	Paediatric Critical Care Society
PCCU	Paediatric Critical Care Unit
PCR	polymerase chain reaction
PICU	Paediatric Intensive Care Unit
PICS	Paediatric Intensive Care Society
PPHN	persistent pulmonary hypertension of the newborn
PHDU	Paediatric High Dependency Unit
PPI	Public and Patient Interest
PICANet	Paediatric Intensive Care Audit Network
PIM	Paediatric Index of Mortality
PIMS-TS	Paediatric Inflammatory Multisystem Syndrome temporally associated with SARS-CoV-2
run	Placing a patient on extracorporeal membrane oxygenation for one continuous period of time.
RCSI	Royal College of Surgeons in Ireland
ROI	Republic of Ireland
SMR	standardised mortality ratio
UK	United Kingdom
WTE	whole-time equivalent

EXECUTIVE SUMMARY

The Irish Paediatric Critical Care Audit (IPCCA) collects personal, organisational, and clinical data on all infants and children with a clinically determined need for paediatric critical care. The audit database is provided by the Paediatric Intensive Care Audit Network (PICANet), which aims to support the continual improvement of paediatric intensive care provision throughout the United Kingdom (UK) and the Republic of Ireland (ROI) by providing detailed information on paediatric intensive care activity and outcomes. The quality of care delivered is measured against the Paediatric Critical Care Society (PCCS) standards, which cover the entire patient pathway from initial referral to paediatric critical care, specialist transport, and inpatient care.

This is the second national report on Paediatric Critical Care Unit (PCCU) activity in the ROI, provided at Children's Health Ireland (CHI) at Crumlin and CHI at Temple Street in 2020, in addition to data on children cared for in adult Intensive Care Units (ICUs) nationally, and aggregate data from 2018 to 2020 has been included to allow for trend analysis and comparison. The number of patients admitted to PCCUs in 2020 was affected by the onset of the coronavirus disease (COVID-19) pandemic in February 2020. While not a disease primarily of children requiring critical care, the reduced incidence of other respiratory infections and diseases, such as viral bronchiolitis and pneumonia, was reflected in reduced numbers of patients requiring emergency admission to PCCUs.

The total number of children admitted to PCCUs during 2020 was 1,399. This reflects a 9% reduction in overall admissions when compared with 2019. This means that bed occupancy was reduced overall from 100% in 2019 to less than 90% for both Units in 2020. However, more than 155 of PCCU patients admitted required complex levels of critical care that necessitate increased nurse-patient ratios of 2:1, or even 3:1 as required in extracorporeal life support (ECLS). This is not reflected in bed occupancy data but is evident in daily activity data as outlined in Chapter 6 on interventions and outcomes.

The year 2020 was the first year of the COVID-19 pandemic and detailed data from both Units in the ROI on COVID-19 and Paediatric Inflammatory Multisystem Syndrome temporally associated with SARS-CoV-2 (PIMS-TS) admissions of children, including mortality, morbidity, length of stay, and interventions required, are described in Chapter 7. These data show that the burden of COVID-19 in PCCUs from children was minimal.

The risk-adjusted standardised mortality ratio (SMR) is reported in Chapter 6 and allows us to benchmark with other Units participating in PICANet. This shows that mortality in CHI at Crumlin and CHI at Temple Street is in line with international Units and remains low at 4%.

Data on neonatal admissions to PCCUs, which on average account for one-fifth of admissions, are an addition to this report; a breakdown of age and diagnoses is provided in Chapter 4. Cardiac and neurosurgical admissions and outcomes will be reported in future reports in addition to more extensive information on subspecialty admissions and outcomes.

A key recommendation in our first annual report for 2017–2019 was the incorporation of more detailed data collection for future reports, which includes a national database to provide a more comprehensive overview of PCCU in the ROI than what PICANet currently provides. This is required to produce a useful, clinically relevant national report that truly reflects the complex patient population, which ranges from age groups under 25 weeks gestation up to 18 years of age. Failure to document the complexity and intensity of this diverse patient group inhibits advocating on behalf of these patients and illustrating the uniqueness of the case mix in the ROI patient population in international terms. Annual reports should reflect what PCCUs actually do in complex subspecialty reporting.

KEY FINDINGS



The total number of admissions of patients to Paediatric Critical Care Units (PCCUs) in 2020 (including children aged 16 years or over) in the Republic of Ireland (ROI) was 1,399, a decrease of 9% from 2019 (N=1514).



The total number of admissions of patients to all PCCUs in the UK and ROI combined for 2020 (N=16429) decreased by 19% (n=3971) from 2019.



Children's Health Ireland (CHI) at Crumlin had the third-highest number of PCCU admissions (n=968) of all Units in the UK and ROI.



The ROI rate of admissions was 121.3 per 100,000 population (a decrease from 133.4 in 2019) and is the second-highest rate after Scotland (136.4), the country with the highest rate.



Just over one-half, 52% (n=725), of admissions were unplanned (i.e. emergency) in 2020 (a 10% decrease from 2018).



Forty-one percent (n=565) of admissions occurred following surgery (a 10% increase from 2018).



Ten percent (n=444) of patient discharges and 34% (n=1507) of patient admissions occurred out-of-hours (20.00–07.59) during 2018–2020. An out-of-hours discharge of a patient is suboptimal and should be avoided where possible. During the evening and night-time there is reduced medical and nursing staff availability on the wards, and senior staff are less likely to be available to review a patient.



The number of bed days delivered in the ROI in 2020 was 9,312 (a decrease of 1,000 bed days from 2019). CHI at Crumlin delivered 7,101 of these (a reduction from 7,902 in 2019) and CHI at Temple Street delivered 2,211 (a reduction from 2,491 in 2019).



Infants aged under 1 year occupied over two-thirds (68%) of the bed days delivered in 2020.

KEY FINDINGS



The annual average rate of unplanned extubation per 1,000 intubated days was 2.5 per 1,000 in the ROI (a decrease from 4.2 per 1,000 in 2019) and below the acceptable threshold of 5.0 per 1,000. Children who need help breathing may require a flexible plastic tube placed in their throat connected to a machine; this is called invasive ventilation. If the tube is accidentally dislodged, or removed by the patient, this is referred to as unplanned extubation.



Seventy percent of patients received vasoactive medication while in PCCU. Use of these substances can be a potentially life-saving intervention.



There were 25 extracorporeal membrane oxygenation (ECMO) runs in 2020 (an increase from 18 in 2018 and 22 in 2019). ECMO is a life-saving treatment for children with heart or lung failure.








There were 68 children admitted to adult Intensive Care Units (ICUs) in 2020 (a decrease from 111 in 2019): 40% were admitted to Galway ICU and 16% were admitted to Cork ICUs; 31% were aged under 6 years; 31% required invasive ventilation; and the median length of stay (LOS) was 38.5 hours.



From 1 March 2020 to 31 July 2022, there were 82 admissions of children with a COVID-19 diagnosis and 41 admissions with a diagnosis of PIMS-TS to PCCUs. There was no COVID-19 related mortality during this time period. For COVID-19 patients, the median age was 4.0 years, median LOS was 3.0 days, and mechanical ventilation was required by 40% (n=33).

KEY METRICS

1	PICANet METRIC 1 	Case ascertainment and timeliness of data submission	<p>Case ascertainment: Almost all admissions were reported to PICANet (95%) for 2019; ascertainment was not recorded for 2020 due to the COVID-19 pandemic.</p> <p>Timeliness of data submission 2020: The completeness of patients' admission data within 3 months of their discharge from the Unit was 48% for CHI at Crumlin and 85% for CHI at Temple Street. The target is 100%.</p>
2	PICANet METRIC 2 	Retrieval mobilisation times	<p>In 2020, 71% of Irish Paediatric Acute Transport Service (IPATS) journeys to retrieve patients requiring urgent transfer to PCCU began within the hour (18% 0–30 minutes; 53% 31–60 minutes).</p> <p>The UK Care Quality Commission recommends that journeys be commenced within 1 hour (Universities of Leeds and Leicester, 2019).</p>
3	PICANet METRIC 3 	Number of qualified nurses per bed	<p>The recommended standard for nursing levels is 5.5 whole-time equivalent (WTE) staff nurses per critical care bed (Joint Faculty of Intensive Care Medicine of Ireland, 2018). In 2020, CHI at Crumlin met the recommended standard with 5.82 WTE. CHI at Temple Street remained below the recommended standard with 5.46 WTE.</p>
4	PICANet METRIC 4 	Emergency readmissions within 48 hours	<p>In 2020, 1.7% of patients were readmitted within 48 hours of discharge.</p> <p>Emergency readmissions to the same PCCU within 48 hours of discharge from the PCCU may mean that a child was discharged too early or into the wrong care environment, or that the need for future critical care was not predicted. There is no standard acceptable rate of emergency readmissions within 48 hours to PCCU, but they are considered a rare event. Low readmission rates are generally accepted as an indicator of good-quality care.</p>
5	PICANet METRIC 5 	Mortality in PCCU	<p>The mortality rate in PCCUs in the ROI is low, with 96% of patients discharged alive. Deaths in PCCU accounted for 21% of all deaths in the paediatric population in the ROI in 2020.</p> <p>Risk-adjusted standardised mortality ratios (SMRs) for both PCCUs in the ROI indicate that neither Unit had a mortality rate higher than expected.</p>

KEY FINDINGS

Irish Paediatric Critical Care Audit 2020



1399

1399 admissions in 2020.
Down 9% from 2019



52%

52% were infants aged
less than one year



41%

41% following surgery



1.7%

1.7% of patients were
readmitted within
48 hours of discharge



96%

96% survival rate



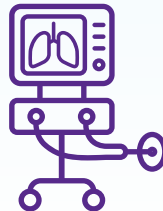
71%

71% of IPATS journeys
were started within one
hour in 2020



63%

63% of patients
required invasive
ventilation



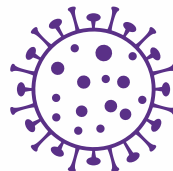
68

68 children admitted to
adult ICUs in 2020:
31% aged under 6 years
31% required invasive
ventilation
38.5 hours median
length of stay



25

25 patients received
lifesaving treatment
ECMO in 2020



82

82 admissions of children
with COVID-19 from
March 2020 to July 2022:
Median age was 4 years
40% required mechanical
ventilation



3

3.0 days median
length of stay
of children
with COVID-19
from March 2020
to July 2022



CHI AT CRUMLIN



48%

48% of admissions to PCCU were unplanned (emergency) admissions and 31% transferred in from other hospitals.



49%

49% of admissions were patients with cardiovascular diagnoses



18%

18% of admissions were patients with respiratory diagnoses



88%

88% average bed occupancy in 2020.
Average 22.4 beds open



21%

21% of admissions were babies under one month old
32% required surgery



2.75

2.75 days median length of stay



5.8

Average of 5.8 whole time equivalent staff nurses per critical care bed



CHI AT TEMPLE STREET



66%

66% of admissions to PCCU were unplanned and 62% transferred in from other hospitals.



24%

24% of admissions were patients with neurological diagnoses



24%

24% of admissions were patients with respiratory diagnoses



82%

82% average bed occupancy in 2020.
Average 7.5 beds open



17%

17% of admissions were babies under one month old
15% required surgery



1.74

1.74 days median length of stay



5.4

Average of 5.4 whole time equivalent staff nurses per critical care bed

KEY RECOMMENDATIONS

RECOMMENDATION 1

A comprehensive dataset should be developed locally, in addition to PICANet data, to accurately reflect the complexity and acuity of the ROI PCCU patient population and the scope of practice to enable accurate audit and reporting.



RECOMMENDATION 2

Adult Intensive Care Units caring for children should ensure the recommendations outlined in the *Model of Care for Paediatric Critical Care* are adhered to. Any child requiring treatment in an adult critical care unit should be discussed with the National Paediatric Critical Care Network to decide if stabilisation and transfer to a PCCU is required or that the child can be safely cared for locally.



RECOMMENDATION 3

Paediatric Critical Care Units should improve timeliness of audit data submission to meet the quality standard.



RECOMMENDATION 4

Paediatric Critical Care Units should monitor and review out-of-hours and delayed discharges.



RECOMMENDATION 5

A National Respiratory Paediatric Extracorporeal Life Support (ECLS) Programme should be progressed in Children's Health Ireland.



CAPTURING THE PATIENT VOICE

My name is Fiona but I'm 'Mammy' to Jacob, Isaac and Anna, all of whom had surgeries in CHI at Crumlin for various reasons. I had open-heart surgery myself at Our Lady's Hospital for Sick Children in the 1980s.

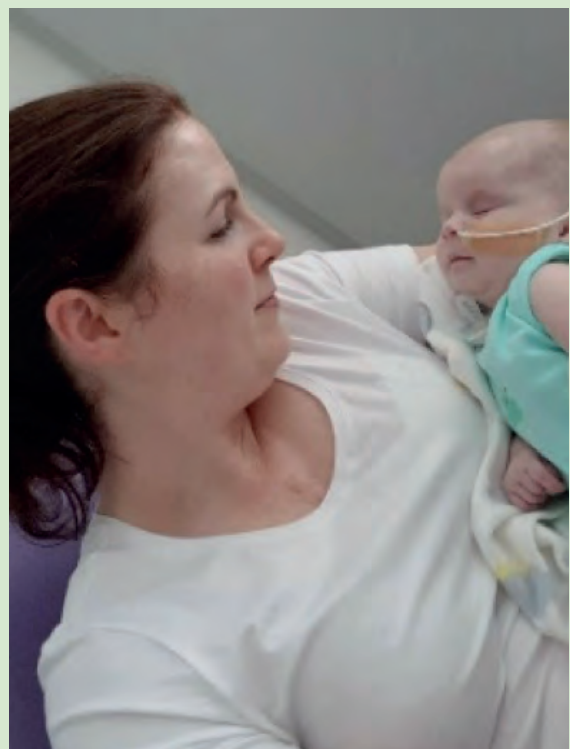
In 2022, I was invited by Heart Children Ireland to be a Public and Patient Interest Representative for the National Office of Clinical Audit, specifically working on the Irish Paediatric Critical Care Audit. I've been actively engaged with Heart Children Ireland and the Irish Heart Foundation since Anna's recovery because I want to help other heart families like mine. My youngest child Anna was born with critical congenital heart disease. Her traumatic first year in and out of hospital has had a huge impact on her life and on our family. Anna spent long periods in the Paediatric Critical Care Unit or PICU2 in CHI at Crumlin during the first year of her life and, naturally, I was there to care for and advocate for her on every step of the journey.

Anna was born in April 2019 in the National Maternity



Hospital (NMH) in Holles Street. She was diagnosed antenatally with congenital heart disease, so I was advised to go to NMH for her birth, just in case. I was informed that she would probably need open-heart surgery at 6 months of age and, while her heart condition was serious, the consultant was optimistic that it could be repaired as she had four good pumping chambers in her heart. At nearly 38 weeks, we rushed

"I've been actively engaged with Heart Children Ireland and the Irish Heart Foundation since Anna's recovery because I want to help other heart families like mine. My youngest child Anna was born with critical congenital heart disease."



to Dublin in the midst of Storm Hannah. Anna seemed well after birth but her condition deteriorated and she had to be 'blue lighted' to the PICU in Crumlin. There we received the shocking news that she needed urgent open-heart surgery. The surgeon needed to fix her extremely hypoplastic aortic arch and other heart defects to give her a chance at life. The previous optimism vanished in the PICU. Anna was sedated, intubated and very unwell. I can still remember the doctor talking to me but only partially hearing the information. I was hearing as if under water, drowning in a sea of medical terminology. My whole world fell away and the only thing I could be sure of was the chair I sat on. Nothing was happening beyond that small PICU in Crumlin. Anna was tiny, her heart was very complicated to operate on and the plan for her survival was constantly evolving. I spent every day beside her holding her tiny fingers, while her brothers tried to continue life as normal in Roscommon with Dad and grandparents.

The amazing medical team worked tirelessly to get Anna well. Two open-heart surgeries, drains and feeding issues led to a gradual recovery and a prolonged stay in PICU (4 weeks the first time). A third open-heart surgery meant Anna was back in PICU at 6 months of age for a week. Anna is now 3 years old and her rollercoaster ride is not over by a long shot, but thankfully she's thriving and won't recall those days in PICU, monitors beeping, trying to talk to her, and praying for her to survive.

I hope that by sharing Anna's story and our family's experiences of PICU, we can add a human dimension to the statistics discussed in this audit. The data in this document are all about amazingly brave and vulnerable children who pass through PICU. Not all of them are as fortunate in their outcomes as Anna. It is so important that clinicians hear from whom they are helping and are reminded why they do their invaluable work and maintain the highest standards. I hope our experience contributes and enhances the PICU experience for children and their families in the future.

Fiona Fallon
Heart Mum

Volunteer with Heart Children Ireland and the Irish Heart Foundation





CHAPTER 1 **INTRODUCTION**

CHAPTER 1: INTRODUCTION

PAEDIATRIC CRITICAL CARE IN IRELAND

A Paediatric Critical Care Unit (PCCU) is a specialised facility within a children's hospital that is charged with the care of infants and children, staffed by a specialist team, and designated to provide an increased level of detailed clinical observation, invasive monitoring, focused interventions, and technical support to facilitate the care of critically ill paediatric patients over an indefinite period of time. A PCCU will care for patients diagnosed with life-threatening but potentially recoverable conditions, postoperative patients who may benefit from close nursing care, and children with chronic, complex medical comorbidities that exceed the care capabilities of other clinical care areas within the hospital.

In the Republic of Ireland (ROI), there are currently two dedicated PCCUs located in Dublin at Children's Health Ireland (CHI) at Crumlin (23 beds) and CHI at Temple Street (9 beds). The current combined capacity of the two PCCUs is 32 beds. The patient profile of the two Units differs. CHI at Crumlin is the National Centre for Paediatric Cardiology and Cardiothoracic Surgery, the National Paediatric Haematology and Oncology Centre, and the National Paediatric Burns Unit. Major specialties at CHI at Temple Street include the national centre for paediatric neurosurgical cases and renal transplants as well as the National Paediatric Craniofacial Centre and the National Centre for Inherited Metabolic Disorders. The new National Children's Hospital – which will be located on a shared campus with St James's Hospital in Dublin – will house one large state-of-the-art PCCU incorporating a general and cardiac care unit with a planned capacity of 42 beds, and a separate Neonatal Intensive Care Unit (NICU) with a planned capacity of 18 beds, making it one of the largest PCCUs in Europe.

The importance of audit in paediatric critical care was outlined in the *National Standards for Paediatric Critical Care Services* (Joint Faculty of Intensive Care Medicine of Ireland, 2013) developed by the Paediatric Critical Care Group and endorsed by the Intensive Care Society of Ireland. The *Model of Care for Paediatric Critical Care* (National Clinical Programme for Critical Care and National Clinical Programme for Paediatrics, 2019) defines the minimum requirements for a PCCU in terms of resourcing, staffing, delivery, and governance.

The Paediatric Intensive Care Audit Network (PICANet) is an audit database, established in 2002, which aims to support the continual improvement of paediatric critical care provision throughout the United Kingdom (UK) and the ROI by providing detailed information on paediatric critical care activity and outcomes. This audit collects personal, organisational, and clinical data on all infants and children with a clinically determined need for paediatric critical care. It audits the quality of care delivered against the Paediatric Critical Care Society (PCCS) standards, which cover the entire patient pathway from initial referral to paediatric critical care, specialist transport, and inpatient care (Healthcare Quality Improvement Partnership, n.d.).

The PCCUs at CHI at Crumlin and CHI at Temple Street first submitted anonymised data to PICANet in 2009 and 2010, respectively.

The National Office of Clinical Audit (NOCA) works with PICANet in the UK to ensure appropriate processes of data validation and data analysis. PICANet produces annual audit reports, which monitor activity and makes comparisons over a 3-year reporting period for PCCUs across England, Scotland, Wales, Northern Ireland (NI) and the ROI.

The PICANet audit includes data from all PCCUs in England along with two non-National Health Service (NHS) Units based in London; all PCCUs in Wales; two PCCUs in Scotland; one in NI; and two in the ROI. Hence, data are captured from all Units in the UK and the ROI combined. There are 32 PCCUs and 12 specialist transport services currently submitting data to PICANet.

PICANet was established to develop and maintain a secure and confidential high-quality clinical database of paediatric critical care activity across the UK and the ROI with the following objectives:

- identify best clinical practice
- monitor supply and demand
- monitor and review outcomes of treatment episodes
- facilitate healthcare planning and quantify resource requirements
- study the epidemiology of critical illness in infants and children.

This is the second Irish Paediatric Critical Care Audit (IPCCA) National Report, providing an accurate measure of activity, level of care, and case complexity across the two PCCUs in the ROI in 2020. In addition to the two specialised Units in CHI at Crumlin and CHI at Temple Street, there is a cohort of children cared for in regional Paediatric High Dependency Units (PHDUs) or in adult Intensive Care Units (ICUs) in regional hospitals across the ROI. Following the roll-out of the Irish National Intensive Care Unit Audit (INICUA) to all adult ICUs, NOCA now captures data on all children cared for in adult ICUs in the ROI, and data for 2020 is included in Chapter 4. In December 2019, a novel strain of coronavirus, commonly known as coronavirus disease 2019 (COVID-19), was identified and spread globally, causing disruption to, and strain on, healthcare services, societal life, and economies worldwide. COVID-19 is an infection caused by the severe acute respiratory syndrome (SARS-CoV-2) virus. Only a small proportion of COVID-19 cases were diagnosed in children when compared with the adult population. This report will include data on children with a confirmed COVID-19 diagnosis treated in a PCCU; however, the reason for admission may not have been due to COVID-19 (see Chapter 7).

NATIONAL OFFICE OF CLINICAL AUDIT

NOCA enables the continuous improvement of the healthcare system in the ROI by maintaining a portfolio of prioritised national clinical audits measured against national and international standards. By making reliable data available to those who use, manage, and deliver healthcare, clinical audits help to refine Irish healthcare, improve patient outcomes, and achieve change at local and national level. NOCA works to promote an open culture of shared learning through national clinical audit in order to improve clinical outcomes and patient safety.

NOCA is funded by the Health Service Executive (HSE) Office of the Chief Clinical Officer, is governed by an independent voluntary board, and is operationally supported by the Royal College of Surgeons in Ireland (RCSI) (see Figure 1.1).



INICUA was established by NOCA in 2013 and focuses on the care of patients in ICUs. Patients cared for in these Units are the sickest patients in the hospital. The Irish National ICU Audit Governance Committee oversees three data collections:

- The Irish National ICU Audit Governance Committee supports and advises the ICU audit clinical leads on the operation of the audits, and these clinical leads report to the NOCA Governance Board. In addition, the Irish National ICU Audit Governance Committee provides guidance on the strategic direction of the ICU audit programme. Members of the committee include professional organisations, Public and Patient Interest (PPI) representatives, a senior accountable healthcare manager, the NOCA Clinical Lead for INICUA, the Clinical Lead for the IPCCa, the NOCA Executive Director, ICU audit managers, and representatives from the ICU audit coordinators. Membership is on a 3-year staggered term; see Appendix 1 for a list of Irish National ICU Audit Governance Committee members in 2020.

24 NOCA NATIONAL OFFICE OF CLINICAL AUDIT

OUR AIM

The overall purpose of the IPCCA is to improve critical care services provided to paediatric patients by measuring the quality of care and outcomes against predetermined standards, using data from the UK and the ROI as a whole as a benchmark.

OBJECTIVE 1

Measure the quality of care in CHI at Crumlin and CHI at Temple Street, and benchmark this against other PCCUs across the UK.

OBJECTIVE 2

Provide data on the epidemiology and complexity of care provided for each patient. This has the potential to link in with best practice tariff reimbursement in the future.

OBJECTIVE 3

Improve the quality of data for the Hospital In-Patient Enquiry (HIPE) scheme by providing data on diagnosis and procedures arising while the patient is in PCCU.

OBJECTIVE 4

Support Irish and international research in order to enhance patient care.

OBJECTIVE 5

Make recommendations based on validated data.

WHO IS THIS REPORT AIMED AT?

This report is intended for use by a wide range of individuals and organisations, including:

- patients and their parents and carers
- patient advocacy groups
- healthcare professionals, hospital managers, and Hospital Groups
- multidisciplinary teams (MDTs) caring for patients in PCCUs or ICUs
- policymakers and researchers.

This report has been presented in two parts:

1. The *Irish Paediatric Critical Care Audit National Report 2020 including a Special Chapter on COVID-19 and Paediatric Inflammatory Multisystem Syndrome (PIMS-TS) 2020–2022*, presenting the key findings from the audit
2. The *Irish Paediatric Critical Care Audit 2020 and COVID-19/PIMS-TS: Summary Report*.

CHAPTER 2

METHODOLOGY



CHAPTER 2: METHODOLOGY

The IPCCA collects demographic, organisational, and clinical data on all infants and children with a clinically determined need for paediatric critical care in the UK and the ROI. These data are used to compare outcomes and activity between PCCUs and specialist transport services as well as between health regions and nations.

There are four different datasets used in this report in order to audit the care given to children admitted to a PCCU or adult ICU in the ROI:

1. The PICANet dataset is used to audit data on children transported and admitted to PCCUs.
2. The Health Protection Surveillance Centre (HPSC) COVID-19 data collection is used to describe children admitted to PCCU with COVID-19 or PIMS-TS.
3. The INICUA Intensive Care National Audit and Research Centre (ICNARC) dataset for adult ICUs is used to audit data on all children admitted to an adult ICU in the participating hospitals in 2020 (see Appendix 2).
4. The Extracorporeal Life Support Organization (ELSO) Registry is used to provide additional detail of patients requiring extracorporeal membrane oxygenation (ECMO) treatment.

DATASET 1: PICANET

PICANet is an international clinical audit of paediatric critical care activity in the UK and the ROI. It was established in 2002 with the aim of providing a secure and confidential high-quality clinical database of paediatric critical care activity (Universities of Leeds and Leicester, 2020). It is now part of the National Clinical Audit and Patient Outcomes Programme and is recognised as the definitive source for paediatric critical care data in the UK and the ROI (Healthcare Quality Improvement Partnership, n.d.).

PICANet is used to audit the care provided to children admitted to PCCUs. It collects demographic and clinical data about the child and organisational data about the Unit, and the data are stored in a secure database. Each organisation can view and download its own data and report on its data quality and activity. PICANet publishes an annual report where comparisons are made between PCCUs, and each Unit is assessed against established clinical standards and guidelines. PICANet reports on five key performance metrics, which are described in more detail in Table 2.1 and in Chapter 8 of this report.

TABLE 2.1: PICANet KEY PERFORMANCE METRICS

Metric	Title	Description
METRIC 1	Case ascertainment and timeliness of data submission	This is a measure of how many admissions were reported to PICANet; 100% ascertainment means that information was received for all admissions.
METRIC 2	Retrieval mobilisation times	This measures the time it takes for the centralised transport service (CTS) team to start their journey to pick up a child who needs urgent paediatric critical care following a clinical decision that paediatric critical care transport is required.
METRIC 3	Number of qualified nurses per bed	In November each year, all PCCUs record how many qualified nursing staff are employed in the PCCU; both their total funded posts and any vacant posts are included.
METRIC 4	Emergency readmissions within 48 hours	For each PCCU, the frequency of emergency readmissions within 48 hours of discharge from the same Unit is recorded and compared to the average for the UK and the ROI. This is calculated using the admission and discharge dates and times. This relative readmission rate allows PCCUs to make comparisons between each other.
METRIC 5	Mortality in PCCU	Mortality (death) rates are assessed for each PCCU based on a statistical approach, which accounts for the severity of the child's illness at the time of admission. This is known as risk adjustment. The number of children predicted to die is calculated and then compared to the number who actually die in order to derive the risk-adjusted standardised mortality ratio (SMR).

Data entry and submission

The IPCCA uses PICANet's information technology (IT) infrastructure in order to collect audit data. The PICANet database is hosted in the University of Leeds Secure Electronic Environment for Data (SEED) system. The database enables the recording of admission, transport, and referral event data, allowing for real-time validation and reporting of the data. Hospital access to the database is restricted to each hospital's own data. Permission to access the PICANet web record for a named hospital or organisation (including retrieval teams) must be granted by the lead clinician.

Individual PCCUs submit data to PICANet using a secure web-based portal. Data submission can involve direct entry of patient data or the monthly upload of a data file from an existing clinical information system (CIS) by the data manager. If Units use their own CIS to collect data, the data are exported in a format specified by PICANet in order to allow them to be imported into the PICANet system. Completion of the PICANet data collection form on the CIS is mandatory and it should be completed at the bedside by nurses. Where a PCCU does not have a CIS, the patient flow sheet at the bedside, which includes the daily interventions, has a specific panel for PICANet data. The audit nurse checks the PICANet data daily on the CIS and patient flow sheets in order to ensure their completeness and correctness.

The data collected include the following:

- **Admission data:** These consist of each child's demographic details, including their date of birth, ethnicity, and sex. The PICANet database also collects details about where children are admitted from, their date of admission, their clinical diagnoses, and some physiological parameters on admission to PCCU, including arterial blood gas results, blood pressure, medical history, and ventilation status. Data on outcome and discharge details are also included. The medical interventions that each child receives each day are also recorded as part of the audit.
- **Referral data:** These include details of the referring hospital, demographic details about the child, the grade of the referring doctor or nurse, the transport team involved, and the destination PCCU.
- **Transport data:** These include details about the transport team, journey times, any interventions carried out, and critical incidents.

Each PCCU has a PCCU audit nurse, a clinical audit and research nurse coordinator, or a data manager who is responsible for the local data entry and who is supported by a clinical lead. PICANet provides documentation on data definitions and standardised data collection forms for the users.

Information governance

PICANet processes data in accordance with the General Data Protection Regulation (GDPR) that came into effect across the European Union (EU) on 25 May 2018. Patient name and full address, while collected at hospital level, are not submitted to PICANet. The UK Information Commissioner's Office released a statement on 28 December 2020 that the treaty (UK-EU Trade and Cooperation Agreement) agreed between the UK and the EU would allow personal data to flow freely from the EU (and European Economic Area) to the UK until adequacy decisions were adopted with effect from 1 January 2021.

Inclusion criteria

This report includes analyses of all data reported to PICANet from the PCCUs in the ROI; that is, all admissions of children whose data were submitted to PICANet for reporting and validation from the two PCCUs in the ROI for the years 2018–2020.

Exclusion criteria

Data for patients admitted who are aged 16 years and over will be presented separately. Although the number is small, it will be counted in the total admissions recorded in Chapter 4 of this report.

DATASET 2: HEALTHCARE PROTECTION SURVEILLANCE CENTRE (HPSC) COVID-19

The HPSC is notified of all COVID-19 PCCU admissions using their Enhanced Surveillance Critical Care Neonatal and Paediatric Admission form (see Appendix 6), which also captures cases of PIMS-TS. The HPSC processes these data on behalf of the HSE regional Directors of Public Health/Medical Officers of Health, and notification is mandatory. These data are entered onto the Computerised Infectious Disease Reporting (CIDR) information system and undergo data validation. This report (see Chapter 7) will include those patients with a date of first COVID-19 positive diagnosis (confirmed via polymerase chain reaction (PCR)) from 1 March 2020 to 31 July 2022.

DATASET 3: IRISH NATIONAL ICU AUDIT

Children who present to hospitals outside Dublin and who require specialist ICU care are cared for in adult ICUs. The numbers of children admitted to adult ICUs are small and will be presented separately from children admitted to PCCUs in this report (see Chapter 4).

INICUA, in partnership with the ICNARC in the UK, reports on benchmarked quality indicators of outcomes and activity for INICUA in order to facilitate quality improvement.

Data entry and submission

NOCA, working in partnership with the HSE, has procured and funded a data collection system for INICUA. The data are collected via a software application provided by DMF Systems called InfoFlex. The system can interface with a hospital's existing CIS and inpatient administration systems. Each ICU has an ICU audit coordinator who is responsible for local data entry and who is supported by a clinical lead. Data are collected for all admissions by the ICU audit coordinators in the participating Units. INICUA and ICNARC provide guidance documentation on data definitions, as well as standardised data collection forms for users.

Data protection and information management

Patient-identifiable information is held on the hospital's local database and stored on a HSE server. Hospital access is restricted to each hospital's own data and access to InfoFlex is restricted to the audit coordinator and the local clinical lead. All InfoFlex users must adhere to their local hospital's data protection policy. No patient-identifiable information is shared with ICNARC, NOCA, or anyone else outside the relevant hospital.

Inclusion criteria

The data reported on from INICUA include all admissions of children aged under 16 years in 2020, whose data were submitted to ICNARC for reporting and validation from all participating adult ICUs (see Appendix 2). The INICUA dataset covers the patient journey throughout the entire acute hospital stay and is outlined in Appendix 3.

DATASET 4: EXTRACORPOREAL LIFE SUPPORT ORGANIZATION (ELSO) REGISTRY

ELSO collects data from more than 50 countries worldwide and has over 180,000 cases submitted. Since joining in 2005, CHI at Crumlin submits data on all ECMO cases to ELSO. Data entry is via a portal on the ELSO website and data definitions, forms, and instructions are available. This is a comprehensive registry and is the world's leading data source on patients receiving ECMO.

ANALYTICAL TECHNIQUES

Data Analysis

NOCA received the finalised data from PICANet as encrypted Excel files. Statistical analysis of these data included simple cross-tabulations and the calculation of crude and risk-adjusted SMRs and 95% confidence intervals. The PICANet dataset was used for the data presented in the majority of the report. However, the HPSC dataset was used for the COVID-19 chapter, the ICNARC dataset was used to describe the children in adult ICUs, and the ELSO dataset was used to describe patients receiving ECMO. Basic descriptive statistics were used to describe the relevant populations.

Data included

Demographic, process, and outcome measures are presented in this report for the participating Units in the ROI. PICANet audits and reports on the clinical care of children admitted to PCCUs in both the UK and the ROI. Therefore, in this report, overall performance on pre-selected metrics (selected by PICANet) is also presented (see Table 2.1). This report presents data for these quality metrics for the ROI and benchmarks performance against other participating PCCUs in England, Wales, Scotland, and NI. Specifically, it includes data from CHI at Crumlin, from CHI at Temple Street, and from the Irish Paediatric Acute Transport Service (IPATS). The data are presented for 2018–2020. This report should be read in conjunction with the *Paediatric Intensive Care Audit Network Annual Report 2021* (Universities of Leeds and Leicester, 2022). Figures and tables have been sourced from the PICANet annual report, and NOCA has reproduced some data from that report.

WHO WE WORK WITH

CHI at Crumlin PCCU

This PCCU is a 23-bed Unit split over two floors. The Unit provides care from all specialties, including cardiothoracic surgery; general surgery; ear, nose and throat; plastic surgery; respiratory medicine; infectious diseases; general medicine; and haematology/oncology. The Unit accepts more than 1,000 admissions per year and is one of the largest PCCUs in Europe.



Clinical Lead PICANet: Associate Professor Martina Healy

PCCU Data Manager: Erika Brereton

PCCU Clinical Nurse Audit and Research Coordinator: Mong Hoi Tan

PCCU Clinical Audit Nurses: Andrea Joan Sequeira, Luiza Dsouza and Malena McLoone

ECLS Coordinator: Sunimol Joseph

PCCU Clinical Nurse Manager 3: Lorraine O'Reilly

CHI at Temple Street PCCU

This PCCU is a nine-bed Unit. The Unit provides care from all specialties, including trauma; orthopaedics; neurosurgery; endocrinology; nephrology; general paediatrics; ear, nose and throat; plastic surgery; inherited metabolic disorders; infectious disease; neurology; and respiratory medicine. CHI at Temple Street is the only centre in the ROI for children requiring neurosurgery or a renal transplant. The PCCU accepts an average of 450 admissions per year.



PCCU Clinical Lead: Professor Dermot Doherty

PCCU Consultant in Paediatric Critical Care and Retrieval Medicine: Dr Aisling Walsh

PCCU Clinical Nurse Audit and Research Coordinator: Marie Lawlor

PCCU Clinical Nurse Manager 3: Deirdre Hughes

HOSPITALS AND PEOPLE WE WORK WITH

NOTE: Dublin Hospitals have been displayed collectively by hospital group

SAOLTA UNIVERSITY HEALTH CARE GROUP

Letterkenny University Hospital
University Hospital Galway

RCSI HOSPITALS

Our Lady of Lourdes Hospital Drogheda
Beaumont Hospital
Connolly Hospital
Cavan Regional Hospital

DUBLIN MIDLANDS HOSPITAL GROUP

Tallaght University Hospital
Naas General Hospital
Midland Regional Hospital Tullamore
St James's Hospital

IRELAND EAST HOSPITAL GROUP

Wexford General Hospital
Mater Misericordiae University Hospital
St Vincent's University Hospital
Regional Hospital Mullingar
St Luke's General Hospital, Carlow/Kilkenny

CHILDREN'S HEALTH IRELAND

Children's Health Ireland at Crumlin
Children's Health Ireland at Temple Street

UL HOSPITAL GROUP

Regional Paediatric High Dependency Unit
University Hospital Limerick

SOUTH/SOUTH WEST HOSPITAL GROUP

Cork University Hospital
Mercy University Hospital
South Tipperary General Hospital
University Hospital Kerry
University Hospital Waterford

LETTERKENNY UNIVERSITY HOSPITAL

UNIVERSITY HOSPITAL GALWAY

OUR LADY OF LOURDES HOSPITAL, DROGHEDA

CONNOLLY HOSPITAL

BEAUMONT HOSPITAL

CAVAN REGIONAL HOSPITAL

ST JAMES'S HOSPITAL

TALLAGHT UNIVERSITY HOSPITAL

MIDLANDS REGIONAL HOSPITAL, TULLAMORE

NAAS GENERAL HOSPITAL

**REGIONAL PAEDIATRIC HIGH DEPENDENCY
UNIT UNIVERSITY HOSPITAL LIMERICK**

CLINICAL LEAD:

Dr Orla Neylon
Consultant Paediatric Endocrinologist

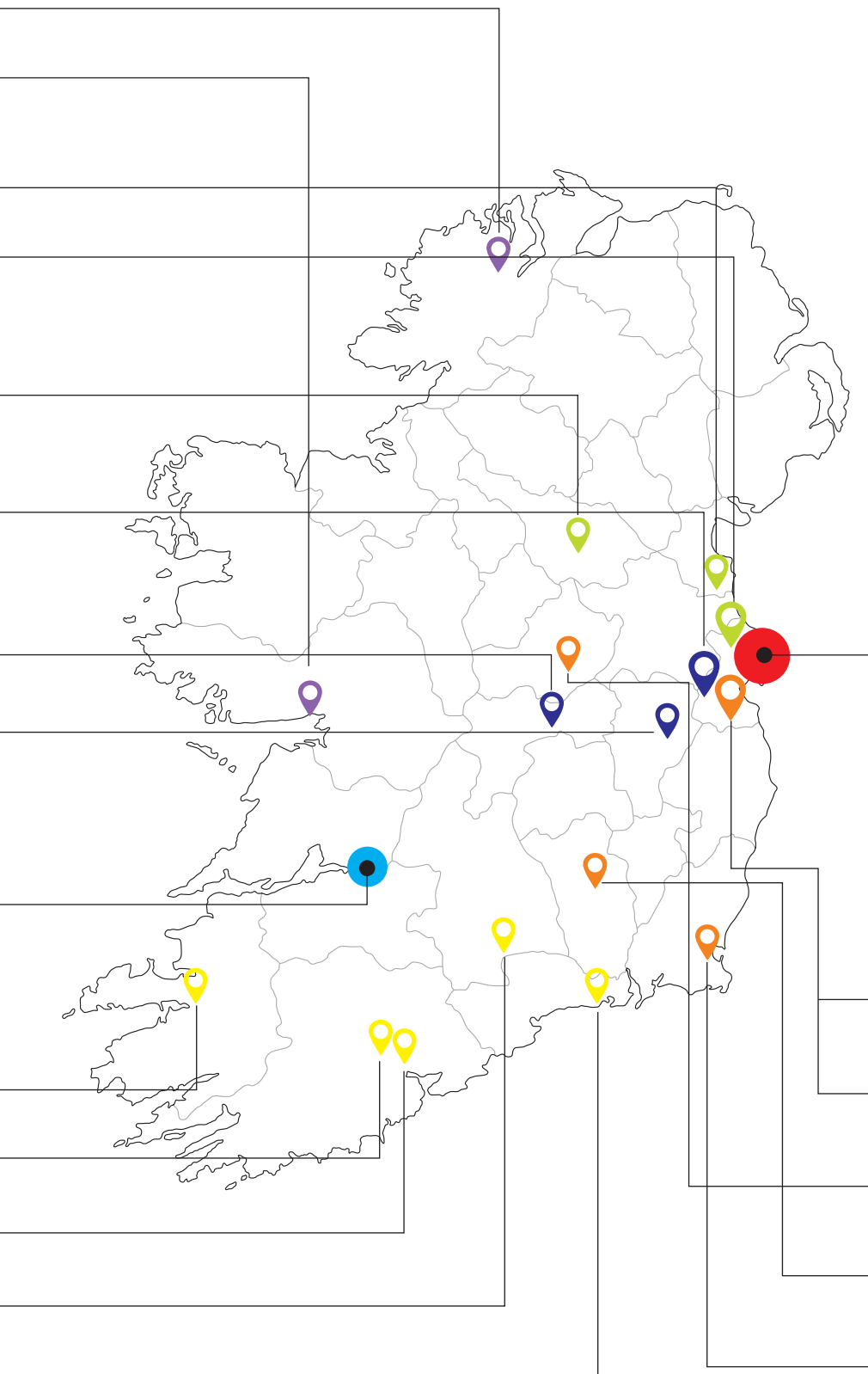
UNIVERSITY HOSPITAL KERRY

MERCY UNIVERSITY HOSPITAL

CORK UNIVERSITY HOSPITAL

SOUTH TIPPERARY GENERAL HOSPITAL

UNIVERSITY HOSPITAL WATERFORD



CHILDREN'S HEALTH IRELAND AT CRUMLIN

CLINICAL LEAD PICANet:

Associate Professor Martina Healy

PCCU DATA MANAGER:

Erika Brereton

PCCU CLINICAL NURSE AUDIT AND RESEARCH COORDINATOR:

Mong Hoi Tan

PCCU CLINICAL AUDIT NURSES:

Andrea Joan Sequeira, Luiza Dsouza and Malena McLoone

ECLS COORDINATOR:

Sunimol Joseph

PCCU CLINICAL NURSE

MANAGER 3: Lorraine O'Reilly

CHILDREN'S HEALTH IRELAND AT TEMPLE STREET

PCCU CLINICAL LEAD:

Professor Dermot Doherty

PCCU CONSULTANT IN PAEDIATRIC CRITICAL CARE AND RETRIEVAL MEDICINE:

Dr Aisling Walsh

PCCU CLINICAL NURSE AUDIT AND RESEARCH COORDINATOR:

Marie Lawlor

PCCU CLINICAL NURSE

MANAGER 3: Deirdre Hughes

MATER MISERICORDIAE UNIVERSITY HOSPITAL

ST VINCENT'S UNIVERSITY HOSPITAL

REGIONAL HOSPITAL MULLINGAR

ST LUKE'S GENERAL HOSPITAL

WEXFORD GENERAL HOSPITAL

CHAPTER 3

DATA QUALITY



**Coverage of
Data Release**



**Completeness of
Data Release**



**Accuracy of
Data Release**

CHAPTER 3: DATA QUALITY

DATA QUALITY STATEMENT OF IPCCA NATIONAL REPORT 2020

Tables 3.1, 3.2 and 3.3 provide an assessment of the quality of the IPCCA data in this report using internationally agreed dimensions of data quality, as laid out in *Guidance on a Data Quality Framework for Health and Social Care* (Health Information and Quality Authority, 2018).

TABLE 3.1: CONTEXT OF DATA QUALITY STATEMENT

Scope	<p>This data quality statement provides an assessment of the data released for this report. This statement solely focuses on the data quality dimension of accuracy and reliability, and specifically on the characteristics of</p> <ul style="list-style-type: none"> • coverage of data release • completeness of data release • accuracy of data release.
Purpose	<p>These will help the reader decide whether the data is fit for the user's specific purpose.</p>
Data source	<p>Sources of data for this report are data from PCCU admissions submitted to PICANet, data on COVID-19 PCCU admissions submitted to HPSC, data from adult ICU on paediatric admissions submitted to INICUA (ICNARC), and data on patients who received ECMO submitted to ELSO.</p> <p>While the overall numbers of patients who received ECMO are extracted from PICANet, Table 6.2 of this report includes additional data on ECMO from data submitted by CHI at Crumlin to the ELSO Registry.</p>
Timeframe of data release	<p>PICANet: The data published in this report are based on data collected within the period 1 January 2018 to 31 December 2020.</p> <p>HPSC COVID-19: The data are based on data collected within the period 1 March 2020 to 31 July 2022.</p> <p>INICUA: The data published in this report are based on data collected within the period 1 January 2019 to 31 December 2020.</p> <p>ELSO: The data published in this report are based on data collected within the period 1 January 2018 to 31 December 2020.</p>
Type of data	<p>Final data, which have been validated by PICANet, HPSC, ICNARC and ELSO.</p>

TABLE 3.2: CHARACTERISTICS OF DATA QUALITY




<p>Coverage of data release</p> 	<p>PICANet collects data from all 32 PCCUs in the UK and the ROI, giving 100% coverage. Case ascertainment within each PCCU is measured as the proportion of total number of admissions reported to PICANet and is usually assessed by validation visits from the PICANet team. In 2020, due to the COVID-19 pandemic, these routine visits did not take place. In 2019, at least 95% of admissions were captured in each Unit.</p> <p>HPSC COVID-19 collects data on all ICU admissions of patients with a confirmed positive COVID-19 PCR test in the ROI and notification is mandatory, giving 100% coverage.</p> <p>INICUA collects data from 25 Intensive Care Units from 21 hospitals in the ROI, which represents 92% of all critical care in HSE-funded hospitals (see Appendix 2 for data coverage in each participating hospital for 2020).</p> <p>ELSO collects data from more than 50 countries worldwide and has a total of 180,900 cases submitted. CHI at Crumlin submits data on all ECMO cases to ELSO.</p>
<p>Completeness of data release</p> 	<p>PICANet: CHI at Crumlin and CHI at Temple Street did not achieve 100% completeness within 3 months of discharge during the reporting period; however, 100% completeness was achieved prior to the final data lock for the reporting period that occurs on 31 March each year.</p> <p>HPSC COVID-19: The CIDR information system runs weekly validation of core data items and missing fields are followed up with PCCUs for correction.</p> <p>INICUA: Missing fields are identified as such and are thus corrected by each participating Unit or are deemed unavailable before data are reported on. Missing/incomplete data are documented in the <i>Irish National ICU Audit National Report 2020</i> (NOCA, 2022).</p> <p>ELSO: Data validation reports identifying missing fields are available to participating Units. CHI at Crumlin had 100% completeness for the reporting period.</p>
<p>Accuracy of data release</p> 	<p>PICANet: It is not possible to provide this figure for 2020 due to COVID-19 restrictions and lack of independent assurance.</p> <p>HPSC COVID-19: The CIDR information system runs weekly validation of core data items and cross-checks with PCCUs and lab results.</p> <p>INICUA: Critical care units collect data on all patients admitted to their Unit. Data are run against over 600 validation checks that identify potential errors as well as missing and unusual data. The Units use these checks to update their data before returning it for further validation checks. Once the data has passed all validation checks it is ready for analysis.</p> <p>ELSO: Data validation reports identifying missing fields are available to participating Units.</p>

TABLE 3.3: ASSESSMENT OF DATA QUALITY

Strengths of data in this report	PICANet: Despite the fact that there is no exact estimate of case ascertainment available for 2020, PICANet has consistently had high-case ascertainment each year (2015–2019, 97% or higher); therefore, we can be confident about 2020 data.
	HPSC COVID-19: This is a national surveillance mandated data collection.
	INICUA: This is a robust dataset that includes case mix, activity, and outcome data, which is routinely validated and risk adjusted for reporting purposes.
	ELSO: This is a comprehensive registry and the world's leading data source on patients receiving ECMO.
Limitations of data in this report	Data analysis should be carried out on all admissions to be confident that findings are interpreted appropriately. Due to the COVID-19 pandemic and the HSE cyberattack, this report is publishing data that is not as timely as it should be.



CHAPTER 4
**ADMISSIONS AND
PATIENT PROFILE
IN PAEDIATRIC
CRITICAL CARE UNITS**

CHAPTER 4: ADMISSIONS AND PATIENT PROFILE IN PAEDIATRIC CRITICAL CARE UNITS

ADMISSIONS TO PCCU

In 2020, in the ROI, there were 1,377 admissions of patients aged under 16 years to PCCU, 99 of whom were from NI. There were 22 additional admissions of patients aged 16 years or over during 2020, bringing the total number of admissions to 1,399. These patient numbers do not include paediatric patients treated in adult ICUs.

Between 2018 and 2020, there were 57,009 admissions to PCCUs across the UK and the ROI (CHI at Crumlin and CHI at Temple Street) (see Table 4.1). The ROI Units accounted for 8% (N=4320) of all admissions. Between 2019 and 2020, there was a large decrease (N=3971, 19%) in the number of admissions both in the ROI and the UK, decreasing from 20,400 admissions in 2019 to 16,429 admissions in 2020. All areas experienced a decrease in admissions, ranging from a 31% decrease in Scotland to just a 9% decrease in the ROI. This decrease is most likely attributable to the COVID-19 pandemic.

TABLE 4.1: NUMBER OF ADMISSIONS AGED <16 YEARS, BY COUNTRY AND YEAR, 2018–2020

Country	2018	2019	2020
ENGLAND	16 389	16 208	13 158
SCOTLAND	1351	1697	1178
NORTHERN IRELAND	501	492	353
WALES	510	489	363
REPUBLIC OF IRELAND	1429	1514	1377
TOTAL	20 180	20 400	16 429

PREVALENCE OF ADMISSION

The rate of PCCU admissions recorded in the ROI in 2020 was 121.3 per 100,000 childhood population. The highest rate was recorded in Scotland, with Units collectively reaching 136.4 admissions for every 100,000 children, followed by the ROI, England (115.2 per 100,000), Wales (114.6 per 100,000), and NI (83.3 per 100,000). The admission rates in all areas decreased significantly between 2019 and 2020 (see Table 4.2). Rates of admission per 100,000 children are presented in Figure 4.1 for 2020. In 2020, admission rates were lower in all countries, again reflecting the impact of the COVID-19 pandemic. The largest decrease was seen in NI, with the rate in 2020 being one-half that in 2018 (83 admissions per 100,000 compared with 167 in 2018). In the ROI, rates were similar across all three years, ranging from 121 to 133 admissions per 100,000 children.

TABLE 4.2: RATES OF ADMISSION AGED <16 YEARS, BY COUNTRY AND YEAR, 2018–2020

Country	2018	2019	2020	2018-2020
ENGLAND	141.1	141.1	115.2	132.4
SCOTLAND	154.3	191.8	136.4	160.8
NORTHERN IRELAND	166.6	159.3	83.3	136.4
WALES	139.6	140.2	114.6	131.5
REPUBLIC OF IRELAND	127.8	133.4	121.3	127.5
TOTAL	141.6	144.3	116.1	134.0

* Children with unknown country of residence or country of residence outside of the UK or ROI were excluded from this analysis, leaving n=55466 admissions.

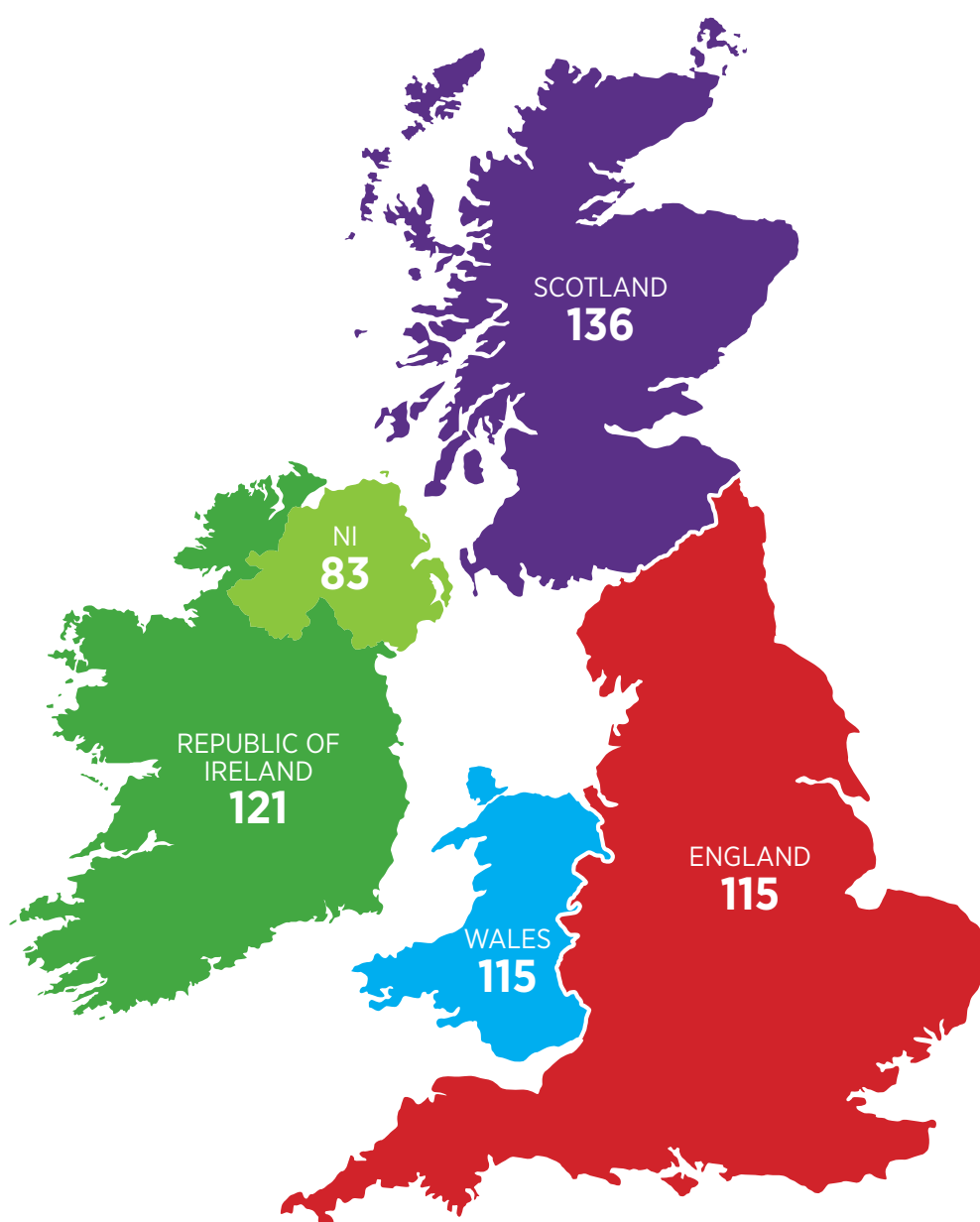


FIGURE 4.1.: RATE OF ADMISSIONS PER 100,000 CHILDHOOD POPULATION, 2020

Figure 4.2 shows the rates of admission for children (aged under 16 years), for each ROI county per 100,000 childhood population for 2020. Leitrim (186.9 per 100,000), Wicklow (167.3 per 100,000), and Dublin (164.1) had the highest rates of admission, while Cavan (64.1 per 100,000), Meath (85.7 per 100,000), and Clare (95.5 per 100,000) had the lowest rates of admission.

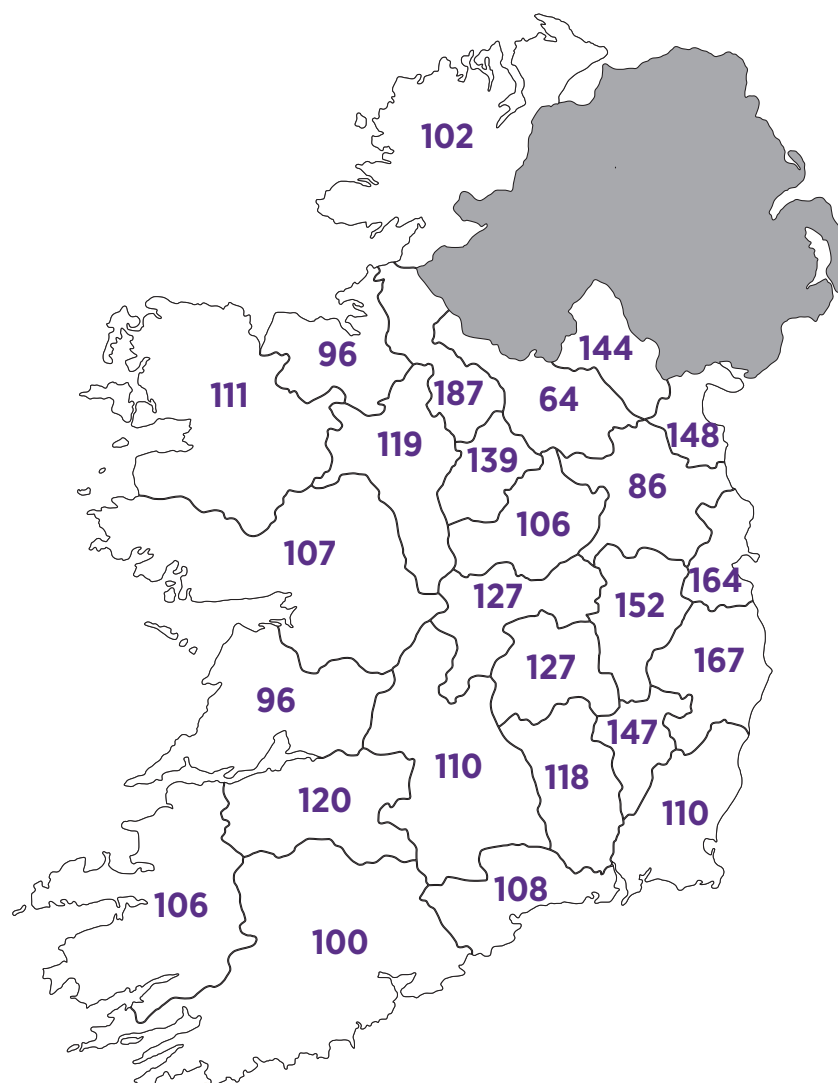


FIGURE 4.2: AGE-SEX ADJUSTED PREVALENCE (PER 100,000 CHILDHOOD POPULATION PER YEAR) FOR ADMISSIONS TO PAEDIATRIC CRITICAL CARE UNITS IN REPUBLIC OF IRELAND, BY COUNTY, 2018-2020

NOTES

1. Data are based on healthcare area of residence.
2. Children with unknown or ambiguous sex are excluded from this analysis.
3. For children treated in the ROI, county of residence was recorded and validated by the admitting PCCU
4. Calculation of prevalence uses populations obtained from the Central Statistics Office Census 2016 (CSO, 2017)
5. Population estimates are based on mid-year 2016 age-sex data for each county.

The total number of admissions per Unit for 2020 is illustrated in Figure 4.3. CHI at Crumlin had the third-highest number of PCCU admissions of all PICANet participating Units, at 968, after Birmingham Children's Hospital (V) and Great Ormond Street Hospital (E1). See Appendix 5 for the PICANet organisation key. There was an overall reduction in PCCU admissions to all Units in 2020 due to the COVID-19 pandemic, which may be explained by a reduction in respiratory illness overall in 2020 as a result of lockdown policy.

There was a 5% decrease in the number of admissions to CHI at Crumlin in 2020, decreasing from 1,024 in 2019 to 968 in 2020, while admissions to CHI at Temple Street PCCU decreased by 17% from 490 in 2019 to 409 in 2020 (see Figure 4.4).

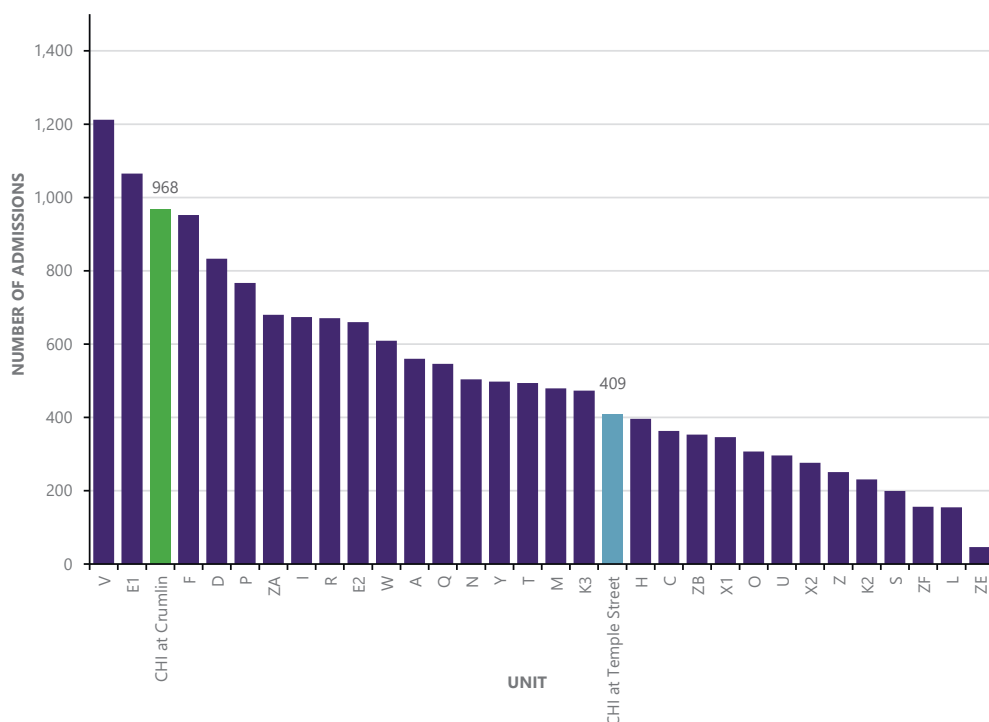


FIGURE 4.3: TOTAL NUMBER OF ADMISSIONS TO PICANet PARTICIPATING UNITS, BY UNIT, 2020 (N=16429)

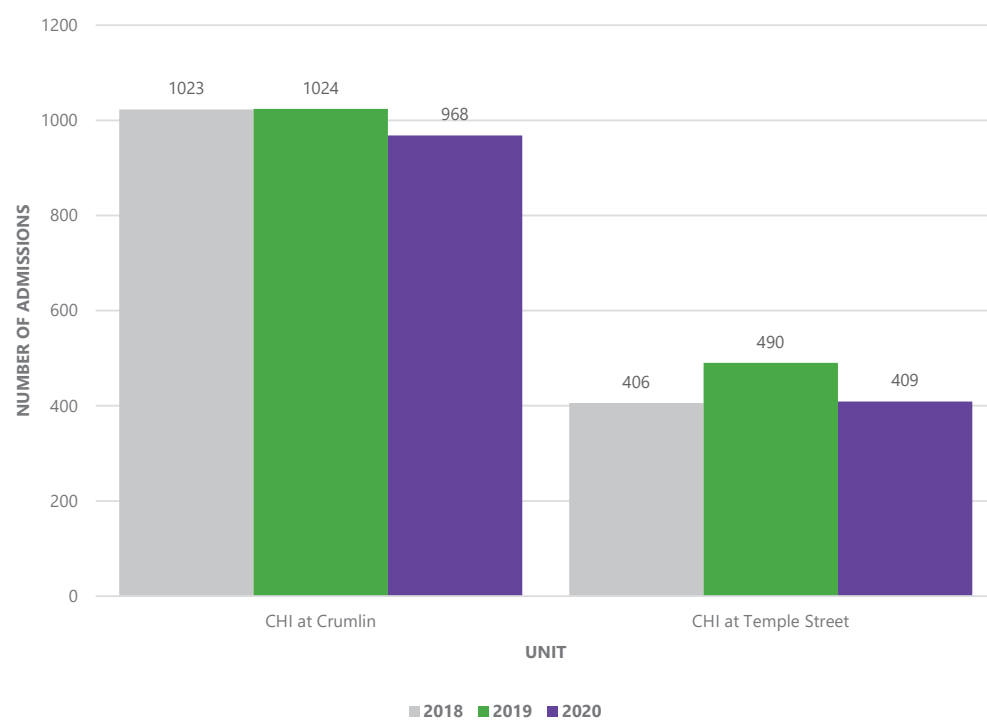


FIGURE 4.4: ADMISSIONS BY PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, 2018–2020 (N=4320)

ADMISSIONS BY TYPE AND SOURCE

Over the 3-year period 2018–2020, 42% (n=1793) of admissions to PCCUs in the ROI were planned. The proportion of planned admissions following surgery has increased each year from 31% (n=445) in 2018 to 41% (n=565) in 2020. The greatest proportion of admissions to PCCUs during the reporting period, at 58% (n=2527), were unplanned (i.e. emergencies), with differences between the two Units. Almost one-half of admissions to CHI at Crumlin PCCU in 2020 were unplanned (n=455, 48%), while in CHI at Temple Street unplanned admissions accounted for the majority of admissions, 66% (n=270) (see Figure 4.5).

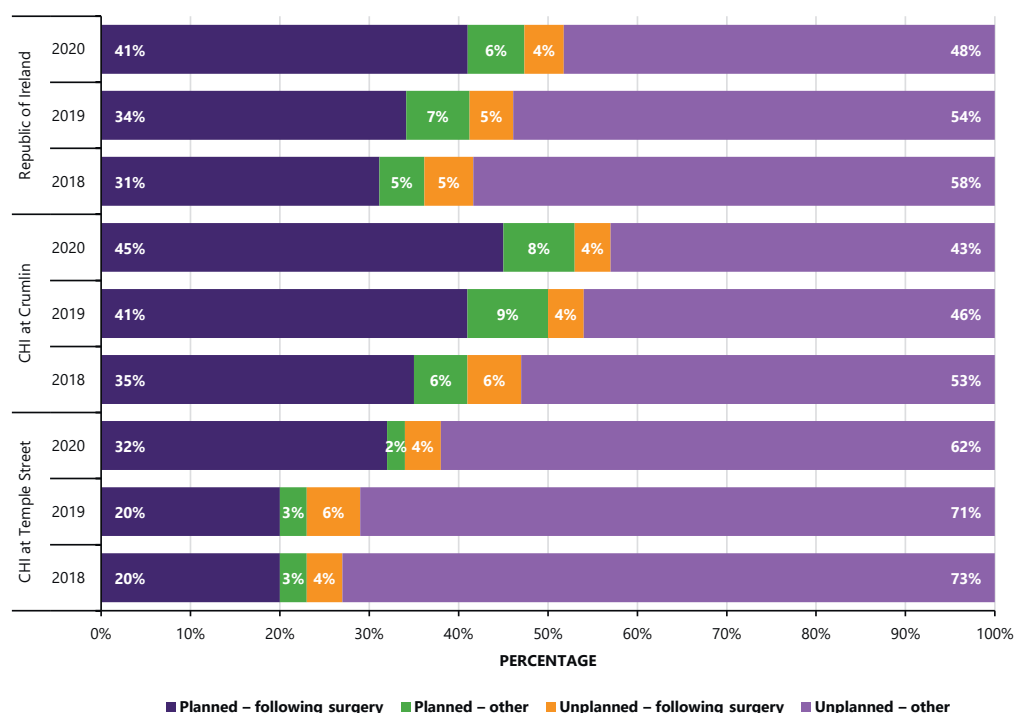


FIGURE 4.5: TYPES OF ADMISSION TO PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, 2018–2020 (N=4320)

SOURCE OF ADMISSION

The source of unplanned admissions varied between CHI at Crumlin and CHI at Temple Street. In CHI at Crumlin, a higher proportion of unplanned admissions to PCCU were inpatients of the same hospital, whereas in CHI at Temple Street, a greater proportion of unplanned admissions to PCCU were transfers from another hospital (see Figure 4.6). The proportion of unplanned admissions from outside the hospital to the CHI at Crumlin PCCU reduced from 39% (n=211) in 2018 to 31% (n=126) in 2020. This can be accounted for by the high number of in-house emergency admissions to PCCU in CHI at Crumlin. There was less variation in the ratio of transferred inpatient admissions in CHI at Temple Street (see Figure 4.6).

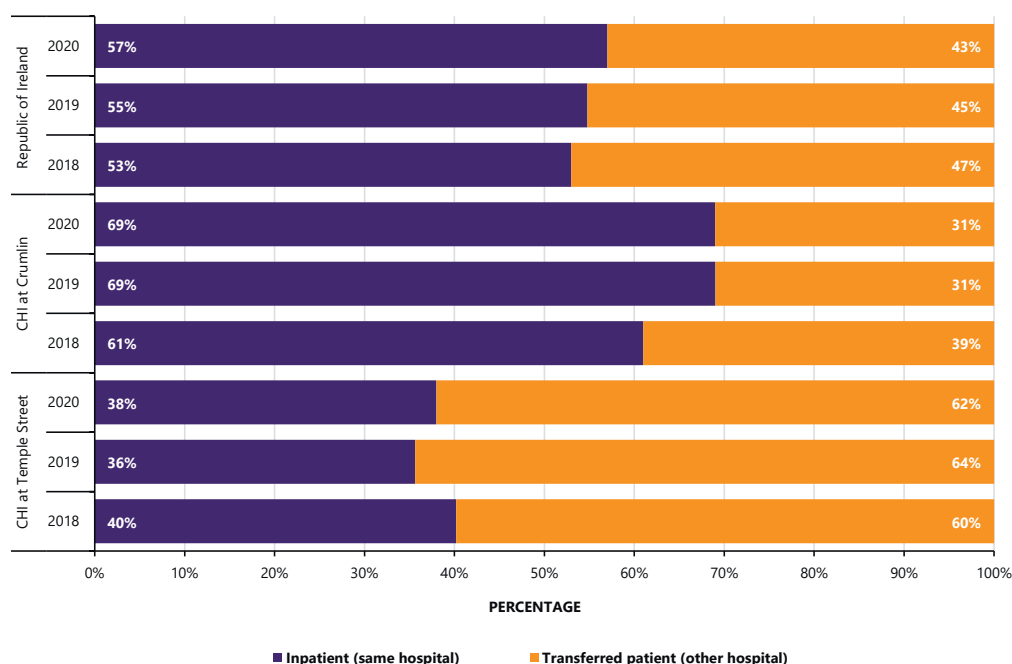


FIGURE 4.6: SOURCE OF 'UNPLANNED - OTHER' ADMISSIONS TO PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, 2018-2020 (N=2314)¹

¹ Figure 4.6 included 'Unplanned - Other' admissions only.

AGE PROFILE OF CHILDREN ADMITTED TO PCCUs

A breakdown of the age profile of children admitted to individual PCCUs in the ROI in 2020 is provided in Figure 4.7. Infants (under 1 year) accounted for over one-half of all admissions (n=565, 58%) to CHI at Crumlin and for 37% (n=151) of admissions to CHI at Temple Street. Overall, patients admitted to PCCU in CHI at Temple Street were older than those admitted to CHI at Crumlin.

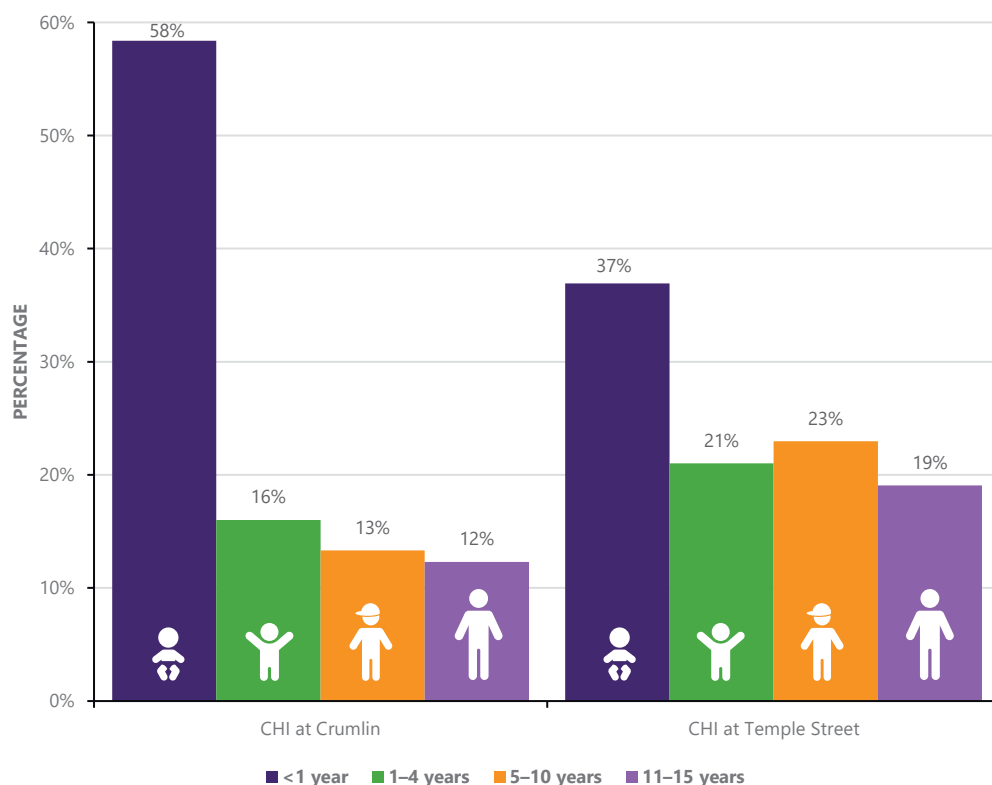


FIGURE 4.7: AGE PROFILE OF CHILDREN IN CHILDREN'S HEALTH IRELAND AT CRUMLIN AND CHILDREN'S HEALTH IRELAND AT TEMPLE STREET, 2020 (N=1377)

The age distribution of children admitted to PCCUs in the ROI between the years 2018 and 2020 is presented in Figure 4.8. Just over one-half (n=2253, 52%) of children admitted were infants aged under 1 year.

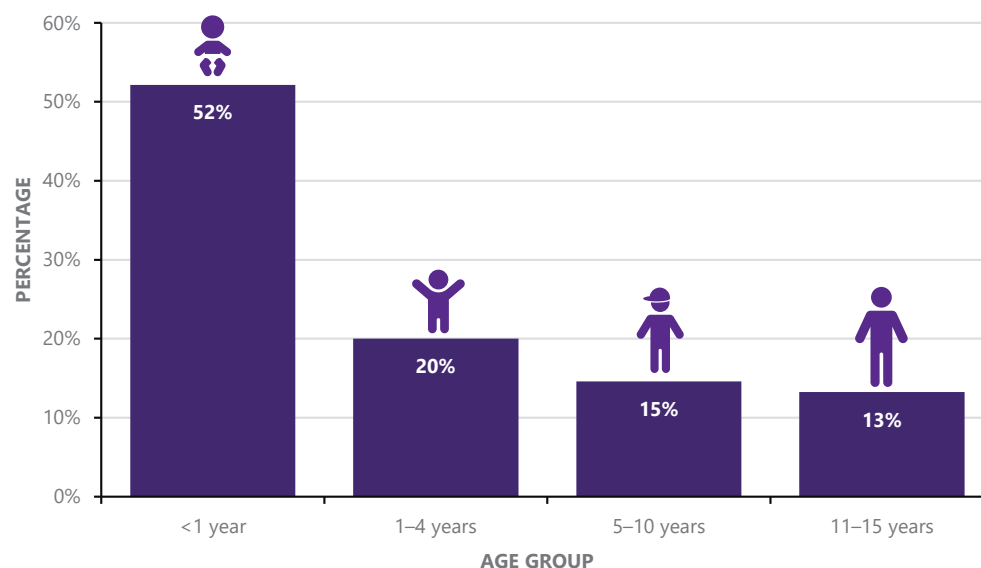


FIGURE 4.8: AGE PROFILE OF CHILDREN IN PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, 2018-2020 (N=4320)

NEONATAL ADMISSIONS

CHI at Crumlin provides both general and cardiac surgical neonatal services, while CHI at Temple Street provides neurological, neurosurgical, and metabolic expertise at tertiary care level. Newborns ranging in age from 23 weeks to 1 month corrected gestational age are admitted from maternity hospitals to PCCU or may be referred for multidisciplinary team input subspecialist care, for example, ear, nose and throat (ENT), nephrology, gastroenterology, etc. Neonates may also be admitted with acute respiratory distress, for example, respiratory syncytial virus (RSV) infection, sepsis or neurological issues. Of particular note, in 2020, 39% of neonatal admissions were cardiology/cardi thoracic admissions in CHI at Crumlin. It is important to capture and report these neonatal data, as the ROI Units are one of the few PCCUs participating in PICANet to have up to 30% of all admissions in the neonatal age category with a large proportion aged under 38 weeks.

Figure 4.9 presents the number of neonatal admissions to PCCU over the 3-year reporting period by their gestational age at delivery in weeks. Neonatal admissions were defined as aged at or under 28 days at time of admission to PCCU. Forty-two neonates aged under 28 weeks were admitted to PCCU over the 3-year period mainly for surgical procedures. In CHI at Crumlin, there were 643 neonatal admissions (219 in 2020); 40% (n=257) of whom were born preterm and 81% (n=208) of which were moderate-to-late preterm (33–37 weeks). In CHI at Temple Street, there were 216 neonatal admissions (76 in 2020); 61% (n=132) of whom were born preterm and 71% (n=94) of which were moderate-to-late preterm (33–37 weeks). During the reporting period, neonatal admissions accounted for 21% of the total admissions to CHI at Crumlin and 17% for CHI at Temple Street.

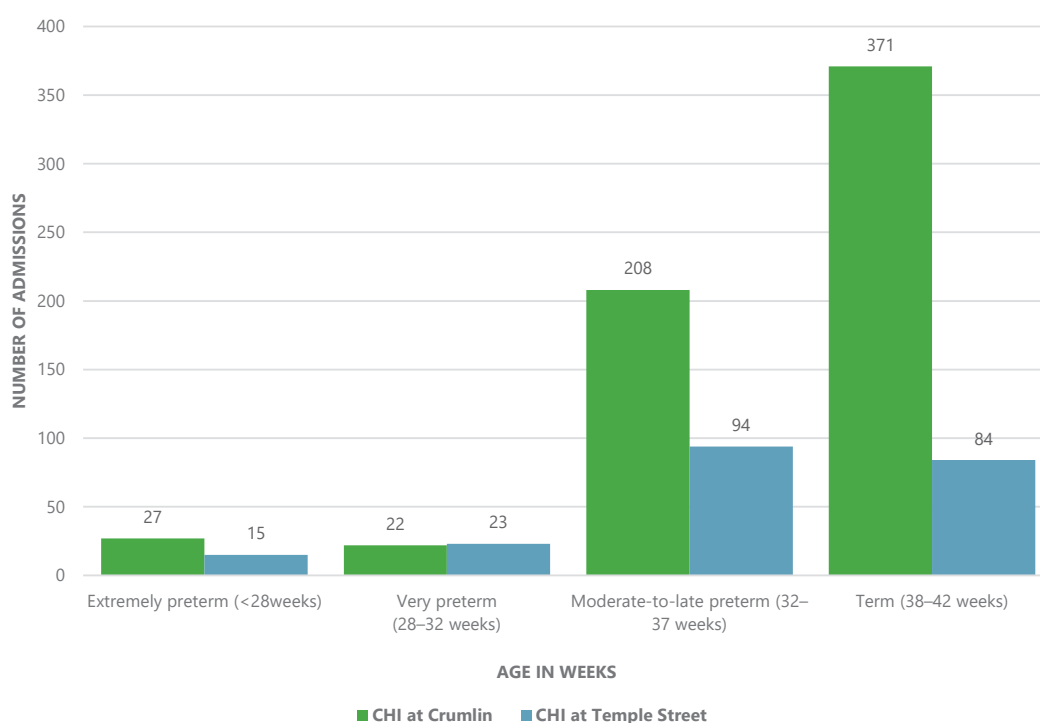


FIGURE 4.9: NEONATAL ADMISSIONS TO CHILDREN'S HEALTH IRELAND AT CRUMLIN (N=628) AND CHILDREN'S HEALTH IRELAND AT TEMPLE STREET (N=216), BY GESTATIONAL AGE (WEEKS) AT DELIVERY, 2018–2020²

² Fifteen admissions had a gestational age recorded as unknown in CHI at Crumlin and thus have been excluded from Figure 4.9.

NEONATAL ADMISSIONS BY PRIMARY DIAGNOSIS GROUP

Figure 4.10 presents the breakdown of primary diagnosis of neonatal admissions to PCCU in 2020 (n=291); the majority were due to cardiovascular problems (n=114, 39%), followed by respiratory problems (n=58, 20%).

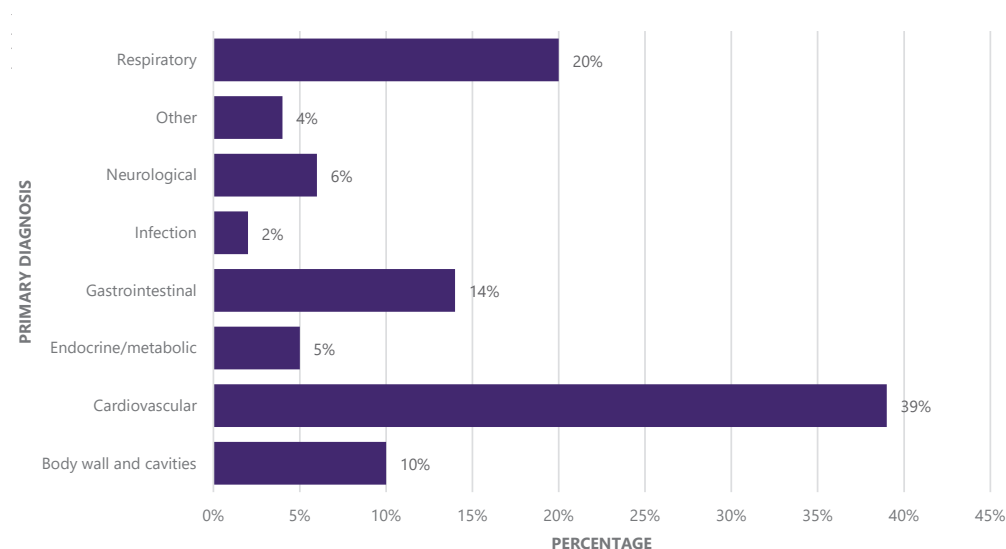


FIGURE 4.10: NEONATAL ADMISSIONS TO PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, BY PRIMARY DIAGNOSIS, 2020 (N=291)^{3,4}

Figures 4.11a and 4.11b present the breakdown of neonatal admissions to each PCCU during 2018–2020. In CHI at Crumlin, almost 50% (n=318) of neonates were admitted due to cardiovascular problems, followed by respiratory problems (n=108, 17%). Almost one-third (n=204, 32%) of neonatal admissions to CHI at Crumlin required surgery. In contrast, in CHI at Temple Street, respiratory problems (n=66, 31%) and gastrointestinal problems (n=56, 27%) were the main reasons for admission. Almost 15% (n=31) of neonatal admissions to CHI at Temple Street required surgery.

Coding of admissions in PICANet provides a non-specific picture of complex surgical and medical patients. For example, the body wall and cavities diagnosis category may refer to general surgery, laparotomy, congenital diaphragmatic hernia (CDH), or trachea-oesophageal hernia, as can gastrointestinal diagnosis categories. In order to provide a more complete picture of the ROI PCCU population, data need to be subcategorised into general surgery, cardiac surgery, neurology or neurosurgery, and provide audit data on complexity and outcomes of these specific patient subgroups.

³ Other includes: Oncology, Blood/lymph, Multisystem, Musculoskeletal, Trauma.

⁴ Excludes four cases where diagnosis was not recorded.

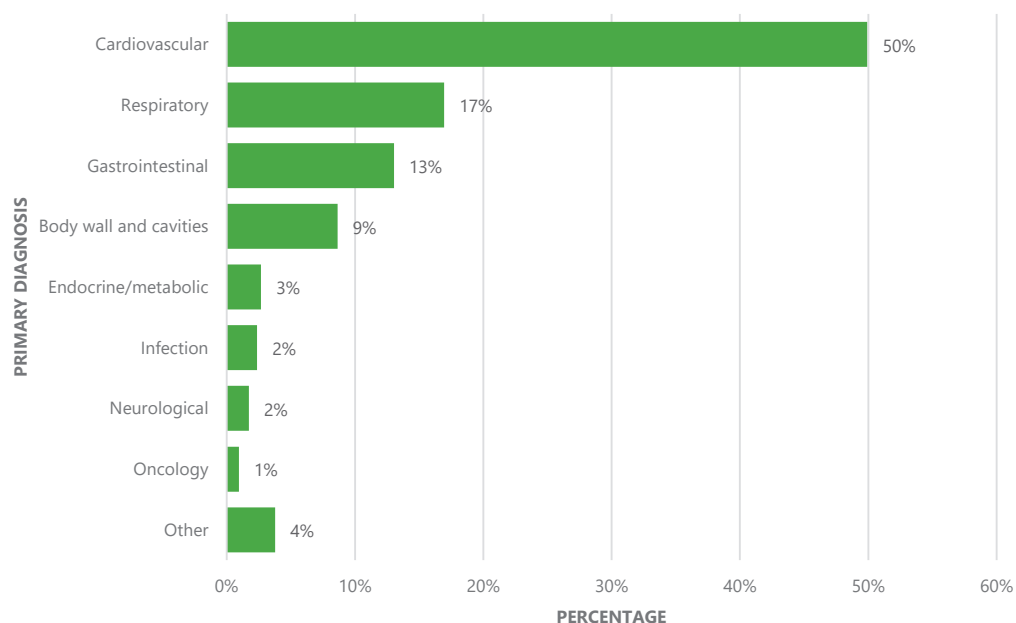


FIGURE 4.11A: NEONATAL ADMISSIONS TO CHILDREN'S HEALTH IRELAND AT CRUMLIN PAEDIATRIC CRITICAL CARE UNIT, BY PRIMARY DIAGNOSIS, 2018-2020 (N=637)⁵

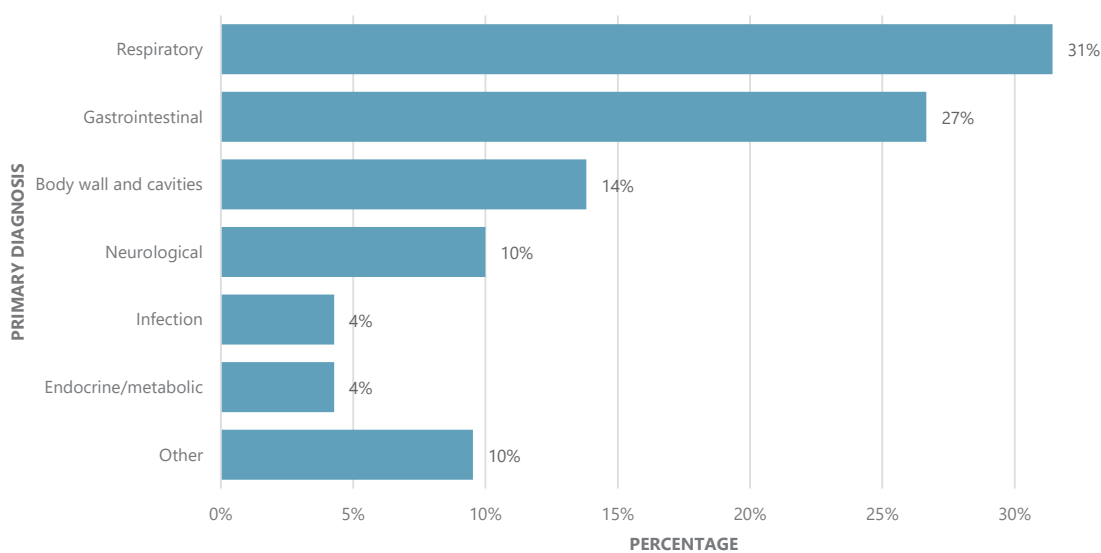


FIGURE 4.11B: NEONATAL ADMISSIONS TO CHILDREN'S HEALTH IRELAND AT TEMPLE STREET PAEDIATRIC CRITICAL CARE UNIT, BY PRIMARY DIAGNOSIS, 2018-2020 (N=210)⁶

⁵ Other includes: Musculoskeletal, Trauma, Blood/lymph.

⁶ Other includes: Musculoskeletal, Cardiovascular, Oncology, Multisystem.

ADMISSIONS BY PRIMARY DIAGNOSIS GROUP

Admission by primary diagnosis group varied by Unit. The number of admissions to each Unit in 2018–2020 grouped by primary diagnosis is outlined in Figure 4.12a and 4.12b. In CHI at Crumlin, the largest proportion of patients admitted to PCCU each year were those with cardiovascular diagnoses. This finding is not surprising as CHI at Crumlin is the tertiary referral centre for paediatric cardiothoracic surgery and cardiology. Respiratory diagnoses accounted for between 18% and 25% of admissions in this Unit.

The pattern of admission over the 3-year reporting period differed for CHI at Temple Street, where the largest proportion of patients were admitted for respiratory diagnoses, followed by neurological diagnoses, including all neurosurgical cases requiring PCCU care.

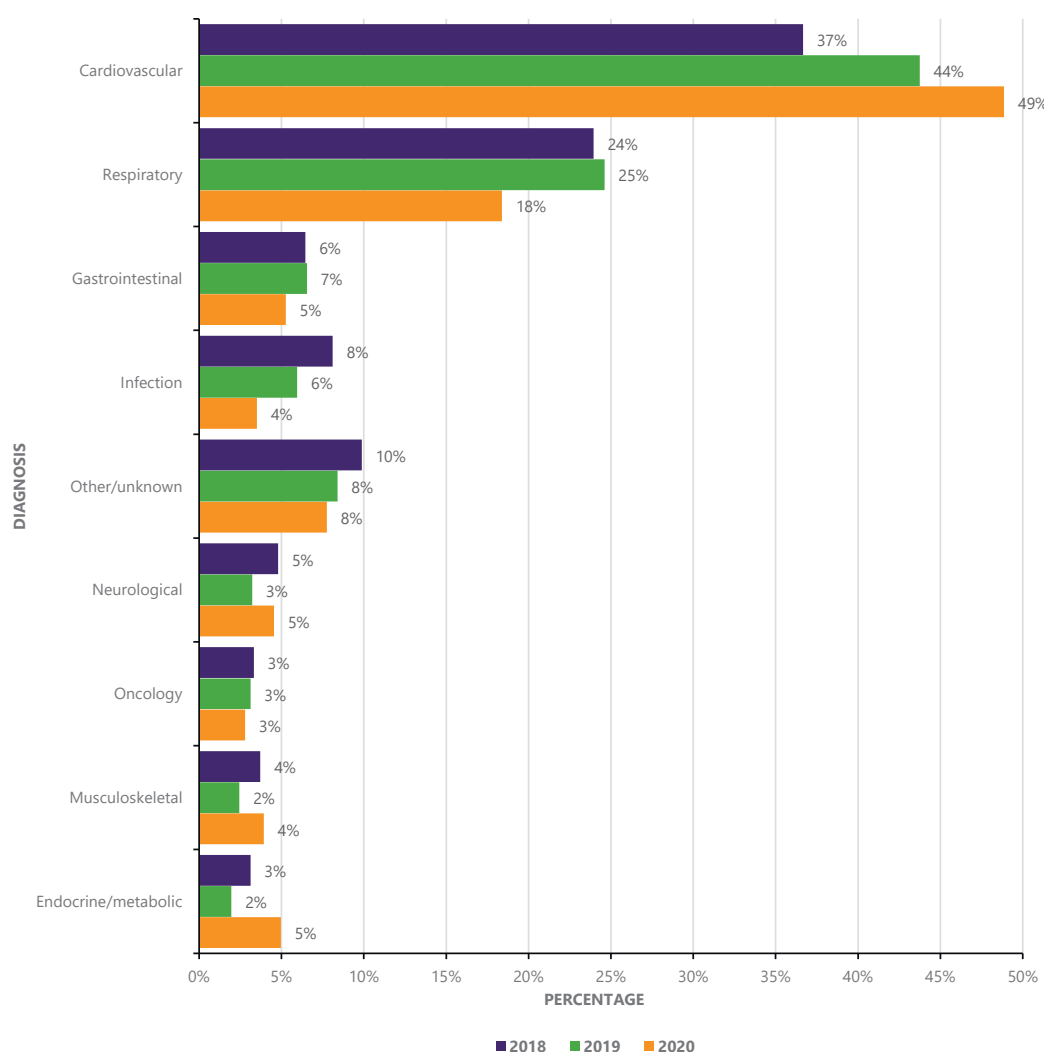


FIGURE 4.12A: ADMISSIONS TO CHILDREN'S HEALTH IRELAND AT CRUMLIN PAEDIATRIC CRITICAL CARE UNIT, BY PRIMARY DIAGNOSIS AND YEAR, 2018–2020 (N=3015)

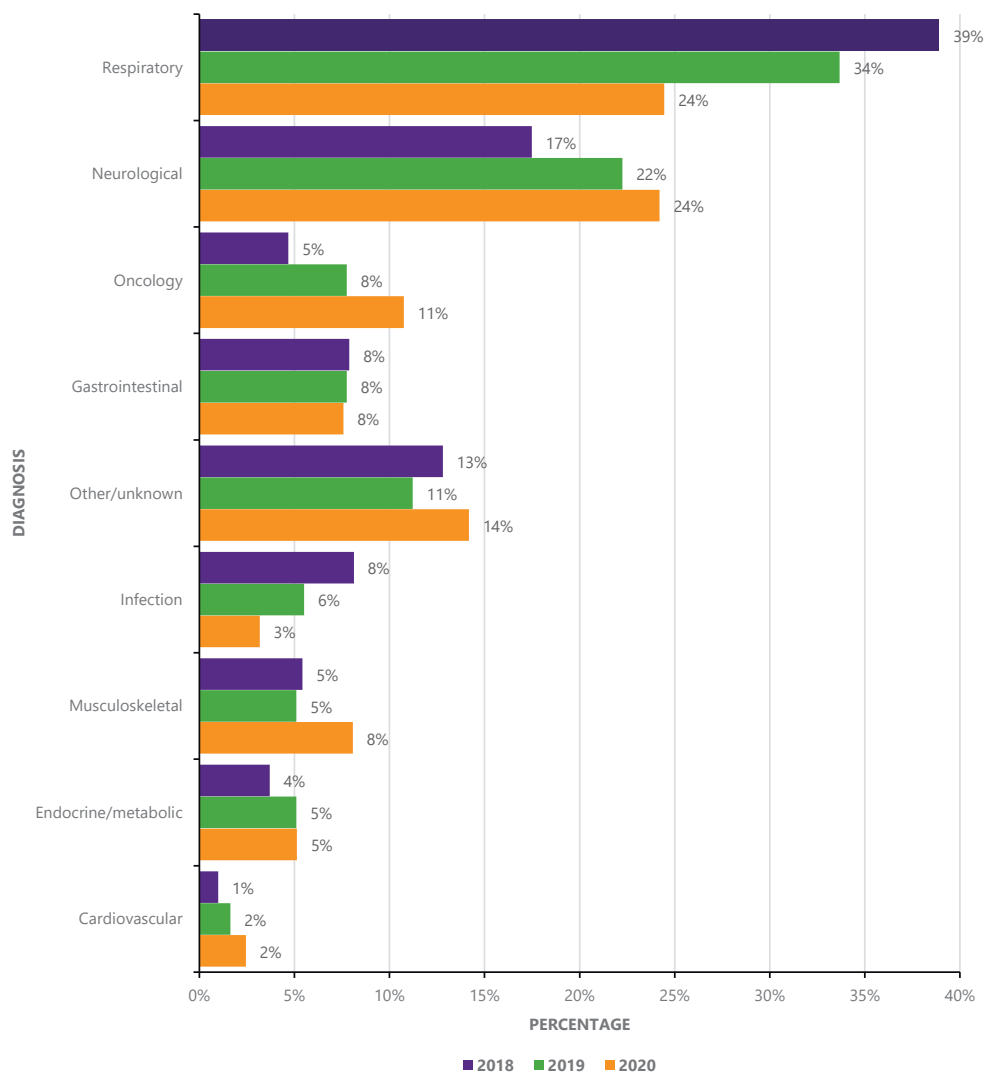


FIGURE 4.12B: ADMISSIONS TO CHILDREN'S HEALTH IRELAND AT TEMPLE STREET PAEDIATRIC CRITICAL CARE UNIT, BY PRIMARY DIAGNOSIS AND YEAR, 2018-2020 (N=1305)

TIME OF ADMISSION AND DISCHARGE

Over the 3-year reporting period, the majority of patients were admitted and discharged in the afternoon (see Figures 4.13 and 4.14). Over one-third (n=1507, 34%) of all admissions to PCCUs in the ROI were admitted out-of-hours between 20.00 and 07.59 (see Figure 4.13), while 10% (n=444) of patients were discharged during this time (see Figure 4.14). An out-of-hours discharge of a patient is suboptimal and should be avoided where possible. It is important to record the reason for late discharges. For example, there may be no bed available on the ward and in order to facilitate the admission of a critically ill patient a direct swap may take place. Annual audit should record the reasons for out-of-hours discharges and clearly indicate if ward capacity is the issue and communicate this to hospital management. This is important as during the evening and night-time there is reduced medical and nursing staff availability on the wards, and senior staff are less likely to be available to review a patient. In addition, it is less likely that a parent/guardian will be present to accompany the child if the discharge occurs during the night.

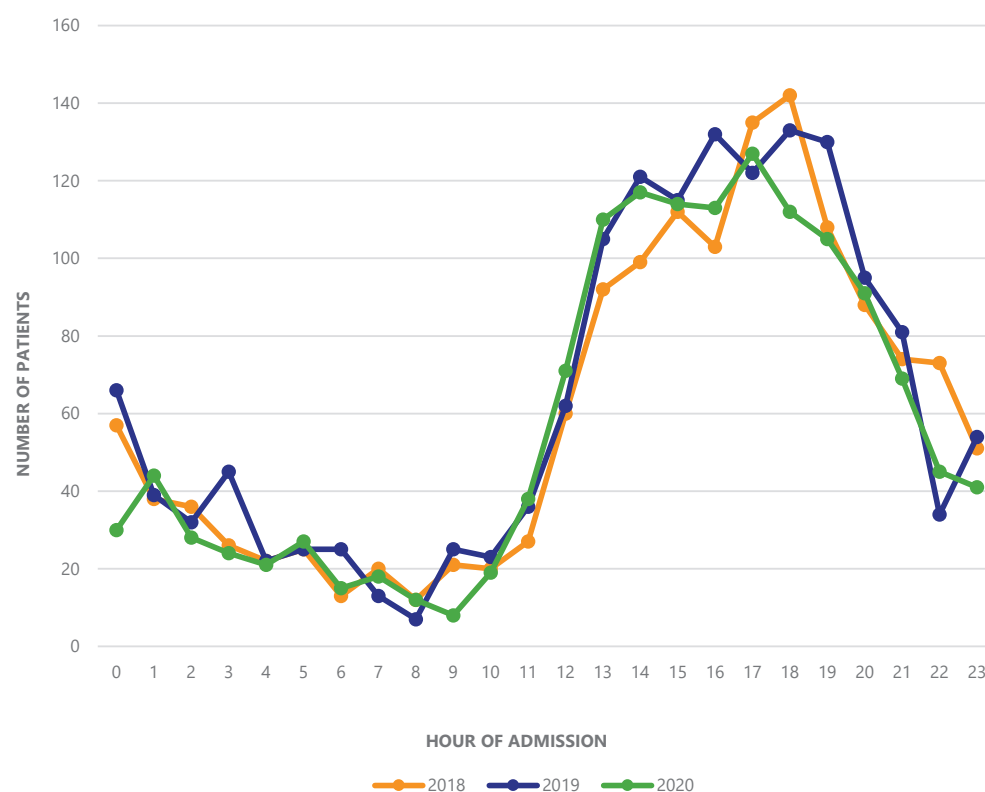


FIGURE 4.13: NUMBER OF PATIENTS ADMITTED TO PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, BY HOUR, 2018–2020

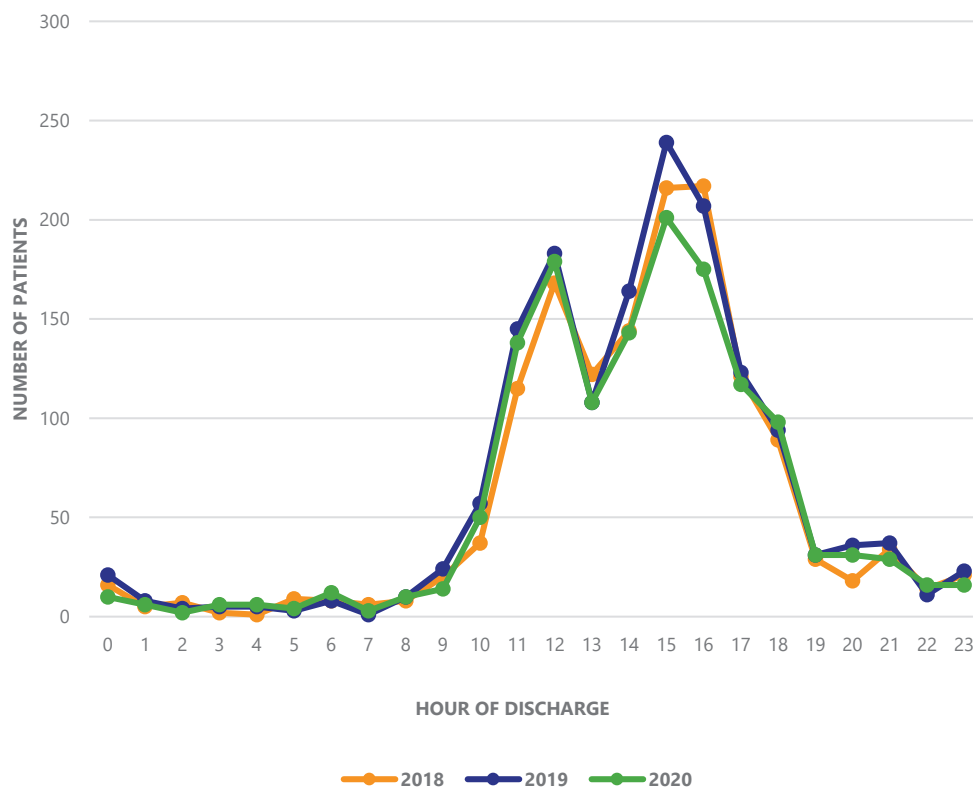


FIGURE 4.14: NUMBER OF PATIENTS DISCHARGED FROM PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, BY HOUR, 2018-2020

ADMISSIONS OF CHILDREN TO ADULT INTENSIVE CARE UNITS

Prior to 2019, there was no system in place to capture and collect validated data on children aged under 16 years who were cared for in hospitals without specialised paediatric critical care. However, with the introduction of the ICNARC, and the collection of data from each adult ICU in the ROI, these data have now become available.

It is important to state that in some cases children are best cared for in a regional High Dependency Unit, as outlined in the *Model of Care for Paediatric Critical Care* (National Clinical Programme for Critical Care and National Clinical Programme for Paediatrics, 2019), but accurate audit of data on children cared for locally is essential to provide evidence that this is in the best interests of ill children. This includes evidence that outcomes are measured, that Paediatric Index of Mortality (PIM) and diagnoses are recorded, and that data are published annually as in tertiary PCCUs.

In 2019, 111 children aged under 16 years were admitted to adult ICUs in the ROI, which decreased to 68 children in 2020 and may be related to the impact of the COVID-19 pandemic. Of these 68 children, 5 (7%) were aged under 1 year and 16 (24%) were aged under 6 years. Of particular note, 21 (31%) of these patients required invasive ventilation (see Table 4.3).

TABLE 4.3: CHILDREN AGED <16 YEARS ADMITTED TO ADULT INTENSIVE CARE UNITS: AGE, CASE MIX, VENTILATION, LENGTH OF STAY, AND SURVIVAL TO HOSPITAL DISCHARGE (2019–2020)

Parameter	2019	2020
Patients <16 years old	111	68
Age, mean (median; interquartile range (IQR))	7.5 (8; 2–13)	9 (12; 5–14)
Aged <1 year	18	5
Age 1–6 years	44	16
Admissions after surgery	34	7
Admissions with sepsis	22	11
Invasive ventilation	20 (18%)	21 (31%)
Unit LOS, mean (median; IQR) (hours)	27 (18; 12–24)	38.5 (16; 10–32)
Unit survivors	110 (99%)	67 (99%)
Hospital survivors	107 (96%)	65 (96%)

Source: NOCA (2022), *Irish National ICU Audit National report 2020*

Table 4.4 outlines the number of children admitted to adult ICU in 2020, by hospital. The Unit with the largest number of children was University Hospital Galway ICU (n=27), followed by Cork University Hospital General ICU (n=10). The mean length of stay (LOS) for children was short in University Hospital Galway (21 hours); it may be because their condition was expected to improve quickly or may indicate they were awaiting specialist transfer to a paediatric unit if ICU care was going to be prolonged. Just over one-half (52%) of these children were aged under 6 years (n=14) and 6 patients (22%) were ventilated.

Children in adult ICUs present particular challenges with respect to staffing the Unit with nurses trained in paediatric critical care, as per national standards. The *Model of Care for Paediatric Critical Care* (National Clinical Programme for Critical Care and National Clinical Programme for Paediatrics, 2019) states that if a patient is ventilated or stays for longer than 24 hours, communication with a PCCU and transfer out is recommended. It is recognised that this may pose a difficulty for families where geographical distance is a factor, but adherence to national and international standards regarding the care of children in adult ICUs is recommended.

TABLE 4.4: NUMBERS OF PATIENTS IN ADULT INTENSIVE CARE UNITS, BY AGE, LENGTH OF STAY, AND NUMBERS VENTILATED (N=68)

	Patients <1 year	Patients 1-6 years	Patients 7-16 years	Total (n)	Mean LOS (hours)	Ventilated (n)
Beaumont Neuro ICU	0	0	2	2	50	0
Mater (MMUH) ICU	0	0	1	1	184	1
Tallaght ICU	0	0	1	1	18	0
Galway ICU	3	11	13	27	21	6
Limerick ICU	0	0	1	1	14	0
Waterford ICU	0	1	4	5	42	1
Mullingar ICU	0	0	1	1	7	1
Wexford ICU	0	0	4	4	40	2
St Vincent's ICU	0	0	1	1	574	1
Cork CT ICU	0	0	1	1	4	1
Cork GICU	0	0	10	10	46	5
Letterkenny ICU	2	2	2	6	14	3
University Hospital Kerry	0	2	6	8	29	0

Source: NOCA (2022), *Irish National ICU Audit National report 2020*

KEY FINDINGS FROM CHAPTER 4

- The total admissions for the UK and the ROI (N=16429) decreased by 19% from 2019.
- There was a total of 1,399 admissions in the ROI in 2020, which was a 9% decrease from 2019.
- CHI at Crumlin had the third-highest number of admissions for the UK and the ROI in 2020 (n=968).
- The ROI rate of admission was 121.3 per 100,000 childhood population (a decrease from 133.4 in 2019) and the second-highest rate after Scotland (136.4).
- 52% of admissions were unplanned (emergency).
- 41% of admissions were following surgery, which was a 10% increase from 2018 (31%).
- Primary diagnoses of patients in PCCU:
 - CHI at Crumlin: 49% were cardiovascular (a 12% increase from 2018) and 18% were respiratory.
 - CHI at Temple Street: 24% were neurological (a 7% increase from 2018) and 24% were respiratory.
- 34% of admissions and 10% of discharges in the ROI were out-of-hours (2018–2020).
- Children in adult ICUs: there were 68 admissions in 2020 (a decrease from 111 in 2019):
 - 40% were admitted to Galway ICU and 16% admitted to Cork ICUs.
 - 31% were aged under 6 years, 31% required invasive ventilation, the median LOS was 38.5 hours, and there were 11 admissions with sepsis (a 50% decrease from 2019).



CHAPTER 5 **BED ACTIVITY AND OCCUPANCY IN PAEDIATRIC CRITICAL CARE UNITS**

CHAPTER 5: BED ACTIVITY AND OCCUPANCY IN PAEDIATRIC CRITICAL CARE UNITS

NUMBER OF BEDS DELIVERED

The total number of bed days delivered is calculated as the sum of children receiving critical care in a PCCU each day. A 'bed day' is counted if a child is in a PCCU bed for part of any day during the reporting period. National figures of bed days delivered for individual countries are presented in Table 5.1 and total figures for individual Units over the 3-year reporting period are illustrated in Figure 5.1.

From PICANet data, the number of bed days provided fluctuated throughout the 3-year reporting period in all admitting countries. The average number of bed days delivered by the two PCCUs in the ROI within this reporting period was 9,960 annually; however, the number decreased significantly in 2020 (by over 1,000 bed days). More than three-quarters (76%) of the bed days per annum were provided in the Unit in CHI at Crumlin.

TABLE 5.1: NUMBER OF BED DAYS DELIVERED, BY COUNTRY OF ADMISSION AND YEAR ⁷

Country	2018	2019	2020
ENGLAND (NHS)	117 425	115 088	91 393
SCOTLAND	10 319	12 055	8666
NORTHERN IRELAND	3275	3422	2669
WALES	2509	2626	2117
REPUBLIC OF IRELAND	10 176	10 393	9312
TOTAL	143 704	143 584	114 157

⁷ Figures include children admitted prior to the reporting period, but discharged during it, counted from 00.00 on 1 January 2018 until discharge (or until 23.59 on 31 December 2020 if not discharged). Children admitted during the reporting period but discharged in 2020 are counted from admission date until 23.59 on 31 December 2020.

The total bed days delivered for each Unit during 2020 is illustrated in Figure 5.1. Data for each PCCU in the ROI by year are provided in Figure 5.2. The number of bed days delivered showed a decline in 2020 for both CHI at Crumlin and CHI at Temple Street. For this reporting period, CHI at Crumlin had the third-highest number of bed days of all PCCUs in the UK and the ROI, after Birmingham Children's Hospital and Great Ormond Street Hospital. Throughout the reporting period in the ROI, the majority of bed days were occupied by the youngest children (aged under 1 year) (see Figure 5.3a). In 2020, children aged under 1 month accounted for the highest proportion of bed days in both Units (see Figure 5.3b).

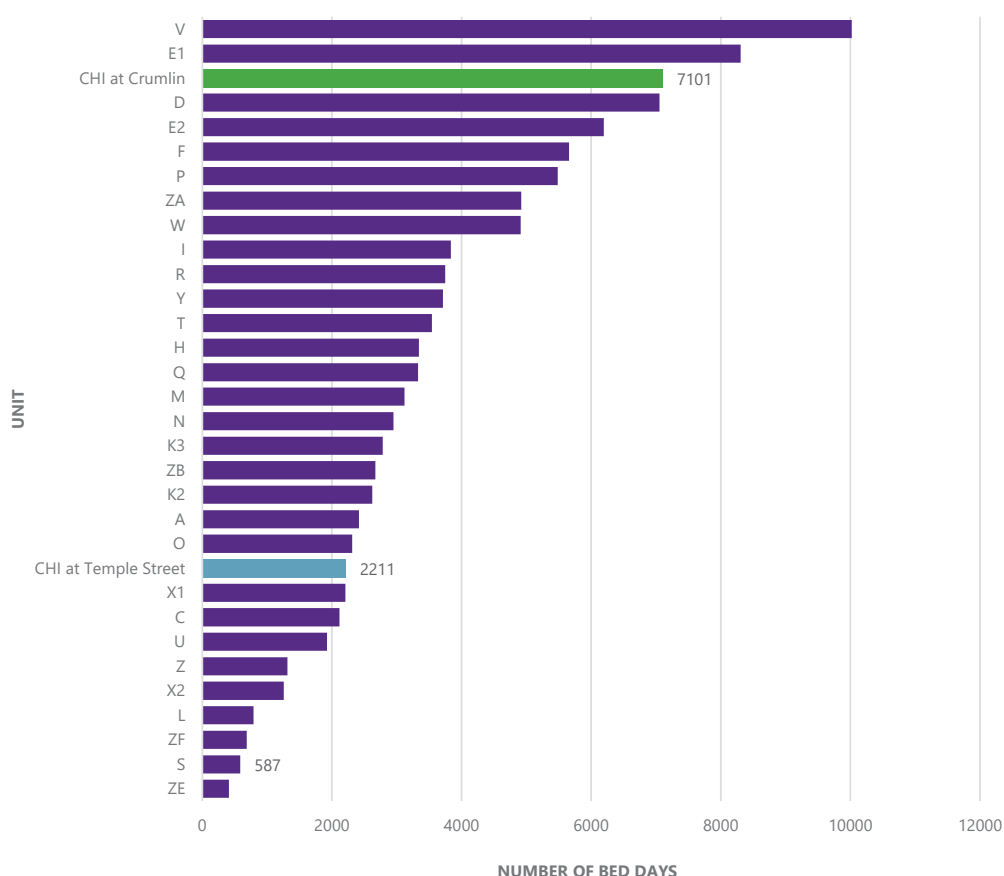


FIGURE 5.1: NUMBER OF BED DAYS DELIVERED BY EACH UNIT PARTICIPATING IN THE PAEDIATRIC CRITICAL CARE AUDIT NETWORK, UNITED KINGDOM AND REPUBLIC OF IRELAND, 2020⁸

⁸ Figures include children admitted prior to the reporting period, but discharged during it, counted from 00.00 on 1 January 2020 until discharge (or until 23.59 on 31 December 2020 if not discharged).

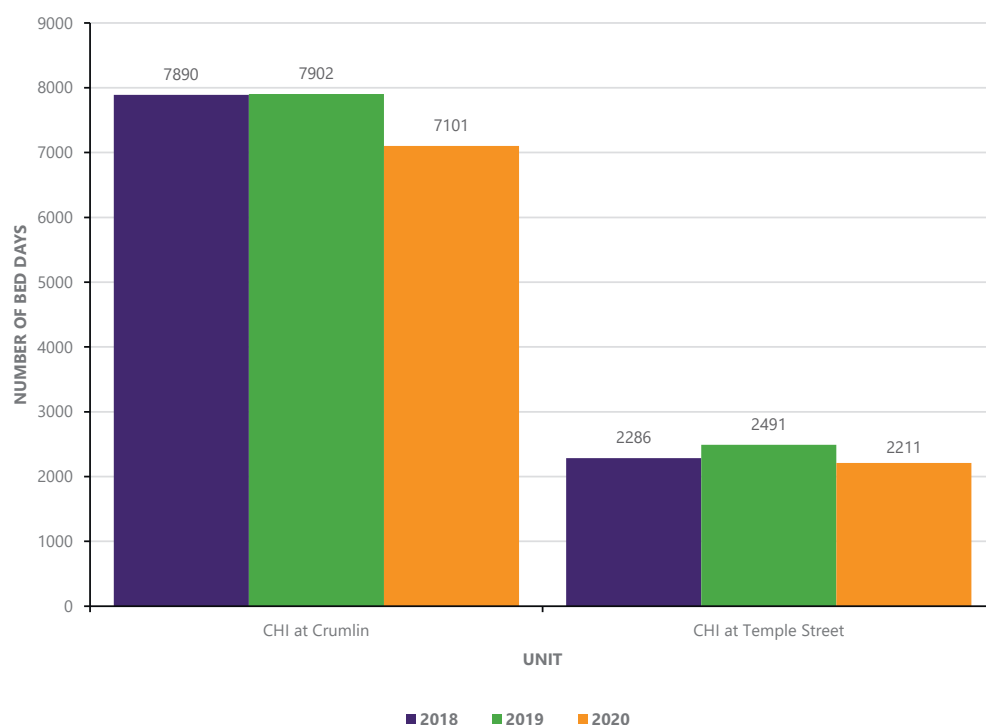


FIGURE 5.2: NUMBER OF BED DAYS DELIVERED IN PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, BY YEAR, 2018–2020⁹

⁹ Figures include children admitted prior to, but discharged during, the reporting period, counted from 12.00am on 1 January 2017 until discharge (or until 11.59pm on 31 December 2019 if not discharged during the reporting period). Children admitted during the reporting period but discharged in 2020 are counted from admission date until 11.59pm on 31 December 2019.

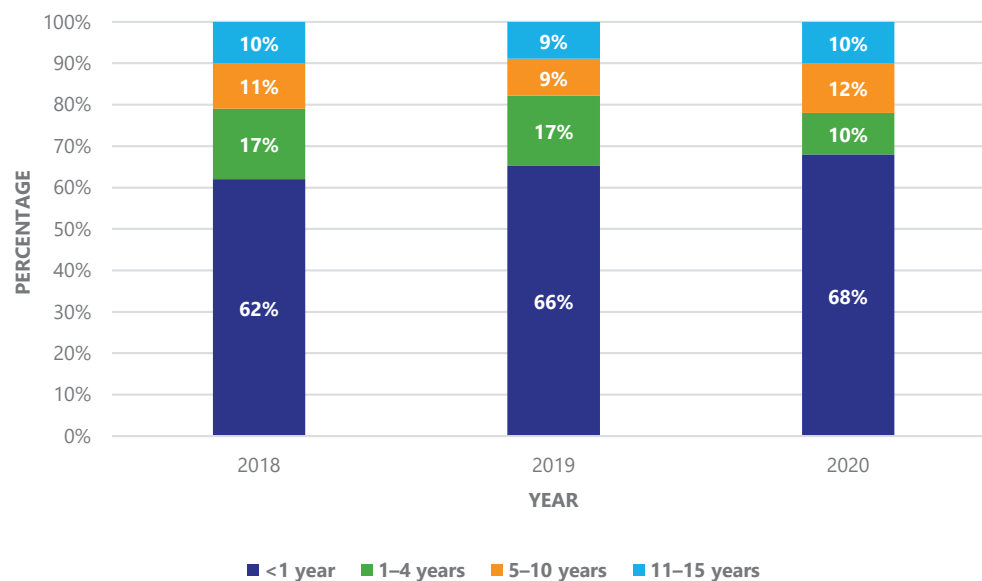


FIGURE 5.3A: PERCENTAGE OF BED DAYS DELIVERED IN PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, BY AGE, 2018-2020

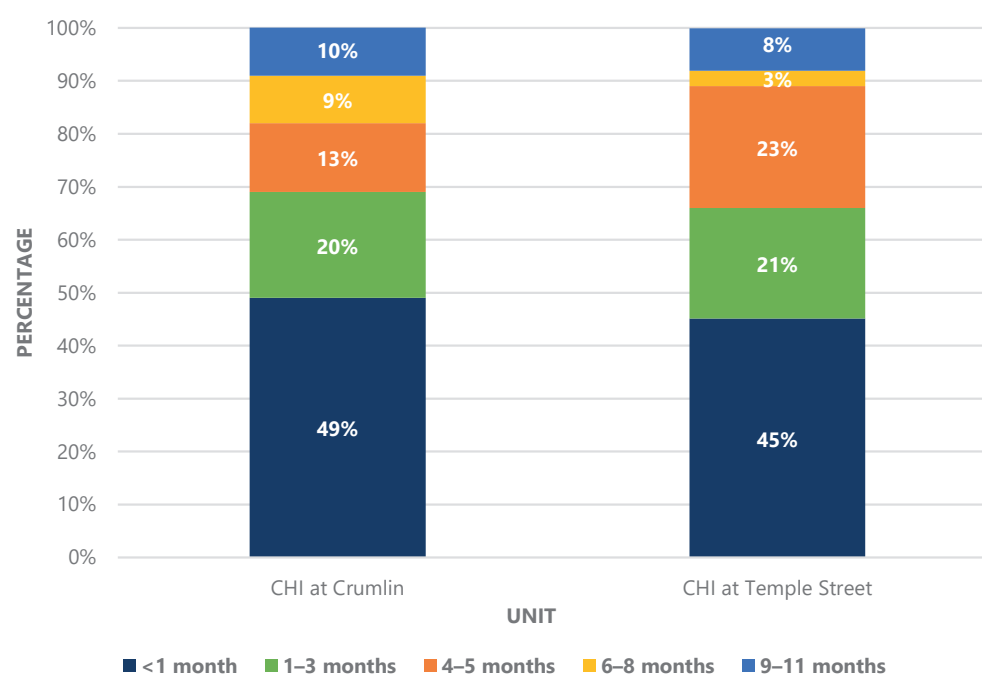


FIGURE 5.3B: PROPORTION OF BED DAYS DELIVERED IN PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, FOR CHILDREN AGED UNDER 1 YEAR, BY INFANT AGE IN MONTHS, 2020

BED OCCUPANCY IN PCCU IN THE ROI

Accurate daily bed data are required for the planning and delivery of PCCU services. These data should be collected twice daily in order to reflect changes in staffing during the twice-daily nursing shift system. The physical number of beds does not reflect bed availability, occupancy, or issues with staffing. An actual PCCU bed should reflect national PCCU standards for medical and nursing staff cover.

For the period 2018–2020, CHI at Crumlin had 25 bed spaces available, which reduced to 23 bed spaces in April and May 2020 due to COVID-19 pandemic requirements for social distancing and placement of protective screens between bed spaces. Average bed numbers open and staffed during 2020 was 22.4. Bed occupancy for each Unit, expressed as the percentage of bed days used out of the total bed days available each year, is outlined in Figure 5.4. The proportion of bed occupancy for CHI at Crumlin has decreased substantially between 2019 and 2020, from 100% (n=8006) in 2019 to 88% (n=8191) in 2020, and reflects an overall reduction in admission numbers and bed days used nationally and internationally due to the reduction of other illnesses during lockdown. These data do not reflect acuity, where one bed could require a nurse–patient ratio of 3:1; for example, if the patient is on extracorporeal life support (ECLS) or continuous venovenous haemodialysis (CVVH).

Detailed local data for daily bed availability in CHI at Temple Street were unavailable for 2018. Recording has been updated and data are now available for 2019 and 2020. CHI at Temple Street had 9 bed spaces available, of which an average of 7.5 per year were open and staffed. These data indicate that bed occupancy in CHI at Temple Street also decreased between 2019 and 2020, from 88% (n=2499) in 2019 to 82% (n=2730) in 2020 (see Figure 5.4). Bed occupancy figures for CHI at Crumlin exceeded the recommended limit of 85% each year, while CHI at Temple Street exceeded the recommended limit in 2019 (Joint Faculty of Intensive Care Medicine of Ireland, 2018).

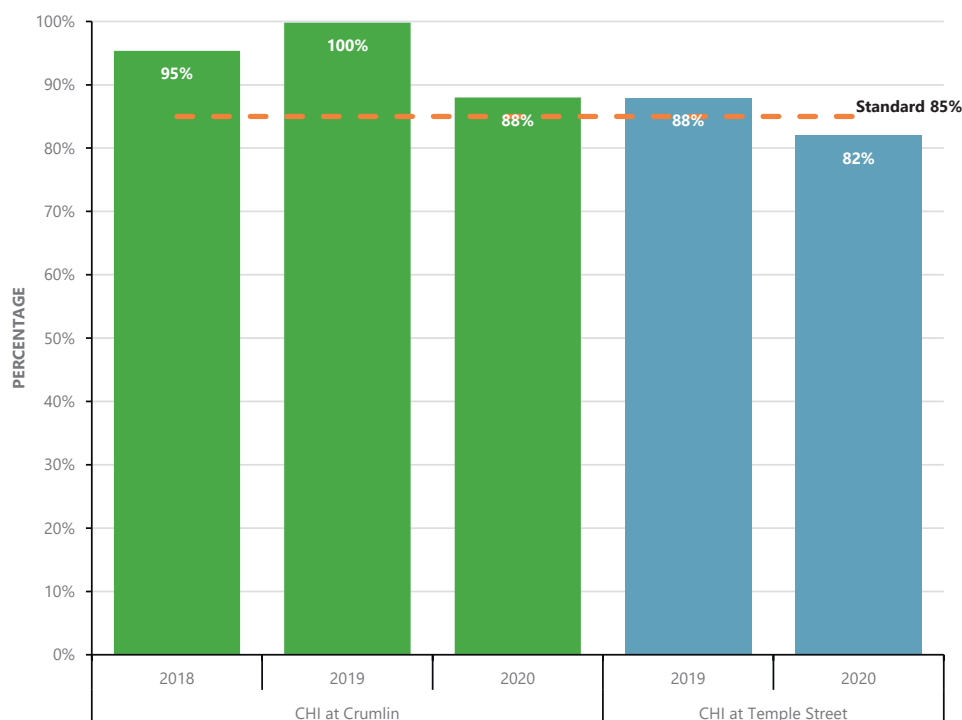


FIGURE 5.4: BED OCCUPANCY IN PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, 2018–2020¹⁰

¹⁰ Accurate data are not available for CHI at Temple Street for 2018.

Distribution of bed occupancy figures for each Unit by month for 2020 are outlined in Figure 5.5. These data indicate that bed occupancy was lower in the spring and summer months, which was most evident in CHI at Temple Street, reflecting unplanned admissions from outside Dublin that are transferred there due to bed availability. For CHI at Crumlin, this seasonal variation was less evident in 2020, reflecting more planned admissions due to scheduled cardiothoracic and other semi-elective surgery and a cohort of children with complex illnesses who require care throughout the year. Both PCCUs experienced high occupancy levels in the winter months during 2020. These data do not reflect the complexity of collecting data to determine overall bed availability, occupancy, and staffing issues.

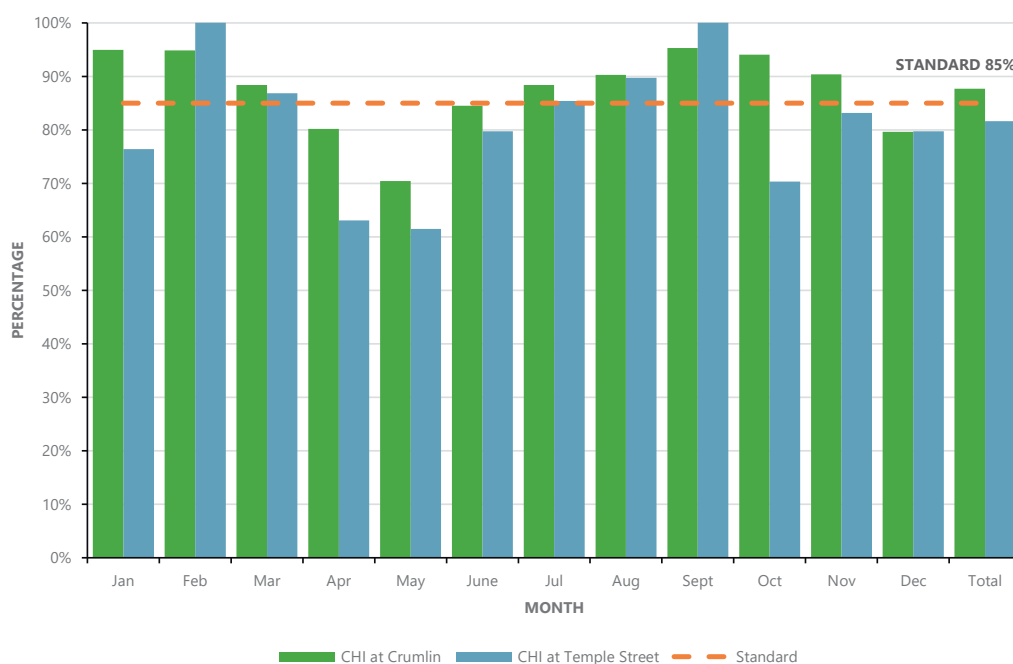


FIGURE 5.5: BED OCCUPANCY IN CHILDREN'S HEALTH IRELAND AT CRUMLIN PAEDIATRIC CRITICAL CARE UNIT, 2020 (N=7182 BED DAYS USED OF 8191 BED DAYS AVAILABLE) AND CHILDREN'S HEALTH IRELAND AT TEMPLE STREET PAEDIATRIC CRITICAL CARE UNIT (N=2229 BED DAYS USED OF 2730 BED DAYS AVAILABLE), 2020

LENGTH OF STAY

Median length of stay (LOS) for each Unit is presented in Table 5.2 as the median number of days, along with the interquartile range (IQR), by age group and year. In 2020, the median LOS in CHI at Crumlin was 2.75 days and in CHI at Temple Street was 1.74 days. In both PCCUs, the median LOS was highest for infants aged under 1 year, with CHI at Crumlin at 3.96 days and CHI at Temple Street at 2.99 days. LOS was higher for patients in CHI at Crumlin than for CHI at Temple Street for each age group and year examined.

TABLE 5.2: LENGTH OF STAY BY AGE GROUP, 2018–2020 (MEDIAN DAYS, INTERQUARTILE RANGE)

	2018		2019		2020	
	Median	IQR	Median	IQR	Median	IQR
	CHI at Crumlin					
<1 YEAR	4.24	(2.0–8.7)	4.03	(1.9–8.6)	3.96	1.8–7.6
1–4 YEARS	2.17	(1.0–4.6)	1.96	(1.0–4.5)	1.69	0.9–2.9
5–10 YEARS	2.04	(1.0–4.8)	1.73	(0.9–3.9)	1.78	0.9–4.2
11–15 YEARS	2.07	(1.0–4.6)	2.38	(1.0–4.1)	1.62	0.9–4.0
ALL AGES	3.08	(1.6–6.8)	3.08	(1.3–6.9)	2.75	1.1–6.5
	CHI at Temple Street					
<1 YEAR	2.60	(1.3–5.6)	2.08	(0.9–4.8)	2.99	1.2–5.3
1–4 YEARS	1.71	(0.8–5.1)	1.42	(0.8–3.5)	1.26	0.8–2.7
5–10 YEARS	1.55	(0.8–3.9)	1.05	(0.7–3.2)	1.49	0.8–3.8
11–15 YEARS	1.78	(1.0–6.8)	1.65	(0.7–4.3)	1.00	0.8–1.8
ALL AGES	1.92	(0.9–5.6)	1.70	(0.8–4.1)	1.74	0.9–4.1

The LOS in days (median, IQR) for patients by the six most common diagnosis groups and hospitals is presented in Table 5.3. The highest median length of stay in both CHI at Crumlin and CHI at Temple Street was for patients in the diagnosis group Infection (4.0 days and 3.5 days, respectively), followed by Respiratory, with a median LOS of 3.8 days and 2.9 days, respectively.

Once again more detailed subgroup analysis would be highly useful in future annual reports with a closer look at the Infection category. It would also be beneficial to have a detailed chapter on cardiovascular data to look at postoperative congenital cardiac and cardiology outcomes and more detailed data on postoperative neurosurgical and neurology outcomes.

TABLE 5.3: MEDIAN LENGTH OF STAY (INTERQUARTILE RANGE) IN PAEDIATRIC CRITICAL CARE UNITS BY PRIMARY DIAGNOSIS AND UNIT, 2018–2020¹¹

	CHI at Crumlin	CHI at Temple Street
Cardiovascular	3.0 days (1.7–6.7)	0.6 days (0.4–1.1)
Gastrointestinal	2.9 days (1.6–6.7)	2.7 days (1.0–6.0)
Infection	4.0 days (2.2–7.4)	3.5 days (1.8–6.3)
Musculoskeletal	1.1 days (0.9–2.0)	1.02 days (0.8–1.6)
Neurological	2.0 days (0.9–5.1)	1.5 days (0.8–3.4)
Respiratory	3.8 days (1.3–7.3)	2.9 days (1.2–5.7)

¹¹ Primary diagnosis group classification is based on the National Health Service (NHS) Clinical Terms Version 3 (The Read Codes).

KEY FINDINGS FROM CHAPTER 5

- 9,312 bed days were delivered in the ROI, which was a decrease of 1,000 from 2019.
- 68% of bed days were occupied by infants aged under 1 year.
- Average bed occupancy (the standard is less than 85%) in 2020:
 - The rate in CHI at Crumlin was 88%, which is a decrease from 100% in 2019.
 - The rate in CHI at Temple Street was 82%, which is a decrease from 88% in 2019
- Median LOS in 2020:
 - in CHI at Crumlin was 2.75 days.
 - in CHI at Temple Street was 1.74 days.
- Neonates had the highest LOS of all patients in both Units



CHAPTER 6

INTERVENTIONS AND OUTCOMES IN PAEDIATRIC CRITICAL CARE UNITS

CHAPTER 6: INTERVENTIONS AND OUTCOMES IN PAEDIATRIC CRITICAL CARE UNITS

DAILY ACTIVITY DATA: PAEDIATRIC CRITICAL CARE MINIMUM DATA SET (PCCMDS)

PICANet received daily activity data from 32 organisations over the 2018–2020 reporting period. These data cover paediatric patients of all age groups.

The purpose of the Paediatric Critical Care Minimum Data Set (PCCMDS) is to provide the basis for payment by results through the establishment of UK Healthcare Resource Groups (HRGs). HRGs were specified to take into account differing levels of activity in PCCUs. The data received by PICANet have been grouped into these HRGs using the *HRG4+ 2018/19 Reference Costs Grouping* (National Casemix Office, NHS UK, 2019). New HRG definitions highlight differences in the intensity and complexity of support provided in PCCUs. This is important in terms of beds days used, staffing, and bed availability (see Table 6.1). Definitions for the levels of paediatric critical care in the ROI are detailed in Appendix 4.

TABLE 6.1: DESCRIPTION OF THE HEALTHCARE RESOURCE GROUP DEFINITIONS USED IN THIS ANALYSIS

HRG definitions (used in this analysis)	Current HRG definition	Description
PCC High Dependency	Basic critical care	Monitoring and interventions, high flow oxygen therapy
PCC High Dependency Advanced	Intermediate critical care	Non-invasive mechanical ventilation, inotropic support
PCC Intensive Care Basic	Advanced critical care 1	Invasive ventilatory support and/or support for two or more organ systems
PCC Intensive Care Basic Advanced	Advanced critical care 2	Invasive ventilatory support and/or support for two or more organ systems
PCC Intensive Care Advanced	Advanced critical care 3	Complex interventions/organ support
PCC Intensive Care Advanced Enhanced	Advanced critical care 4	Complex interventions/organ support
PCC Intensive Care ECMO/ECLS	Advanced critical care 5	ECMO

There is still wide variation in the level of intensive care activity delivered in different PCCUs (see Figure 6.1). Some of this variation may reflect differences in practice between cardiac and non-cardiac PCCUs that make like-for-like comparisons less clear.

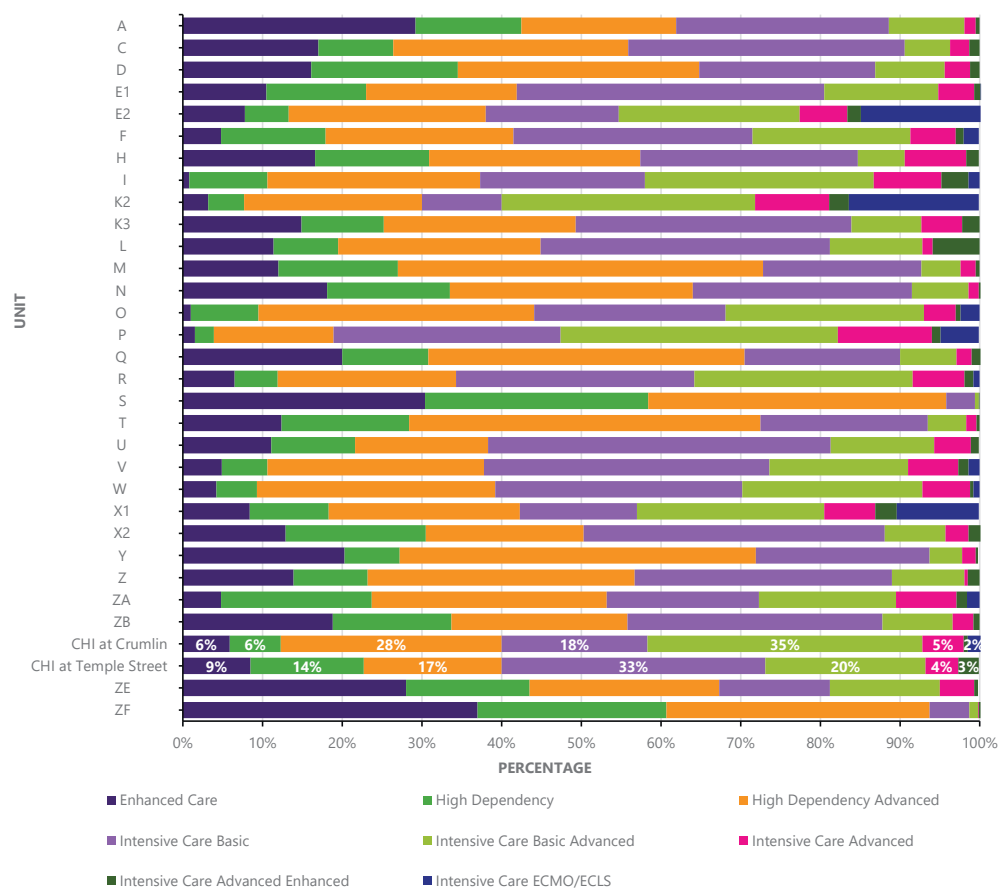


FIGURE 6.1: PROPORTION OF DAYS OF CARE DELIVERED AT EACH HEALTHCARE RESOURCE GROUP LEVEL, BY UNIT, 2018-2020

The proportion of days of care delivered over the reporting period of 2018–2020 at each HRG group level in CHI at Crumlin and CHI at Temple Street PCCUs is illustrated in Figure 6.2. The most frequent care delivered to patients in CHI at Temple Street was Level 1 (33%), followed by Level 2 (20%), with more complex care Level 3 and Level 4 at 7%. Patients in CHI at Crumlin most frequently received High Dependency Advanced (28%) and Level 2 (35%), with more complex care Levels 3, 4 and 5 accounting for 8%. This more complex care requires complex interventions and/or organ support for patients and higher nurse–patient ratios of 2:1 and 3:1.

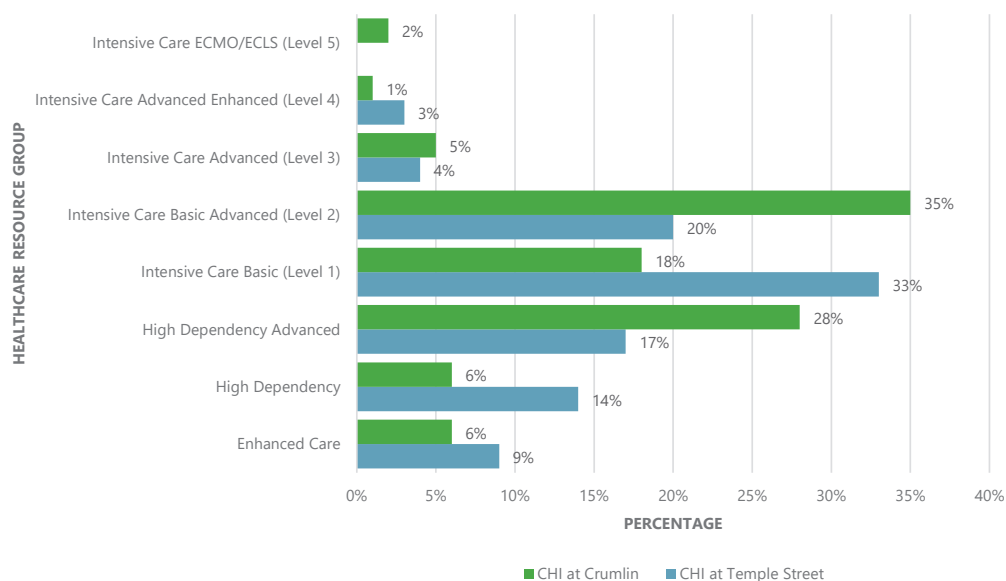


FIGURE 6.2: PROPORTION OF DAYS OF CARE DELIVERED AT EACH HEALTHCARE RESOURCE GROUP LEVEL IN PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, 2018–2020

INTERVENTIONS IN PCCUs IN IRELAND

Figure 6.3 illustrates the patient interventions carried out in the PCCUs in CHI at Crumlin and CHI at Temple Street in 2020. The most frequently used intervention for patients in both PCCUs during the reporting period was invasive ventilation (e.g. an endotracheal tube). There was a much greater use of vasoactive medication to support the patient's cardiovascular system in CHI at Crumlin (55%, n=533), compared with CHI at Temple Street (15%, n=63), which is reflected in the enhanced activity data in Figure 6.2. During the reporting period, 11% (n=45) of patients in CHI at Temple Street had an intracranial pressure (ICP) device placed due to the proportion of neurosurgery patients in that PCCU. The percentage of patients requiring renal support was broadly similar in both Units (3%) and 2% of patients (n=22) received ECMO in CHI at Crumlin.

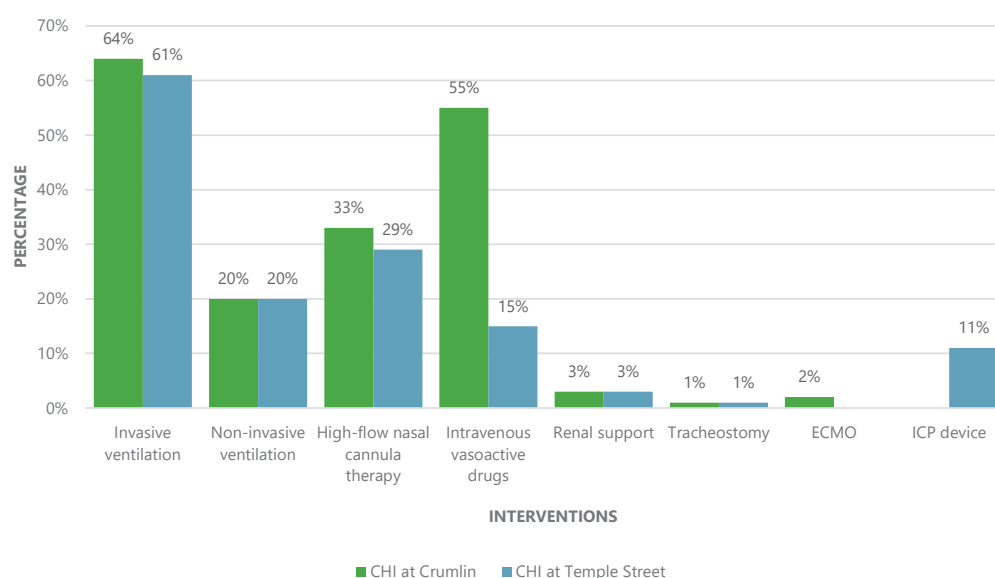


FIGURE 6.3: DAILY INTERVENTIONS WHILE IN PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, 2020

TYPE OF VENTILATION

Almost 50% of children admitted to each PCCU in the ROI underwent invasive ventilation, with a small additional percentage receiving non-invasive ventilation (see Figure 6.4).

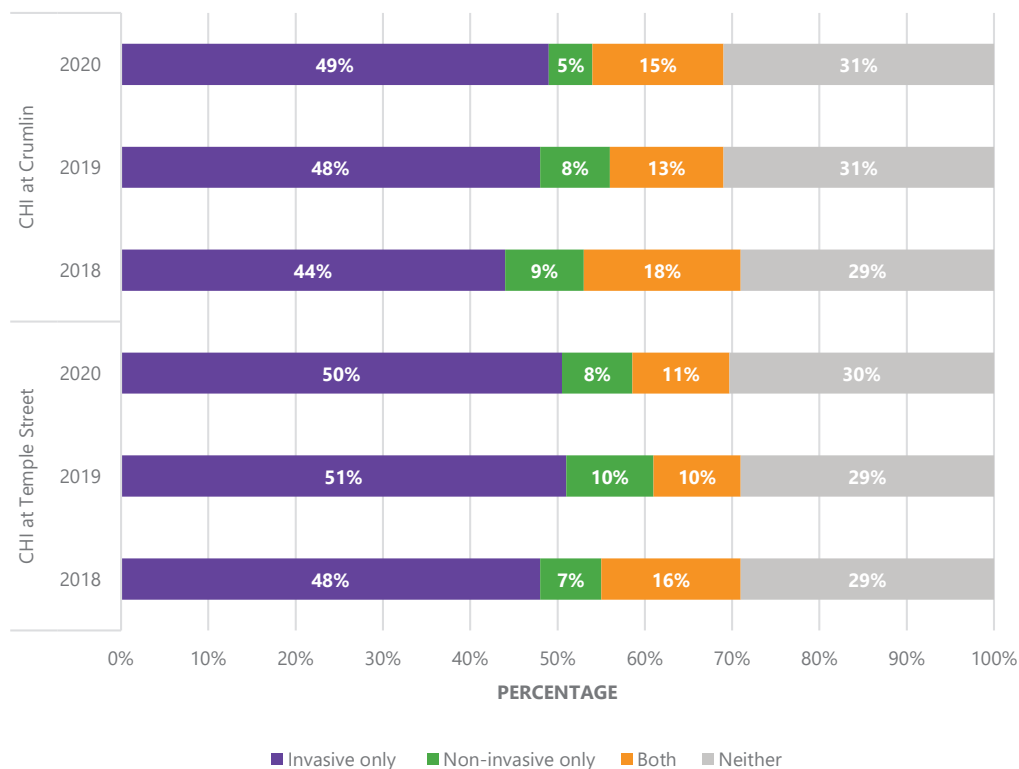


FIGURE 6.4: TYPE OF VENTILATION IN PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND, BY YEAR, 2018–2020

ECLS AT CHILDREN'S HEALTH IRELAND

The ECLS cardiac programme in CHI at Crumlin commenced in 2005 and is recognised as a centre of excellence by ELSO. The CHI at Crumlin PCCU had a total of 65 ECLS runs for the period 2018–2020 (see Table 6.2). A large number of these (n=30) were cardiac surgical patients. However, 12 ECLS runs were required for respiratory patients in CHI at Crumlin; a number of these patients were transferred abroad for treatment, as there is no formally funded and resourced paediatric respiratory ECMO programme in the ROI. Respiratory ECMO provides life-saving treatment for infants and children with very severe lung failure.

A number of these patients had an LOS greater than 70 days in another European country, which has both financial and social implications for the HSE and for the families of these patients. Although survival rates were favourable, a small number of patients died while undergoing treatment abroad.

TABLE 6.2: TOTAL EXTRACORPOREAL MEMBRANE OXYGENATION RUNS IN CHILDREN'S HEALTH IRELAND AT CRUMLIN, 2018–2020

ECMO	2018	2019	2020	TOTAL
Cardiac ECMO	13 runs: • extracorporeal cardiopulmonary resuscitation (ECPR) • cardiac surgery	19 runs: • ECPR • cardiology • cardiac surgery	21 runs: • ECPR • cardiology • cardiac surgery	53
Respiratory ECMO	5 runs: • airway repair • congenital diaphragmatic hernia (CDH) and persistent pulmonary hypertension of the newborn (PPHN) transferred to Sweden	3 runs: • CDH transferred to Sweden • CDH and Tetralogy of Fallot – ECMO in CHI at Crumlin	4 runs: • PPHN + meconium aspirate transferred abroad • CDH - ECMO in CHI at Crumlin	12
Total ECMO: Cardiac and respiratory	18	22	25	65
Total ECMO days in CHI at Crumlin	92	118	148	358
Total ECMO days abroad	40	37	13	90
Total bed stay abroad	72 days	43 days	17 days	132
Survival to decannulation	89%	91%	92%	
Survival to discharge	78%	82%	68%	

UNPLANNED EXTUBATION

Children who need help breathing may require a flexible plastic tube placed in their throat connected to a machine; this is called invasive ventilation. If the tube is accidentally dislodged, or removed by the patient, this is referred to as unplanned extubation. Unplanned extubation remains a relatively rare event in PCCU. It is the most common adverse event to airway management in critical care and can result in clinical complications such as hypoxaemia (very low blood oxygen), hypercarbia (high blood carbon dioxide), and sometimes but very rarely death (Kanthimathinathan *et al.*, 2015). A single-cohort study using routine clinical data from 12,533 admissions to a single PCCU between 2010 and 2013 identified an acceptable notional threshold rate of unplanned extubations of less than 10 per 1,000 invasive ventilation days (Kanthimathinathan *et al.*, 2015). The *Paediatric Intensive Care Unit (PICU) Quality Dashboard 2021/2022* (NHS England, 2021) aims for a threshold of less than 5 per 1,000 invasive ventilation days. Rates of unplanned extubation should be carefully monitored, and PICANet is considering including this as a key metric in the future.

Rates of unplanned extubation per 1,000 intubated days by country of admission are shown in Table 6.3. In 2020, all countries reported unplanned extubation rates at or below 6 per 1,000 intubated days. For the reporting period 2018–2020, the Republic of Ireland had a rate of 3.6 per 1,000 intubated days (n=57), which falls below the PICU Quality Dashboard threshold of less than 5 per 1,000 invasive ventilation days.

TABLE 6.3: RATE OF UNPLANNED EXTUBATION PER 1,000 DAYS OF INVASIVE VENTILATION, BY COUNTRY OF ADMISSION, 2018–2020

Country	2018	2019	2020	2018-2020
ENGLAND (NHS)	5.1 (n=284)	4.7 (n=248)	4.5 (n=176)	4.8 (n=708)
WALES	2.4 (n=<5)	2.9 (n=<5)	6.0 (n=<5)	3.4 (n=10)
SCOTLAND	6.4 (n=25)	6.2 (n=25)	5.7 (n=16)	6.1 (n=66)
NORTHERN IRELAND	3.5 (n=5)	5.9 (n=8)	0.9 (n=<5)	3.6 (n=14)
REPUBLIC OF IRELAND	4.0 (n=22)	4.2 (n=23)	2.5 (n=12)	3.6 (n=57)
TOTAL	5.0 (n=339)	4.8 (n=307)	4.3 (n=209)	4.7 (n=855)

Figure 6.5 illustrates rates of unplanned extubation across all participating PCCUs (UK and ROI) in the 2018–2020 reporting period. There was a decrease in unplanned extubation in both Units in the ROI in 2020. Both Units fell well below the acceptable threshold rate of 10 per 1,000 invasive ventilation days.

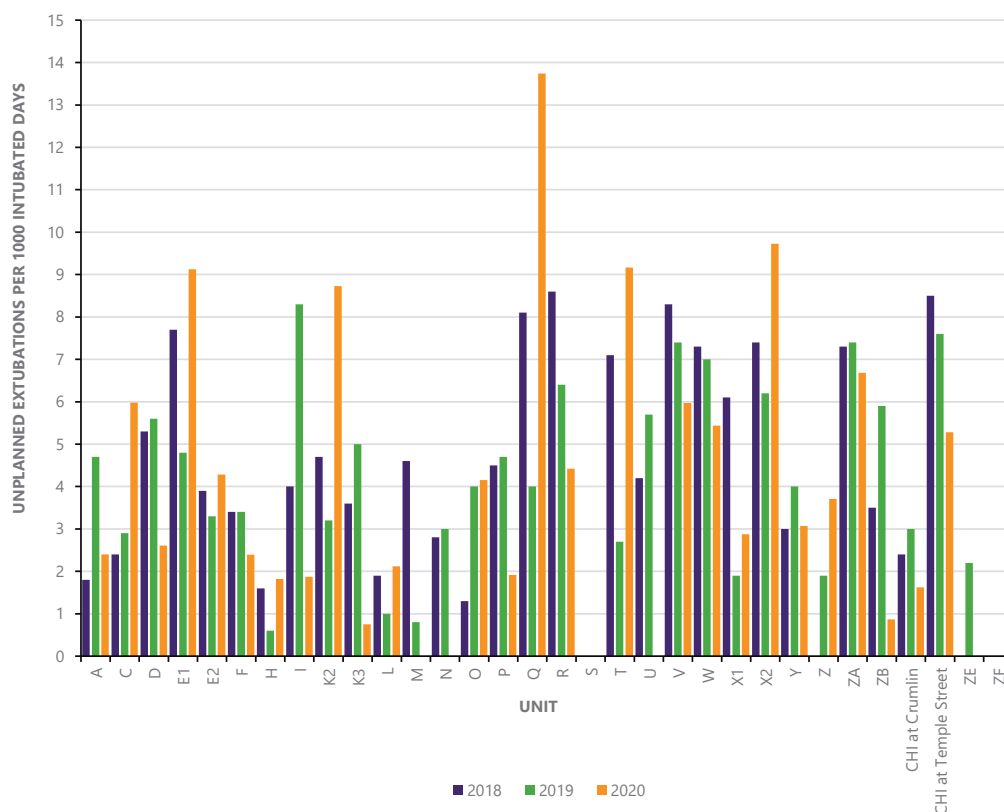


FIGURE 6.5: RATES OF UNPLANNED EXTUBATIONS AT PAEDIATRIC CRITICAL CARE UNITS, BY YEAR, 2018–2020

PAEDIATRIC INDEX OF MORTALITY

The Paediatric Index of Mortality (PIM) is a severity scoring system for predicting the risk of mortality of patients admitted to PCCU, based on data collected within the first hour following admission. The PIM was updated (PIM3) in 2013 to provide better estimates of mortality risk among children admitted to critical care in the UK, Ireland, Australia, and New Zealand. When estimating risk, the model adjusts for case mix, including factors such as diagnosis, recovery post-procedure, type of admission, and mechanical ventilation, as well as physiological variables such as systolic blood pressure and pupillary reaction (Straney *et al.*, 2013).

The PIM3 risk grouping of children admitted to PCCU in both CHI at Crumlin and CHI at Temple Street in the 2018–2020 reporting period is presented in Table 6.4. In 2020, the majority of children admitted to CHI at Crumlin were in the 1 to <5% PIM3 risk group (n=508, 52%), whereas in CHI at Temple Street the majority of admissions were in the lower <1% PIM3 risk group (n=182, 44%).

TABLE 6.4: ADMISSIONS BY PAEDIATRIC INDEX OF MORTALITY 3 RISK GROUP FOR EACH UNIT, 2018–2020

PIM3 risk group	2018		2019		2020	
	N	%	N	%	N	%
CHI at Crumlin						
<1%	321	31	358	35	293	30
1 to <5%	508	50	511	50	508	52
5 to <15%	151	15	128	12	134	14
15 to <30%	36	4	16	2	25	3
≥30%	7	1	11	1	8	1
Total	1023	100	1024	100	968	100
CHI at Temple Street						
<1%	193	48	235	48	182	44
1 to <5%	151	37	186	38	158	39
5 to <15%	43	11	54	11	52	13
15 to <30%	15	4	11	2	8	2
≥30%	4	1	4	1	9	2
Total	406	100	490	100	409	100

DEATHS IN PCCU

The numbers of deaths that occur after admission but prior to discharge from PCCUs included in PICANet are shown in Figure 6.6. Estimates for each Unit are based on total number of admissions to that Unit for 2020. In 2020, CHI at Crumlin had a crude mortality rate of 4% (n=38), while CHI at Temple Street also had a crude mortality rate of 4% (n=16).

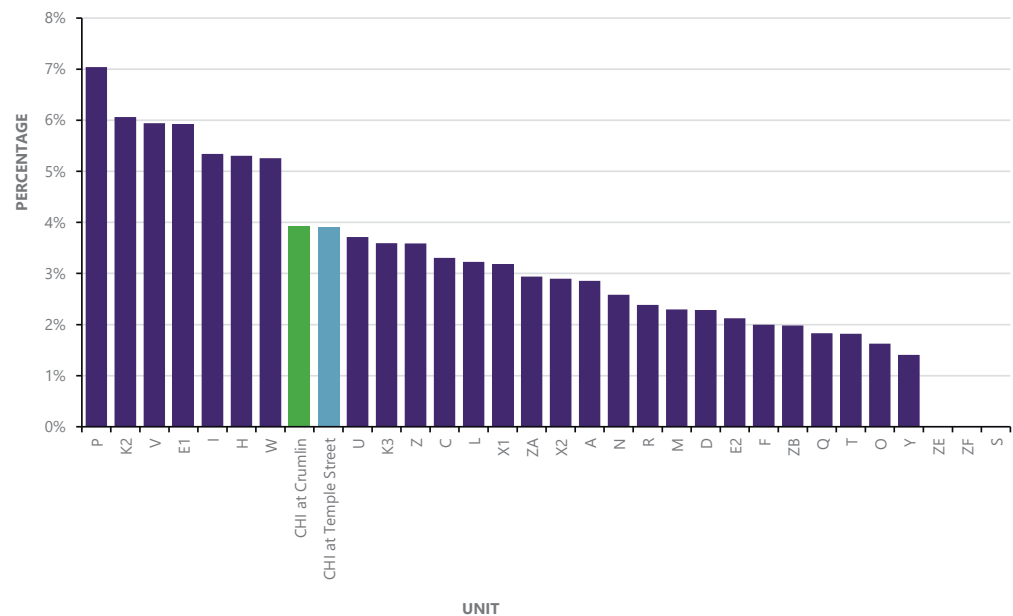


FIGURE 6.6: PROPORTION OF DEATHS IN PAEDIATRIC CRITICAL CARE UNITS, BY UNIT, 2020 (N=16424)

STANDARDISED MORTALITY RATES FOR PCCU IN CHI AT CRUMLIN AND CHI AT TEMPLE STREET

Mortality rates are assessed for each PCCU based on a statistical approach that takes into account the severity of the child's illness at the time of admission. The risk adjustment method used is PIM3. The number of children predicted to die is calculated and then compared with the number who actually die in order to derive the risk-adjusted SMR (Universities of Leeds and Leicester, 2019).

The risk-adjusted SMR for each PCCU in the UK and the ROI is displayed in a funnel plot (plotted against the number of admissions) for 2020 (see Figure 6.7). In this reporting period, after allowing for the level of sickness at time of admission, no PCCU in the ROI had a mortality rate higher than expected. Risk-adjusted mortality is an important high-level quality indicator. Transparent presentation of this information is important to assure the public, parents, and the health service at large that hospitals are continuously monitoring important outcomes and that there are systems in place to review any areas of concern.

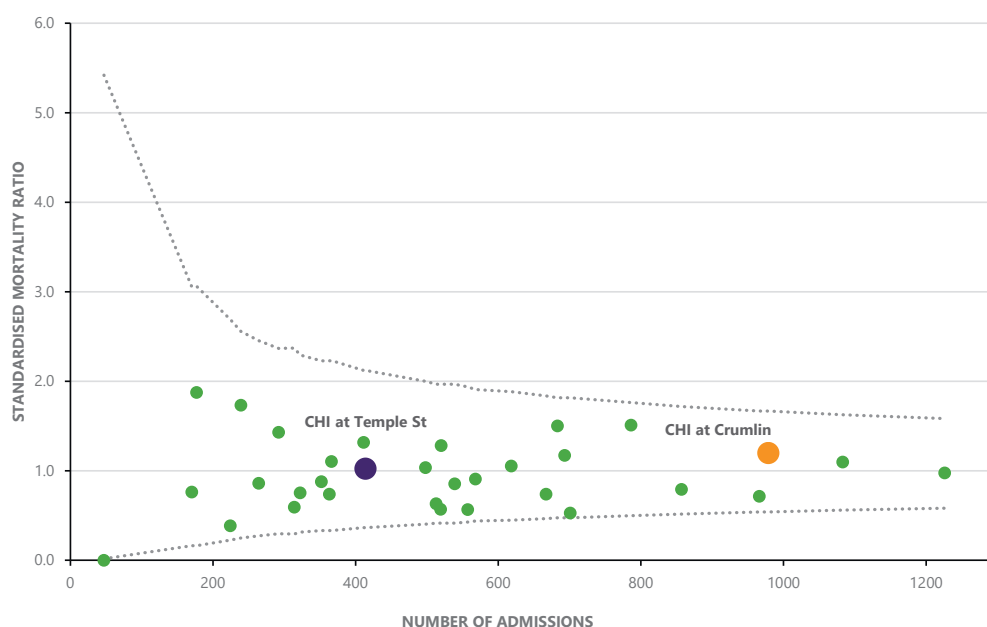


FIGURE 6.7: RISK-ADJUSTED STANDARDISED MORTALITY RATIO, BY PARTICIPATING PAEDIATRIC CRITICAL CARE UNIT, 2020

KEY FINDINGS FROM CHAPTER 6

- Patients requiring invasive ventilation in 2020:
 - 64% at CHI at Crumlin.
 - 61% at CHI at Temple Street.
- 70% of patients received vasoactive medication while in PCCU.
- The rate of unplanned extubation in the ROI was 2.5 per 1,000 (a decrease from 4.2 in 2019).
- There were 25 ECMO runs (an increase from 18 in 2018).
- The crude mortality rate was 4% for both CHI at Crumlin and CHI at Temple Street.
- The risk-adjusted SMR showed no PCCU in the ROI had a mortality rate higher than expected.

CHAPTER 7

COVID-19 & PAEDIATRIC INFLAMMATORY MULTISYSTEM SYNDROME (PIMS-TS)



CHAPTER 7: COVID-19 AND PAEDIATRIC INFLAMMATORY MULTISYSTEM SYNDROME (PIMS-TS)

COVID-19

COVID-19 is an infection caused by the severe acute respiratory syndrome (SARS-CoV-2) virus. The first case of COVID-19 was reported in Ireland on 29 February 2020 and the COVID-19 pandemic was declared by the World Health Organization in March 2020. In 2020, PCCUs in the ROI saw a relatively small proportion of children presenting with COVID-19 when compared with the adult population and most children were asymptomatic or exhibited mild-to-moderate symptoms. In the first year of the pandemic, approximately 6% of all COVID-19 cases (adults and children) required hospitalisation, with 10% of these requiring ICU care. The proportion of cases requiring hospitalisation varied considerably with age, with noticeably few cases in children, less than 1% of 5–12-year-olds, compared with more than 30% of 75–84-year-old cases being hospitalised (HPSC, 2022). COVID-19 is thus seen as a mild illness in children and is reflected in the low PCCU numbers.

PIMS-TS

Paediatric inflammatory multisystem syndrome (PIMS) temporally associated (TS) with SARS-CoV-2 is linked to and follows on from infection with SARS-CoV-2. It is thought to be an autoinflammatory response and was identified as a new entity in April 2020. PIMS-TS is a clinical diagnosis which needs to be differentiated from Kawasaki disease and other causes of myocarditis. PIMS-TS is rare, affecting about 1 in every 3,000 children infected with the COVID-19 virus (Royal College of Paediatrics and Child Health, 2020).

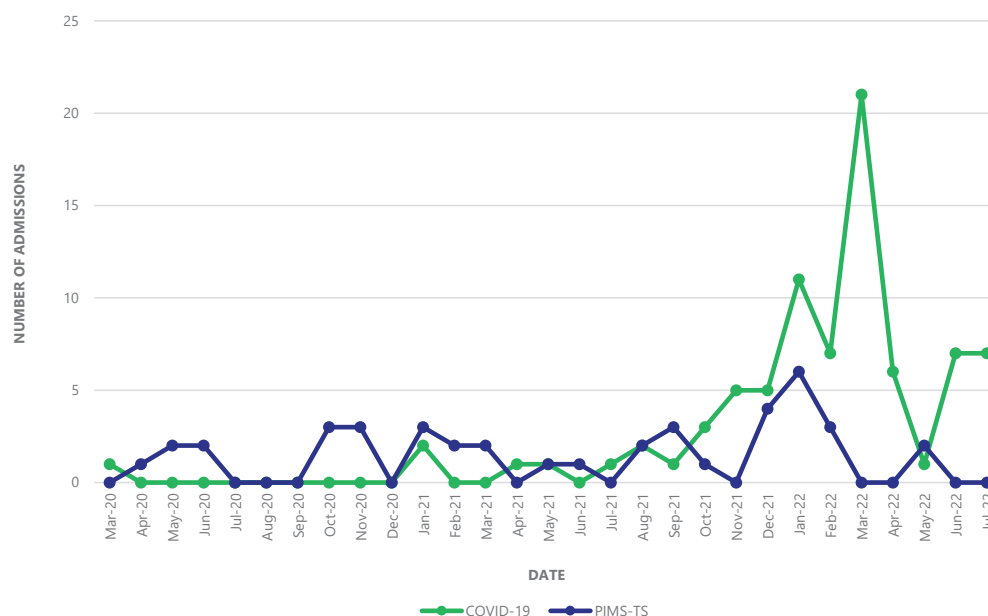
ADMISSIONS TO PCCU IN THE ROI

All children admitted to PCCUs in the ROI were routinely tested for COVID-19 and cases were confirmed by a positive PCR lab test. In 2020, 12 children were admitted to PCCU with COVID-19 or PIMS-TS. There were 82 children in total admitted to PCCUs in the ROI who tested positive for COVID-19 and 41 admissions with PIMS-TS during the period 1 March 2020 and 31 July 2022 (see Table 7.1). Patients with COVID-19 were more likely to require mechanical ventilation (40%, n=33) than those with PIMS-TS (22%, n=9). Patients with PIMS-TS were older (median age 10.0 years) than those with COVID-19 (median age 4.0 years).

TABLE 7.1: DESCRIPTION OF COVID-19 AND PIMS-TS ADMISSIONS TO PAEDIATRIC CRITICAL CARE UNITS IN THE REPUBLIC OF IRELAND (MARCH 2020–JULY 2022)¹²

Parameter	COVID-19	PIMS-TS
Patients <16 years old (n)	82	41
Discharge status (alive) (n)	81	41
CHI at Crumlin (n)	46	31
CHI at Temple Street (n)	36	10
Mechanically ventilated (n)	33	9
Age (median)	4.0 years	10.0 years
Unit LOS (median)	3.0 days	4.0 days
Hospital LOS (median)	9.0 days	8.0 days

Figure 7.1 shows the distribution timeline for COVID-19 and PIMS-TS related admissions to PCCUs from March 2020 to July 2022. Of particular note, the vast majority of admissions from March 2020 to October 2021 were PIMS-TS and Delta variant in origin. With the emergence of the Omicron variant, the incidence of COVID-19-positive admissions became dominant, with a fall-off in PIMS-TS admissions during the period October 2021 to July 2022. The reduction in PIMS-TS may also be influenced by the roll-out of the SARS-CoV-2 vaccine in the ROI to children aged under 12 years.

**FIGURE 7.1:** NUMBER OF COVID-19 AND PIMS-TS ADMISSIONS (MARCH 2020–JULY 2022)

¹² Table 7.1 shows that one patient in the COVID-19 group was not discharged alive. However, it should be noted that the cause of death was not attributed to COVID-19 but to another underlying condition.

KEY FINDINGS FROM CHAPTER 7

- 123 COVID-19-related admissions were admitted to PCCU over the period March 2020–July 2022.
- Two-thirds of these admissions were COVID-19 positive and this distribution changed over time with a change in variant.
- One-third of admissions were PIMS-TS, which was a clinical diagnosis.
- The median Unit LOS was 3–4 days.
- The burden of COVID-19 in PCCU from children was minimal and represents approximately less than 3% of total admissions.
- There was no COVID-19-related mortality over this time period 2020–2022.

CHAPTER 8

QUALITY IMPROVEMENT



CHAPTER 8: QUALITY IMPROVEMENT

PICANet makes comparisons between PCCUs in the UK and the ROI, where each Unit is assessed against established clinical standards and guidelines. PICANet reports on five key performance metrics related to paediatric critical care services, which are presented in this chapter.

PICANet METRIC 1: CASE ASCERTAINMENT AND TIMELINESS OF DATA SUBMISSION

Case ascertainment: Case ascertainment is a measure of the proportion of total admissions that are reported to PICANet and is one aspect of data quality; 100% ascertainment would mean that data were submitted for all admissions. Among the 11 PCCUs that PICANet visited between 1 April 2019 and 31 December 2019, the number of PCCU admissions in nine Units (82%) was independently validated. In these nine PCCUs, almost all admissions (at least 95% in each Unit) were reported to PICANet; five Units had reported more than 99% of admissions. A review of the PICANet database was undertaken following validation, resulting in the number of PCCUs reporting more than 99% of admissions increasing to six.

Due to the COVID-19 pandemic, it was not possible to undertake validation visits; therefore, it is not possible to present this metric for 2020.

Timeliness of data submission: The timeliness of data submission is measured using the number of admission events that are completed on the PICANet database within 3 months of discharge – a requirement of the *Quality Standards for the Care of Critically Ill Children* (PICS and West Midlands Quality Review Service, 2015). From 1 January 2022, PICANet will be moving to a 2-month submission guideline in accordance with L3-702 of the *PCCS Quality Standards for the Care of Critically Ill or Injured Children* (PCCS, 2021) and PIC10a of the *PICU Quality Dashboard 2021/2022*. An admission record is defined as complete when all validation checks have been fulfilled.

The completeness of patients' admission data within 3 months of their discharge from the Unit has declined over the 3-year period from 97% in 2018 to 59% in 2020 for the ROI (see Figure 8.1). This situation will need to improve and to this end a recommendation has been made in this report.

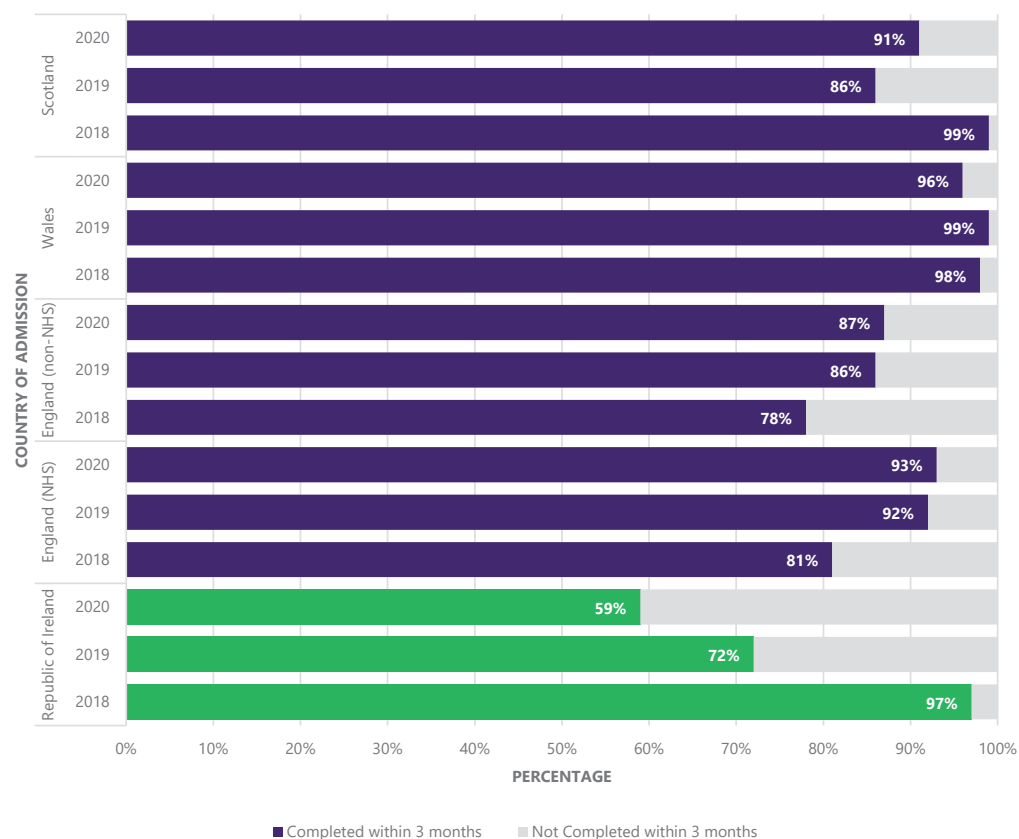


FIGURE 8.1: PROPORTION OF ADMISSION RECORDS COMPLETED WITHIN 3 MONTHS OF DISCHARGE, BY COUNTRY OF ADMISSION, 2018–2020¹³

¹³ Data are not presented for Northern Ireland, as PCCUs there were unable to submit data between May 2018 and January 2019 due to the introduction of GDPR and associated clarifications required. This meant that these PCCUs were unable to provide data within the required timeframe of 3 months during this period.

Figure 8.2 provides a breakdown by Unit of the completeness of patients' admission data within 3 months of their discharge for the 2020 reporting period. CHI at Temple Street achieved 85% completeness; however, CHI at Crumlin only achieved 48% completeness, which was the lowest of all participating PCCUs. CHI at Crumlin had audit resourcing issues during 2020 due to extended sick leave of staff.

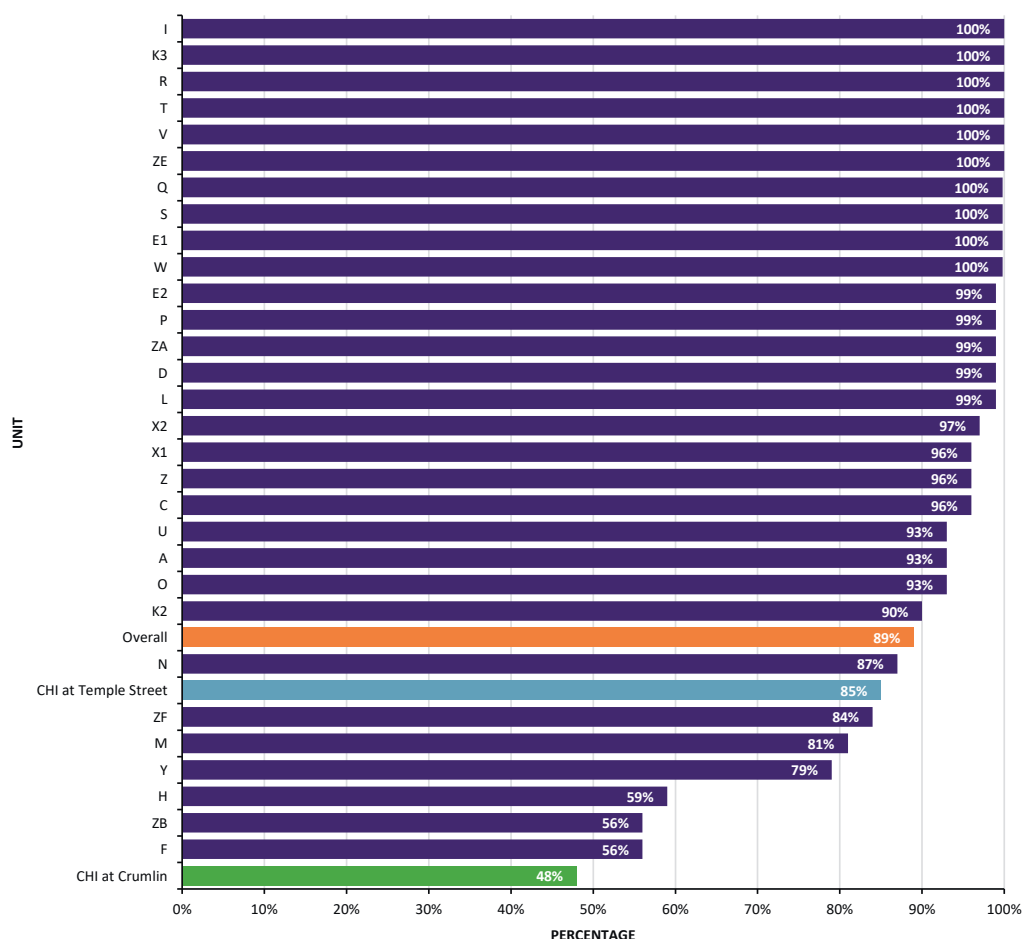


FIGURE 8.2: PROPORTION OF ADMISSION RECORDS COMPLETED WITHIN 3 MONTHS OF DISCHARGE, BY UNIT, 2020¹⁴

¹⁴ The Overall category combines all admissions and calculates the timely completion rate overall; it is not calculated by taking an average of each Unit's completion rate. This figure excludes any patients still in PICU at the time of analysis and includes admissions where the patient was aged 16 years or over at admission or where the patient's age was unknown. Harley Street Clinic, London (ZE) closed permanently to paediatric admissions in March 2020 and data above only represent 3 months' worth of data as opposed to a whole year.

PICANet METRIC 2: RETRIEVAL MOBILISATION TIMES

Figure 8.3 shows the time taken to mobilise a team following a clinical decision that urgent (non-elective) transport is required in the ROI (i.e. IPATS) during the reporting period. Due to IPATS's relatively low volume of calls, both the IPATS registrar and nurse provide support to the PCCU during their shifts. Following activation, the IPATS team must assemble along with the IPATS consultant and the ambulance (or helicopter/aeroplane), which are frequently not co-located. Sometimes retrieval may be from remote geographical areas and may require both road and air travel to achieve retrieval. The planning for these types of transport may further delay mobilisation times. During 2020, there were 62 non-elective transports carried out by IPATS, which is a 25% decrease from 2019 (n=82). The UK Care Quality Commission recommends that journeys be commenced within 1 hour (Universities of Leeds and Leicester, 2020); 71% of IPATS journeys in 2020 were commenced within this timeframe. This metric is considered as a measure of system capacity rather than quality of care; starting the journey is only one part of the timely access.

An improvement in mobilisation times was made in 2020, whereby a higher proportion of transports (18%) happened within 30 minutes in the ROI than in the previous 2 years.

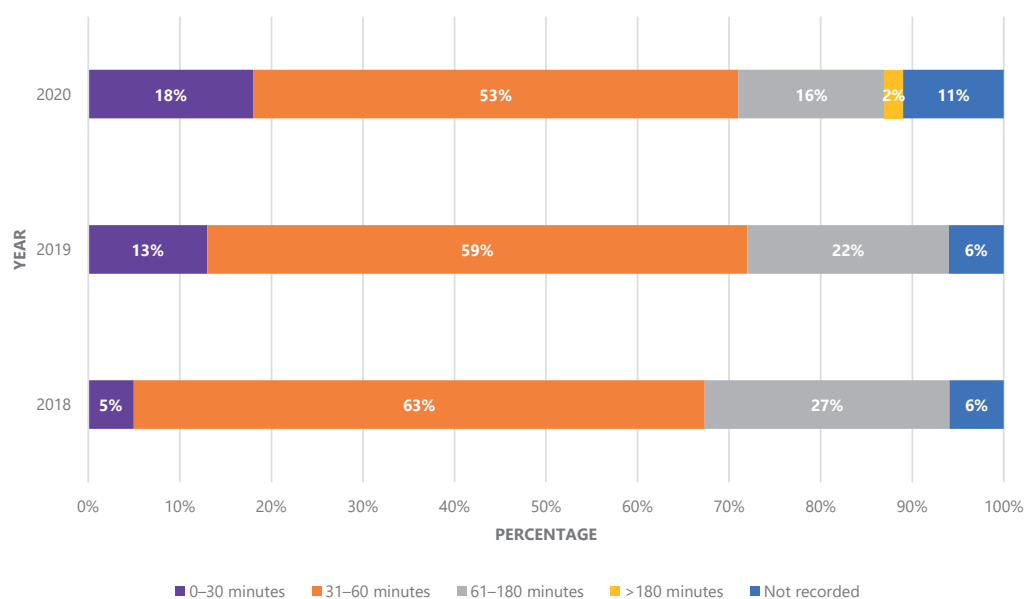


FIGURE 8.3: NON-ELECTIVE TRANSPORTS BY MOBILISATION TIMES (IN MINUTES), IN REPUBLIC OF IRELAND, 2018–2020

PICANet METRIC 3: NUMBER OF QUALIFIED NURSES PER BED

The *National Standards for Paediatric Critical Care Services* (Joint Faculty of Intensive Care Medicine of Ireland, 2018) in Ireland recommend that each critical care bed should be supported by a minimum of 5.5 whole-time equivalent (WTE) staff nurses.

The ROI standard of 5.5 WTE nurses per critical care bed pertains to the number of nurses required in direct patient care, which includes the numbers required for one-to-one direct patient care only, and varies from that used in the UK, which includes nurse managers and other nursing support staff (PICS and West Midlands Quality Review Service, 2015). The UK PICS standards state a minimum number of 7.01 WTE qualified (registered) nurses are needed to staff one Level 3 critical care bed (PICS and West Midlands Quality Review Service, 2015).

Retention of nursing staff is particularly problematic in critical care units for various reasons, including the higher nurse–patient ratios and specialised training required to enable working in a high-stress environment. Staffing shortages in CHI at Temple Street were due to multiple reasons, including retention of staff, ability to recruit suitable qualified staff, and maternity and sick leave. Staffing requirements may vary intermittently and are impacted by multiple factors, including case mix, outbreaks, season, etc.

CHI at Crumlin meet the nursing standard. However, while a gradual improvement is evident, staffing levels in CHI at Temple Street were below the recommended standard for each year reported (see Figure 8.4).

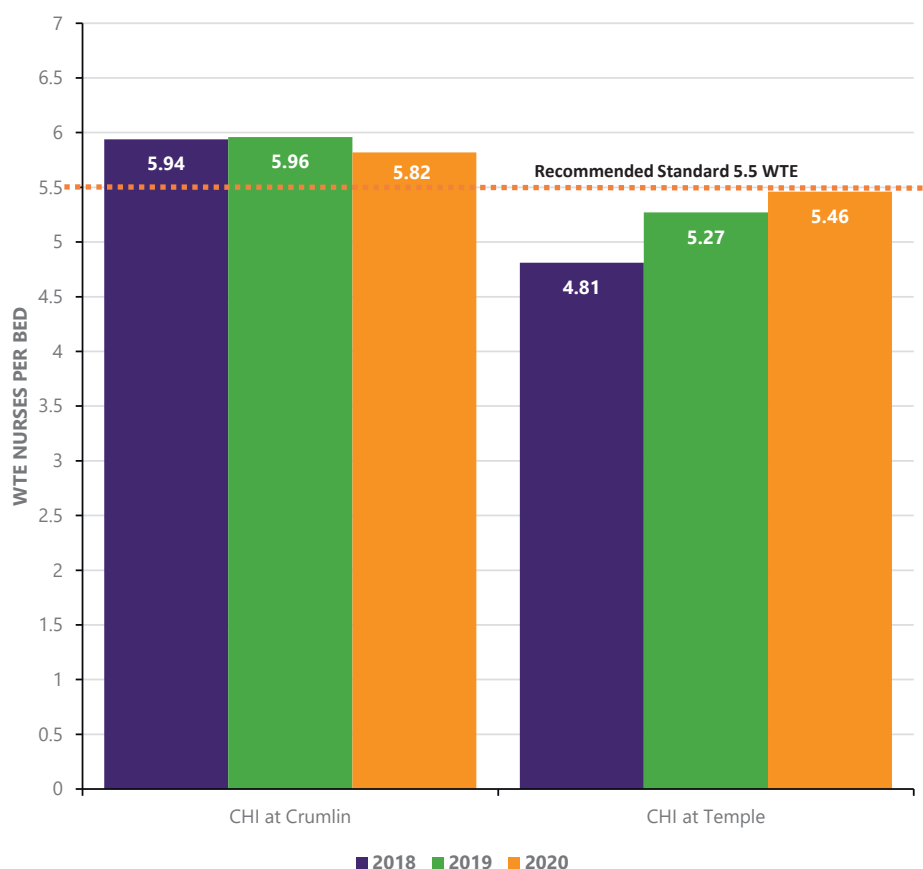


FIGURE 8.4: NUMBER OF CLINICALLY QUALIFIED WHOLE-TIME EQUIVALENT NURSING STAFF IN POST PER BED, 2018–2019

PICANet METRIC 4: EMERGENCY READMISSIONS WITHIN 48HRS

Emergency readmissions to the same PCCU within 48 hours of discharge from the PCCU may mean that a child was discharged too early or into the wrong care environment, or that the need for future critical care was not predicted. There is no standard acceptable rate of emergency readmissions within 48 hours to PCCU, but they are considered a rare event. Low readmission rates are generally accepted as an indicator of good-quality care.

Table 8.1 displays the number and percentage of admissions where the child was readmitted to PCCU within 48 hours of discharge by country for each year of the reporting period.

The ROI had a low rate of readmissions of 1.7% (n=24) for 2020. This is a slight increase from 2018 (1.3%, n=18).

TABLE 8.1: EMERGENCY READMISSIONS WITHING 48 HOURS, 2018-2020

Country	2018		2019		2020		2018-2020	
	N	%	N	%	N	%	N	%
ENGLAND (NHS)	268	1.7	244	1.6	216	1.6	728	1.6
WALES	15	3.1	8	1.6	3	0.8	26	1.9
SCOTLAND	26	1.9	31	1.9	25	2.1	82	1.9
NORTHERN IRELAND	14	2.8	8	1.6	4	1.1	26	1.9
REPUBLIC OF IRELAND	18	1.3	26	1.7	24	1.7	68	1.6
TOTAL	341	1.7	317	1.6	272	1.7	930	1.6

Figure 8.5 shows the relative emergency readmission rate for each individual Unit for the 2018–2020 reporting period. The relative rate is calculated using the overall readmission rate for each specific year based on all participating PCCUs. Relative readmission rates higher than 1 indicate that a PCCU has a higher rate of emergency readmissions within 48 hours than the overall rate for the UK and ROI combined. It is important to note that some Units in the UK were closed to paediatric admissions for part of 2020.

CHI at Temple Street was below the relative rate (1.0) at 0.61, while CHI at Crumlin was slightly above the relative rate at 1.12.

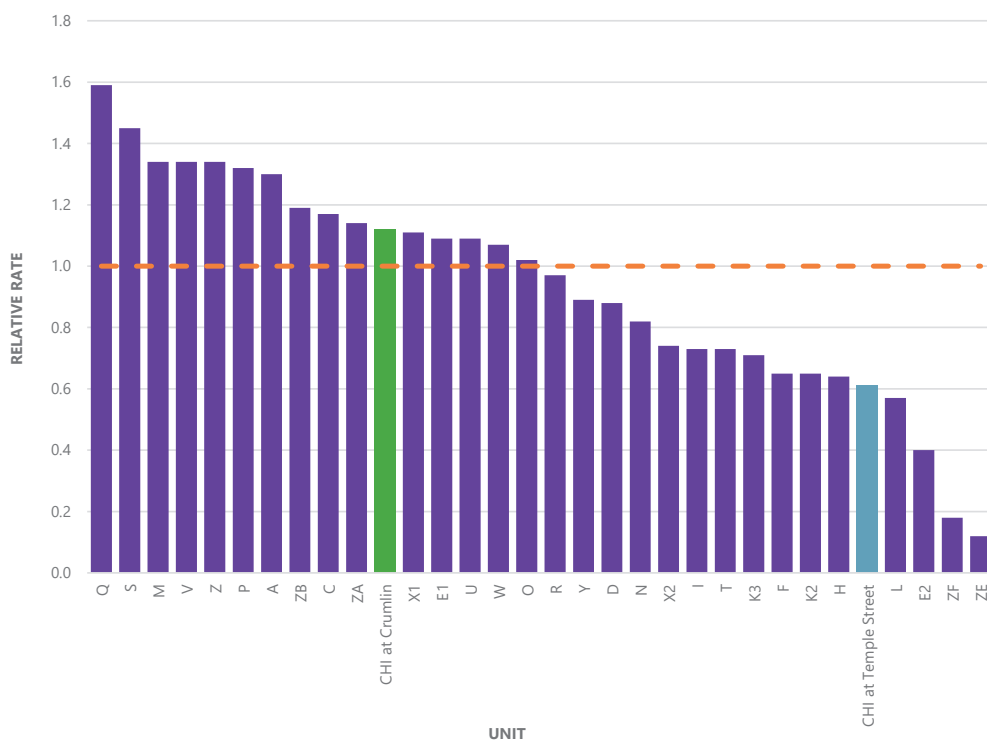


FIGURE 8.5: RELATIVE RATE OF EMERGENCY READMISSION WITHIN 48 HOURS OF DISCHARGE BY PARTICIPATING PAEDIATRIC CRITICAL CARE UNITS IN THE UNITED KINGDOM AND REPUBLIC OF IRELAND, 2018–2020

PICANet METRIC 5: MORTALITY IN PCCU

PCCU deaths in the ROI account for 4% (n=173) of admissions to PCCU in 2018–2020 (see Table 8.2). This indicates that risk of death in PCCU is very low, with 96% of patients discharged alive. The risk-adjusted SMR in Chapter 6 of this report shows no PCCU in the ROI had a mortality rate higher than expected.

TABLE 8.2: DEATHS IN PAEDIATRIC CRITICAL CARE UNIT, BY COUNTRY OF ADMISSION, 2018–2020

Country	2018			2019			2020			2018–2020		
	Admissions	Deaths		Admissions	Deaths		Admissions	Deaths		Admissions	Deaths	
	N	N	%	N	N	%	N	N	%	N	N	%
ENGLAND	15 827	562	4	15 632	576	4	12 666	485	4	44 125	1626	4
WALES	488	22	5	479	10	2	351	12	3	1318	44	3
SCOTLAND	1318	33	3	1664	33	2	1150	27	2	4132	93	2
NORTHERN IRELAND	489	12	2	481	11	2	346	7	2	1316	30	2
REPUBLIC OF IRELAND	1370	59	4	1454	60	4	1323	54	4	4147	173	4
Total	19 492	688	4	19 710	690	4	15 836	588	4	55 038	1966	4

Of all childhood deaths that occurred in Ireland during 2020, 21% died in PCCU, which was a decrease from 25% in 2018 (see Table 8.3). Deaths in PCCU account for one in five deaths in the paediatric population in the ROI in any given year.

TABLE 8.3: PROPORTION OF DEATHS IN PAEDIATRIC CRITICAL CARE UNIT OF ALL CHILD DEATHS IN THE POPULATION, BY COUNTRY OF ADMISSION, 2018–2020

Country	2018			2019			2020		
	Deaths in population	Deaths in PCCU		Deaths in population	Deaths in PCCU		Deaths in population	Deaths in PCCU	
	N	N	%	N	N	%	N	N	%
UK	4028	629	15.6	3962	630	15.9	3653	534	14.6
ROI	234	59	25.2	272	60	22.1	256	54	21.1
Total	4262	688	16.1	4234	689	16.3	3909	588	15.0

LOCAL QUALITY IMPROVEMENT IN CHI PCCUs



CHI AT TEMPLE STREET

**Audit of prescribing errors in PICU in CHI at Temple Street****M. Curtin, A. Walsh**

Prescribing errors are particularly problematic in paediatrics where dose calculations are complicated and small errors can cause significant harm. In 2021, we began a regular audit aimed at identifying the incidence and types of prescribing errors in CHI at Temple Street. We identified key areas for improvement and ran targeted education sessions on these areas. On most recent re-audit our compliance with standards had improved, particularly in the areas of prescribing the correct dose (100% vs 97%) and having an identifiable prescriber (100% vs 87%). Specific areas for further improvement were as-required drug prescriptions (76% vs 89%), the prescribing of continuous drug infusions (30% vs 67%), correct weight documentation (71% vs 50%), and correct medication discontinuation (76% vs 56%). We are introducing systems to help target these areas, such as a Kardex discontinuation stamp and exploring the possibility of electronic prescribing for infusions. We will continue regular re-audits and education sessions.

Introduction of Learning from Excellence Audit in PICU in CHI at Temple Street**S. Casey, L. McIlurray, O. McGowan, K. Gilleese, H. Bruell, S. O'Keefe, R. Cunney, J. Fitzsimons**

<https://learningfromexcellence.com/wp-content/uploads/2021/11/Poster-1.4-Praise-You-Like-I-Should-Introduction-of-Learning-from-Excellence-LfE-to-Temple-Street-PICU.pdf>

Performance assessment in healthcare traditionally focuses on identifying and mitigating errors. Learning from Excellence (LfE) aims to improve performance by focusing on what went well. LfE was introduced by a multidisciplinary team in PICU in CHI at Temple Street in 2020. Electronic excellence report forms were developed and accessed through Quick Response (QR) code cards which were displayed throughout the unit. All reports were forwarded to the recipient. Reports were also discussed at our unit risk meetings and displayed on a notice board. Pre- and post-implementation staff surveys were carried out. Perception that recognition of excellence is good or very good increased from 36% to 73%. The percentage of staff who received some form of positive feedback in the preceding month increased from 54% to 71%. The perception that staff morale is good or excellent increased from 27% to 59%. Some 98% of staff felt that the LfE initiative has had a positive impact on our PICU. Next steps include rolling LfE out across the hospital and developing themes to build learning opportunities.



CHI AT CRUMLIN



PICANet data and the PCCU database have been used for multiple PCCU audit/quality improvement and research projects that lead to oral/poster presentation and publication. Below are some examples.

Determining the prevalence and risk of pressure ulcers within a PICU setting

M.H. Tan, S. Santiago, Z. Moore and H.A. Smith

Rates of pressure ulcers (PUs) in Irish PCCUs is unknown. The Braden Q Scale is widely used to assess a child's risk of developing a PU but its usability within a PCCU setting has not been examined. We aimed to establish the incidence of PUs and determine the suitability of the Braden Q Scale in a PCCU setting. Some 560 Braden Q assessments were completed for 77 children between June and October 2017. The prevalence rate for PUs was 11.7% and all PUs were developed by male patients, 6 were ventilated, and 1 had high-flow nasal cannula. PUs developed after a median stay of 3 days and 77% were Grade 1. Using the Braden Q Scale, those with a mild or moderate risk developed PUs but no child with a high or severe risk developed a PU. We cannot recommend the Braden Q Scale for use in PCCUs as it does not account for medical devices and these may be the prime causative factor for PUs in PCCU. Targeted prevention strategies are required for this group of patients.

EEG in the Paediatric Intensive Care Unit: an Irish experience

L. MacDarby, M. Healy, G. Curley and J.C. McHugh

Journal of Clinical Neurophysiology, 2021; 38(2), pp. 130–134.

doi: 10.1097/WNP.0000000000000673

Continuous electroencephalography (cEEG) is the gold standard for brain monitoring in the PCCU. Seizure detection rates range from 7% to 43% across published studies. This variation is attributable to differences in specified indications, duration of EEG monitoring, and patient cohort. CEEG monitoring is scarce or even unavailable in many hospital settings; therefore, investigation of seizures and evaluation of brain function relies on shorter studies. A 2-year retrospective observational study was undertaken in PCCU, including 108 patients and 196 EEGs totalling 434 hours. Within the context of routine testing, the majority of first-time seizures occur within the first 30 minutes of recording. Patients with abnormal EEG of any type (seizures, slowing, discharges) had an increased mortality rate (25%, $p=0.03$). Total electro cerebral inactivity (isoelectric EEG; 5 patients) and burst suppression (7 patients) were predictive of mortality in 100% of patients. The presence of seizures did not affect duration of ICU stay. EEG is therefore a useful study in the PICU. Specific EEG patterns can be highly predictive of mortality in ICU.

Risk factors for respiratory syncytial virus bronchiolitis admissions

S.M. Meenaghan, C.V. Breatnach and H. Smith

Irish Medical Journal, 2020; 113(1), pp. 9–14. <http://hdl.handle.net/10147/629008>

Population pharmacokinetic modelling of acetaminophen and metabolites in children after cardiac surgery with cardiopulmonary bypass

P. Mian, A.J. Valkenburg, K. Allegaert, B.C.P. Koch, C.V. Breatnach, C.A.J. Knibbe, D. Tibboel and E.H.J. Krekels

Journal of Clinical Pharmacology, 2019; 59(6), pp. 847–855. <https://doi.org/10.1002/jcph.1373>

KEY FINDINGS FROM CHAPTER 8

- The case ascertainment rate in 2019 was 95%, but it was not recorded for 2020.
- Timeliness of data submission in 2020:
 - The rate in CHI at Crumlin was 48%.
 - The rate in CHI at Temple Street was 85%.
 - The overall rate in the ROI was 59%, with a target of 100%.
- Retrieval mobilisation times in 2020:
 - 71% of IPATS journeys were started within the hour (18% 0–30 minutes; 53% 31–60 minutes).
- The number of qualified nurses per bed in 2020, given the standard is 5.5 WTE:
 - The rate in CHI at Crumlin was 5.82 WTE.
 - The rate in CHI at Temple Street was 5.46 WTE.
- For emergency readmissions within 48 hours in 2020, 1.7% of patients were readmitted within 48 hours of discharge.
- Patients in PCCU in 2020 had a 96% survival rate. Deaths in PCCU accounted for 21% of all deaths in the paediatric population in the ROI in 2020.

The background of the page is a photograph of an operating room. It shows various pieces of medical equipment, including monitors and surgical instruments, in a clinical setting. The lighting is bright and sterile. The text 'CHAPTER 9' and 'AUDIT UPDATE' is overlaid on the right side of the image.

CHAPTER 9

AUDIT UPDATE

CHAPTER 9: AUDIT UPDATE

UPDATE ON AUDIT RECOMMENDATIONS FROM PREVIOUS REPORT - IRISH PAEDIATRIC CRITICAL CARE AUDIT NATIONAL REPORT 2017–2019

Recommendation	Update
Children's Health Ireland (CHI) should use the data in this report (NOCA, 2021) to work with the Health Service Executive (HSE) in order to inform the planning and implementation of adequate measures for optimising bed capacity in the Paediatric Critical Care Units (PCCUs) in the Republic of Ireland (ROI). Providing the resources adequate to maintain a bed occupancy of 85% would provide flexibility in order to cover surges, such as flu pandemics and the winter surge, and avoid the late cancellation of semi-elective surgeries.	<p>CHI RESPONSE: There are two services which will exist in the new National Children's Hospital (NICU and PICU); therefore, they must commence prior to opening.</p> <p>NICU: A key strategic priority for CHI is to transition from a 6-bedded Neonatal High Dependency Unit (NHDU)/PICU and ward-based patients across both sites (Crumlin and Temple Street) to a surgical NICU/NHDU model under the governance of neonatology.</p> <p>The CHI model of care for neonatology workforce plan outlines a robust increase in workforce across medical, nursing, and health and social care professions to provide a safe service for the neonatal population in line with international standards. This in keeping with the national Model of Care for Neonatology (HSE, 2015), which recommended a full tier of neonatologists for the children's hospitals (CHI) to provide appropriate specialised care for these vulnerable infants.</p> <p>The aim over the next 2 years (2022–2024), through a process of recruitment of new posts and reconfiguration of shared maternity hospital posts, is to assist with achieving the required staffing levels.</p> <p>Bed occupancy remained high in 2020, despite a drop in the number of admissions due to the COVID-19 pandemic. CHI at Crumlin had 88% occupancy, while CHI at Temple Street had 82% occupancy.</p>

CHI and the National Ambulance Service – Critical Care and Retrieval Services (NAS-CCRS) should operationally enable the extension and development of the Irish Paediatric Acute Transport Service to a 24-hour-per-day, 7-day-per-week centralised transport service (CTS). This will help to ensure that a specialised paediatrics retrieval team transfers all critically ill children.	IPATS must first develop a 7-day-per-week service and then extend this to a 24-hour service. This requires additional resources that will be supported by the development of a senior tier of trainee which will facilitate more remote consultant supervision that can thus be provided over a greater period of time per WTE staff member. The process of extending IPATS was initiated and, as of January 2022, the service now operates 7 days per week (Monday–Sunday, 10.00–16.00). The Fellowship in Paediatric Critical Care Retrieval Medicine (FCCRM) commenced in January 2022.
Procedures for recording, collecting and reporting data included in the Irish Paediatric Critical Care Audit (IPCCA), and submitted to the Paediatric Intensive Care Audit Network (PICANet) dataset, should be reviewed by the National Office of Clinical Audit (NOCA) and PICANet.	NOCA met with PICANet in May 2022 to discuss data quality issues and to take any necessary actions. PICANet will recommence data validation visits to PCCUs as there is a large backlog due to the COVID-19 pandemic. The ROI PCCUs are scheduled for summer 2023. The NOCA audit manager will attend the validation visits.
Future development of the IPCCA should be guided by a review of the scope and governance of the national clinical audit and should include additional detailed data, which will greatly add to the national overview of paediatric critical care.	See the audit development section of this chapter: review of purpose, scope, and governance of IPCCA.

AUDIT ACTIVITY

- The audit manager attended the PICANet Annual Meeting in January 2022.
- The NOCA clinical lead for IPCCA was invited to become a member of the PICANet Clinical Advisory Group, which provides a forum to contribute to discussions on the long-term development of PICANet for data providers and users in the ROI. The meeting was attended in November 2022.
- The NOCA audit manager for IPCCA was invited to become a member of the PICANet Steering Committee, which monitors the progress and ensures the quality of the work of PICANet. The meeting was attended in September 2022.

AUDIT DEVELOPMENTS

- PICANet commenced a pilot expansion study of data collection and reporting from High Dependency Units (HDUs) in July 2022. This pilot study is to test the feasibility and quality of data collection in Level 2 critical care units. The regional PHDU in the University Hospital Limerick is participating in this pilot study.
- From January 2021, PICANet updated the dataset for discharge information to collect mode-of-death information and transplant donor details.
- Review of purpose, scope, and governance of IPCCA:

Arising from the recommendation on the future development of the IPCCA (NOCA, 2021), NOCA planned a review of purpose, scope, and governance of the audit. The importance of this review was underpinned with the expanding scope of the PICANet audit to include data from Level 2 and Level 3 critical care Units as well as children managed in adult ICUs. This review will set out a roadmap for an excellent national clinical audit in line with the *NOCA Strategy 2021-2025* (NOCA, 2021), providing frontline clinicians, healthcare managers, and the public with a truly national overview of paediatric critical care. This review includes the following topics:

- **Purpose and scope of IPCCA:** Quality improvement aim and objectives, scope of the national data collection – population, type of service (critical care +/- transport services), type of units (Level 1 +/- Level 2), inclusion/exclusion criteria, public and independent units, geographical location; underpinning clinical standards, current and potential new datasets.
- **Process of national data collection and reporting:** Audit and data providers, methods of data collection, and sources of data – data dictionaries, additional site and service recruitment, data provider training and engagement, reporting plan for data providers, data users and the general public, data analytic plan – quality improvement indicators, plan for statistical outliers.
- **Governance and management for the national data collection in NOCA.**
- **Information governance and data quality.**

The approach includes but is not limited to the following: desktop review of audit documents; horizon scan of international data collections; targeted consultation; stakeholder workshop on recommendations followed by a final report.

This work commenced in April 2022 and will be completed in 2023. A number of stakeholder workshops were held in July and August 2022 with CHI to discuss the scope of the audit; future workshops are planned with the HSE, Department of Health, and Public and Patient Interest (PPI) groups.

A newborn baby is lying in a hospital bed, covered by a white blanket. The baby's foot is visible, peeking out from under the blanket. In the background, a medical device with a red light and blue tubing is visible, slightly out of focus.

CHAPTER 10 **RECOMMENDATIONS**

CHAPTER 10: RECOMMENDATIONS

RECOMMENDATION 1

A comprehensive dataset should be developed locally, in addition to PICANet data, to accurately reflect the complexity and acuity of the ROI PCCU patient population and the scope of practice to enable accurate audit and reporting.

Rationale

Paediatric critical care audit data need to reflect the complexity and intensity of the medical care provided to the ROI patient population, for example, the specialty subgroup – cardiac, cardiology, oncology, and neurosurgery. It should be possible for these data to be reported in detail in the annual report.

The IPCCA data collection needs to expand to include classification of patient subgroups, as PICANet data do not currently categorise these adequately per clinical diagnoses. This includes a detailed analysis of complex subgroups such as the congenital cardiac group and the complex general surgical group (e.g. tracheoesophageal fistula and congenital diaphragmatic hernia), which reflects the critical care provided; both medical and nursing complexity and intensity, that is, some patients require 3:1 or 2:1 nursing care – ECLS, CVVH. This information is required to allow for nursing and medical workforce planning and reporting on admissions and outcomes in high-risk groups admitted to PCCU.

PICANet is no longer conducting a staffing census. However, IPCCA data collection and reporting should include rates of medical and nursing staffing per bed to ensure it remains in line with recommended Irish standards and to allow for future workforce planning.

What action should be taken?

- An IPCCA data collection and reporting tailored to the actual patient cohort admitted to PCCUs in the ROI should be developed. This dataset should reflect the complexity and acuity of the ROI PCCU population. Currently, data are collected and uploaded at a local hospital level. An agreed extension to the NOCA audit dataset would allow for enhanced reporting.
- A staffing census should be developed on a phased basis to capture nursing, medical, and health and social care profession resources to measure against Irish standards.

Who will benefit from this action/recommendation?

The IPCCA and PCCUs. Detailed data interpretation will allow planning for staffing, both medical and nursing, and will allow benchmarking with PCCUs internationally on a patient subgroup basis, for example, international cardiac databases, with correct and accurate coding of complex operations.

Who is responsible for implementing this action/recommendation?

NOCA.

When will this be implemented?

This enhanced data collection should begin as soon as possible to allow for more detailed reporting in the future annual reports.

Evidence base for recommendation

The Health Information and Quality Authority's *Information Management Standards for National Health and Social Care Data Collections* (HIQA, 2017) and *National Standards for Safer Better Healthcare* (HIQA, 2012) outline key principles for health information and seven dimensions contributing to data quality.

RECOMMENDATION 2

Adult ICUs caring for children should ensure that the recommendations outlined in the *Model of Care for Paediatric Critical Care* are adhered to. Any child requiring treatment in an adult critical care unit should be discussed with the National Paediatric Critical Care Network to decide if stabilisation and transfer to a PCCU is required or that the child can be safely cared for locally.

Rationale

Since the implementation of the Irish National ICU Audit, collection of data on children admitted to each adult ICU Unit in the ROI is now possible. There were 179 admissions of children aged under 16 years to adult ICUs during 2019 (n=111) and 2020 (n=68). A small number of these patients were infants aged under 1 year (n=23) and one-third (n=60) were aged between 1 and 6 years of age. The highest proportion of children (50%, n=89) were admitted to the ICU in University Hospital Galway, followed by the ICU in Cork University Hospital (11%, n=20). The median length of stay was 27 hours in 2019 and 38.5 hours in 2020. Just over one-fifth of patients required ventilation (23%, n=41). The majority of patients were discharged alive (96%).

There is a need to provide regional paediatric HDU beds to ease the strain on PCCUs which are already burdened with high occupancy rates. The only designated regional paediatric HDU is in University Hospital Limerick. The delivery of the national paediatric trauma network, in addition to heightened vigilance for sepsis, means regional HDU beds will be needed to support staff and improve patient outcomes.

What action should be taken?

- Adult ICUs caring for children should ensure the recommendations outlined in the *Model of Care for Paediatric Critical Care* are adhered to (section 6.4: *Indications for transfer to Level 3S PCCU*). Any child requiring treatment in an adult critical care unit should be discussed with the National Paediatric Critical Care Network (telephone number 1800 ACCEPT) to decide if stabilisation and transfer to a PCCU is required or whether the child can be safely cared for locally. This phone line and advice are available 24/7. The National Paediatric Critical Care Network provides advice in resuscitation, stabilisation, and transfer of the critically ill child to an appropriate PCCU bed if required. In the event of a child becoming unexpectedly ill, there may be occasions where only a very short period of intensive care is required that does not necessitate transfer to PCCU. This is based on the clinical judgement of the team caring for the child, possibly in conjunction with input from the PCCU. This is acceptable on the condition that there is a suitable facility within the hospital, such as adult critical care; there are staff with appropriate competencies; and the episode will only last a few hours. If, on subsequent review, the child has not improved or has deteriorated, the initial decision should be re-evaluated and a plan to transfer should be activated.
- University Hospital Galway could consider establishing a regional PHDU. The recommended staffing and equipment requirements for a Level 1 regional PHDU in a Model 4R hospital are outlined in the *Model of Care for Paediatric Critical Care*.
- Further detailed data analysis of the INICUA dataset on children in adult ICU should be undertaken by NOCA to examine the patient's journey, primary diagnosis for admission, and severity of illness score.

Who will benefit from this action/recommendation?

Children requiring critical care and their families. It is recognised that this may pose a difficulty for families where geographical distance is a factor, but adherence to best practice national and international standards regarding the care of children in adult ICUs is recommended.

Who is responsible for implementing this action/recommendation?

- Adult ICUs with the support of the HSE National Clinical Programme for Critical Care
- Saolta Hospital Group/University Hospital Galway
- NOCA

When will this be implemented?

Adherence to best practice national and international standards should be followed on a continuous basis.

Evidence base for recommendation

Children in adult ICUs present particular challenges in regard to staffing the Unit with nurses trained in paediatric critical care, as per national standards. Paediatric and neonatal intensive care should only be provided in designated Units staffed by doctors and nurses with specialised paediatric critical care training. The *Model of Care for Paediatric Critical Care* (National Clinical Programme for Critical Care and National Clinical Programme for Paediatrics, 2019) states that if a patient is ventilated or stays for longer than 24 hours, communication with a PCCU and transfer out is recommended.

Recommendations for the safe and effective care of children in local, regional, and supra regional hospital models were agreed in conjunction with paediatric medicine, adult critical care, and anaesthesia and are outlined in the *National Standards for Paediatric Critical Care Services* (Joint Faculty of Intensive Care Medicine of Ireland, 2018).

RECOMMENDATION 3

PCCUs need to improve timeliness of audit data submission to meet the quality standard.

Rationale

PICANet reports on five key performance metrics, and each participating Unit in the ROI and UK is assessed against these standards and guidelines. Metric 1 is timeliness of data submission. PICANet expects information to be complete and accurate within 3 months of patient discharge.

The proportion of admissions submitted to PICANet within 3 months of discharge for 2020 data by CHI at Crumlin was 48% (67% in 2019) and 85% (83% in 2019) by CHI at Temple Street. This is below the overall average of 89% for all units participating in PICANet. The target is 100%.

The PCCS standard changed in 2021; the new standard has reduced the 3-month submission target to a 2-month submission target and states that 'data for submission to PICANet should be collected and submitted as soon as possible and no later than 2 months after discharge from the PCC unit'.

What action should be taken?

- Hospital management should ensure there is dedicated audit resourcing available. Audit nursing should have sufficient time to focus on data submission and validation. The more timely data submission requirements may require extra resourcing. Contingency planning should be in place to cover for staff absence/sick leave, and training provided if necessary. There is also a vacant data manager post, 0.6 WTE in CHI at Crumlin and 0.4 WTE in CHI at Temple Street, which needs to be filled.
- PCCUs should review data collection workflow processes and procedures to ensure that data are submitted within a 2-month period in order to meet PICANet Metric 1: timeliness of data submission as per the 2021 PCCS Quality Standards. PCCUs need to critically evaluate how they can improve more timely submission and should liaise with PICANet for shared learnings from Units with good practices.

Who will benefit from this action/recommendation?

Children requiring critical care and their families and the health service. Accurate and timely comprehensive data support the appropriate and reliable interpretation of care provided in PCCUs in the ROI. Quality standards should be used to drive quality improvement in services caring for critically ill children.

Who is responsible for implementing this action/recommendation?

CHI hospital management and PCCU audit staff.

When will this be implemented?

Q1 2023: Improvement should be implemented for 2023 data submission.

It is acknowledged that there have been ongoing challenges with data submission. The HSE cyberattack in the ROI affected 2021 data submission timelines, while the University of Leeds, which hosts the PICANet platform, experienced a cyberattack in 2022 that impacted 2022 data submission timelines.

Evidence base for recommendation

PCCS Quality Standards and the PICU Quality Dashboard include timely data submission as a key performance indicator. PICANet data submissions should be made as soon as possible and no later than 2 months after discharge from PCCU (PICU Quality Dashboard – PIC10a Domain 4: *Ensuring that people have a positive experience of care*) (NHS England, 2021).

The HIQA *Guidance on a Data Quality Framework for Health and Social Care* (2018) states the importance of accurate and timely data.

PICANet does not have a defined WTE per bed for audit nurses. INICUA in adult critical care Units recommended standard for audit nursing WTE per bed is 1.0 WTE per 10 critical care beds, based on the *Critical Care Nursing Workforce Report* (Office of Nursing and Midwifery Services Director, 2021). However, it should be noted that this is a different dataset and INICUA audit coordinators carry out data collection, validation, and reporting.

RECOMMENDATION 4

PCCUs should monitor and review out-of-hours and delayed discharges.

Rationale

Audit data show that during the reporting period 2018–2020, 10% of discharges were between 20.00 and 07.59 (out-of-hours). An out-of-hours discharge of a patient is suboptimal and should be avoided where possible. It is important to record the reason for late discharges. For example, there may be no bed available on the ward and in order to facilitate the admission of a critically ill patient a direct swap may take place. Annual audit should record the reasons for out-of-hours discharges and clearly indicate if ward capacity is the issue and communicate this to hospital management. This is important as during the evening and night-time there is reduced medical and nursing staff availability on the wards, and senior staff are less likely to be available to review a patient. In addition, it is less likely that a parent/guardian will be present to accompany the child if the discharge occurs during the night.

What action should be taken?

- PCCUs should review their out-of-hours and delayed discharges and aim to decrease the number of these discharges:
 - Were these delayed discharges following the decision to discharge?
 - Were delays due to a lack of a stepdown/ward bed?
 - Were patients discharged without being fully ready, as a PCCU bed was needed for an urgent admission?

Who will benefit from this action/recommendation?

Children requiring critical care and their families.

Who is responsible for implementing this action/recommendation?

CHI PCCU Clinical Leads/PCCU Clinical Director.

When will this be implemented?

Over the next 12 months.

Evidence base for recommendation

Discharging a patient out-of-hours is suboptimal and should be avoided, as this is associated with increased in-hospital mortality and ICU readmission (Vollam *et al.*, 2022).

The PCCS Quality Standards (2021) state that PCCU operational policy should be that 'discharges do not normally occur between 20:00 and 07:59' and that 'arrangements for discharge [be] within four hours of the decision to discharge'. In addition, those standards recommend that this information should be audited.

The *Paediatric Critical Care Getting It Right First Time Programme National Specialty Report 2022* states that the out-of-hours discharge target is less than 10% and delays in discharge (>24 hours) should be monitored with a target of less than 5% (NHS England, 2022).

RECOMMENDATION 5

A National Respiratory Paediatric Extracorporeal Life Support (ECLS) Programme should be progressed in Children's Health Ireland

Rationale

The ECLS cardiac programme in CHI at Crumlin commenced in 2005 and is recognised as a centre of excellence by ELSO. The CHI at Crumlin PCCU had a total of 65 ECLS runs for the period 2018–2020. A large number of these (n=30) were cardiac surgical patients. However, 12 ECLS runs were required for respiratory patients in CHI at Crumlin, a number of these patients were transferred abroad for treatment, as there is no formally funded and resourced paediatric respiratory ECMO programme in the ROI. Respiratory ECMO provides life-saving treatment for infants and children with very severe lung failure.

A number of these patients had an LOS greater than 70 days in another European country, which has both financial and social implications for the HSE and for the families of these patients. Although survival rates were favourable, a small number of patients died while undergoing treatment abroad. The numbers requiring respiratory ECLS annually are small and this service can be provided in CHI at Crumlin for a fraction of the cost of treatment abroad. It would be preferable if respiratory ECMO patients could remain in the ROI for treatment under a national cardiac and respiratory paediatric ECMO programme in CHI supported by CHI management and the HSE.

This issue continues to be a deficit in the provision of care to critically ill children in the ROI and the lack of funding for paediatric patients requiring respiratory ECLS needs to be highlighted.

What action should be taken?

- The ECLS programme in CHI at Crumlin should be extended to provide care for respiratory patients requiring ECMO.
- This service should be progressed on a limited basis for a small cohort of patients. Children born with CDH (less than 10 per year) would be an ideal subgroup to commence this service. There should be an increase in staffing in addition to the current cardiac ECMO programme inclusive of medical, nursing, and health and social care profession staff

Who will benefit from this action/recommendation?

Critically ill infants and children requiring ECMO and their families.

Who is responsible for implementing this action/recommendation?

CHI management with support from HSE Acute Operations.

When will this be implemented?

As soon as is feasible, subject to funding for additional resources required and recruitment of appropriately trained staff.

Evidence base for recommendation

The *Model of Care for Paediatric Critical Care* (National Clinical Programme for Critical Care and National Clinical Programme for Paediatrics, 2019) recommends the creation of a respiratory ECLS service.

Callaghan *et al.* (2013) outline the costs associated with transferring an infant abroad for ECMO treatment and discuss the ethical dilemma ensued when a respiratory ECMO bed is not available abroad. The advantage of having both cardiac and respiratory ECMO provided at one site would maintain a critical patient load and the associated expert personnel and equipment.

ECMO transfers are usually high risk and complex (Broman, 2019). To reduce complications in neonatal transports, the data available recommend keeping the transport time short and to acknowledge that fixed-wing aircraft transports carry a higher risk than ground ambulance.

CHAPTER 11

CONCLUSION



CHAPTER 11: CONCLUSION

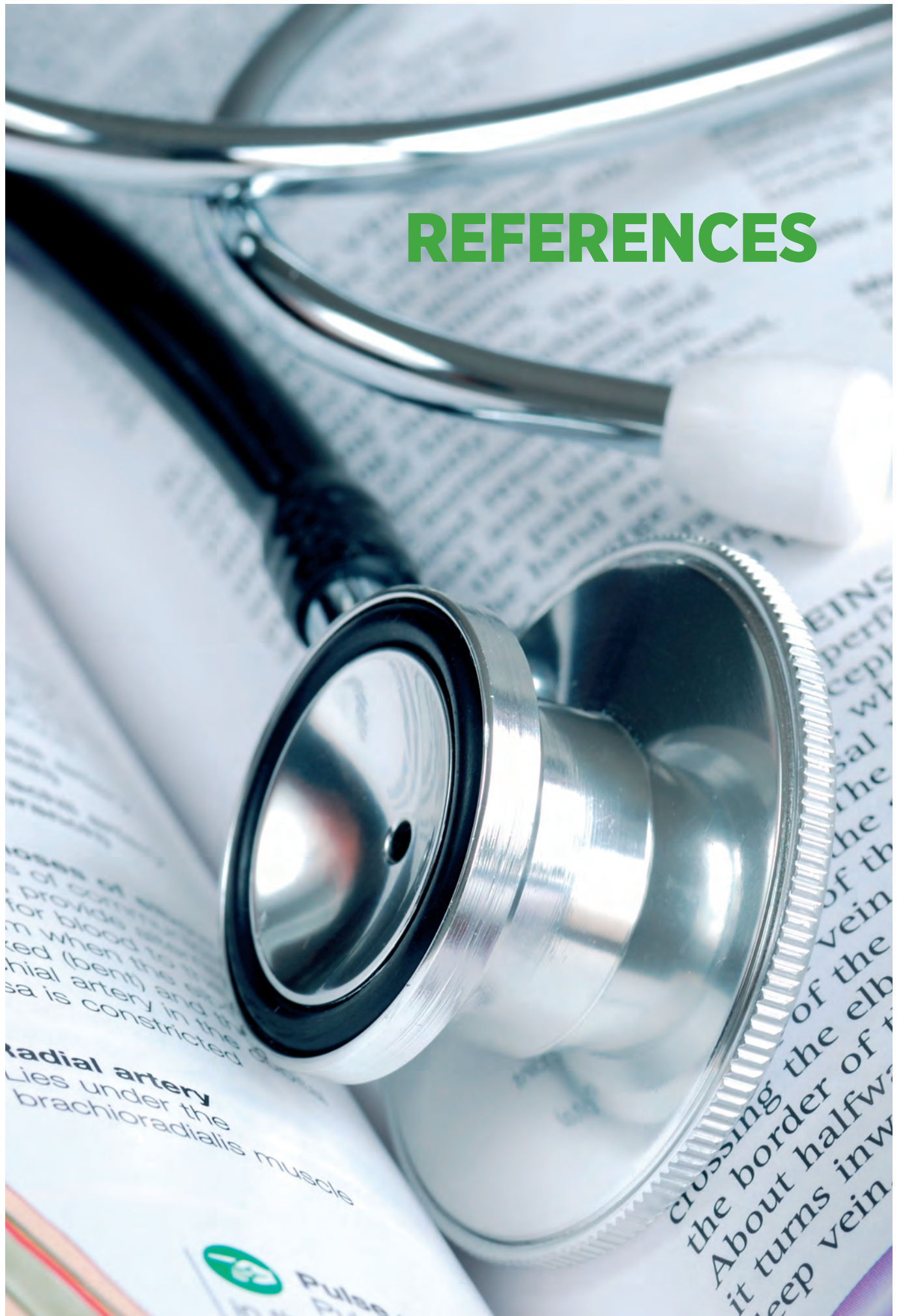
This report provides a detailed account of activity and outcomes in Units providing critical care to children in the ROI during 2020, with aggregate data from 2018 to 2020 included to allow for trend analysis. It also includes a chapter on up-to-date COVID-19 data on children admitted to PCCU from March 2020 to July 2022. While a slight decrease in activity was noted in 2020, with fewer admissions and less bed days, bed occupancy remained high.

The data demonstrate the excellent care provided to sick children across both PCCU sites in CHI, which is safe and comparable to international standards. Areas for improving the standard of care are also highlighted, such as developing a more detailed local and national data collection to show the complexity and diversity of care and monitoring best practice standards with respect to children admitted to adult critical care Units.

The information in this report will be important for informing the planning of critical care services in the short and medium term. Of particular importance will be its usefulness in highlighting deficits and benchmarking against international PCCUs. This year's report includes a section on neonatal admissions, which will be important when planning for the NICU in the new National Children's Hospital.

Audit will be an important part of ensuring that standards of care are maintained in the existing paediatric hospitals as well as in the new National Children's Hospital in the future. This is dependent on complete, accurate, and good-quality data. Continuation and the planned further development of the IPCCCA will contribute to the information available for driving quality improvements in paediatric critical care medicine.

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ACCESSING REPORT APPENDICES



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APPENDIX 1:

IRISH NATIONAL ICU AUDIT GOVERNANCE COMMITTEE MEMBERSHIP AND MEETING ATTENDANCE, 2020

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APPENDIX 2:

IRISH NATIONAL ICU AUDIT PARTICIPATING ADULT ICUS, 2020

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APPENDIX 3:

IRISH NATIONAL ICU AUDIT DATASET

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APPENDIX 4:

DEFINITION OF PAEDIATRIC CRITICAL CARE LEVELS IN IRELAND

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APPENDIX 5:

PICANET ORGANISATIONAL KEY

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APPENDIX 6:

HPSC COVID-19 ENHANCED SURVEILLANCE CRITICAL CARE FORM

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APPENDIX 7:

FREQUENCY TABLES

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