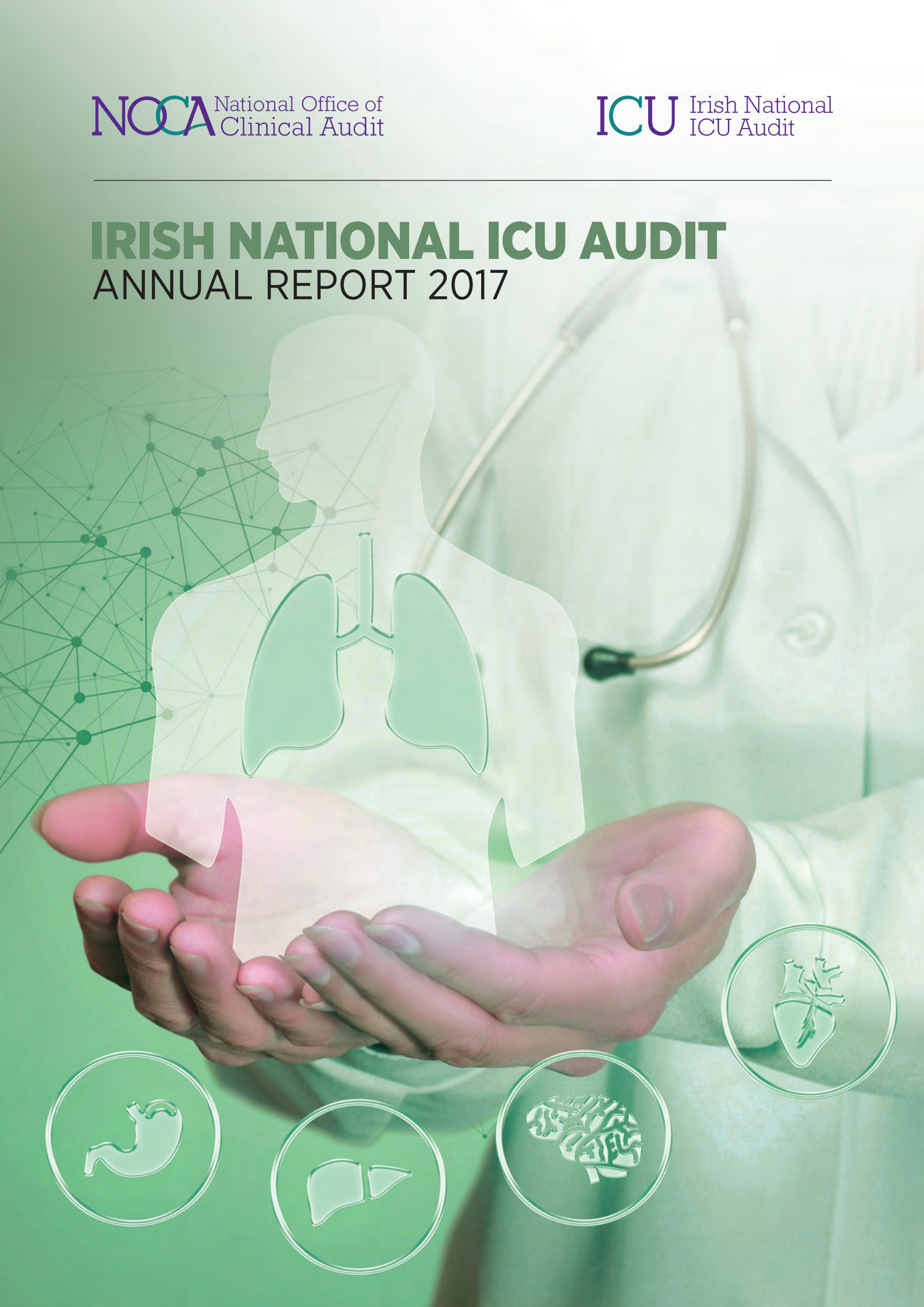
National Office of Clinical Audit

Irish National ICU Audit

IRISH NATIONAL ICU AUDIT
ANNUAL REPORT 2017



REPORT PREPARED BY THE FOLLOWING WITH ASSISTANCE FROM MEMBERS OF THE ICU AUDIT GOVERNANCE COMMITTEE

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NATIONAL OFFICE OF CLINICAL AUDIT (NOCA)

NOCA was established in 2012 to create sustainable clinical audit programmes at national level. NOCA is funded by the Health Service Executive Quality Improvement Division and operationally supported by the Royal College of Surgeons in Ireland.

The National Clinical Effectiveness Committee (NCEC, 2015, p.2) 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". NOCA supports hospitals to learn from their audit cycles.

Electronic copies of this report can be found at:
https://www.noca.ie/publications

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This work uses data provided by patients and collected by their healthcare providers as part of their care. NOCA would like to thank the valuable contribution of all participating hospitals, in particular the Irish National ICU Audit coordinators and clinical leads. Without their continued support and input, this audit could not continue to produce meaningful analysis of critical care in Ireland. NOCA would also like to thank DMF Systems and Chameleon Information Management Services Ltd (CIMS), support and software providers for the Irish National ICU Audit.

NOCA works with the Intensive Care National Audit and Research Centre (ICNARC) in the UK for data validation, data analysis, and the generation of reports on activity in ICUs. ICNARC has been in operation in the UK since the 1990s and has been at the forefront of quality and research initiatives in critical care.

NOCA works with Paediatric Intensive Care Audit Network (PICANet) in the UK for data validation, data analysis, and the generation of reports on activity in PICUs. PICANet was established in 2002 to develop and maintain a secure and confidential high quality clinical database of paediatric intensive care activity.

The Quality Improvement Division (QID) was established to support the development of a culture that ensures improvement of quality of care is at the heart of all services that the HSE delivers. HSE QID works in partnership with patients, families and all who work in the health system to innovate and improve the quality and safety of its care.

ACKNOWLEDGING SIGNIFICANT CONTRIBUTIONS FROM THE FOLLOWING:

NOCA would like to thank Beaumont Hospital, Our Lady's Children's Hospital, Crumlin, St James's Hospital, Temple Street Children's University Hospital and University Hospital Galway for supplying imagery used throughout this report.

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DESIGNED BY SWERVE

National Office of Clinical Audit

Irish National ICU Audit

IRISH NATIONAL ICU AUDIT

ANNUAL REPORT 2017

NOCA National Office of Clinical Audit

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11th January 2019

IRISH NATIONAL ICU AUDIT ANNUAL REPORT 2017

Dear Dr Dwyer & Dr Healy,

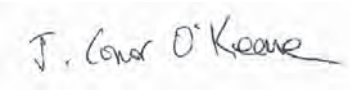
I acknowledge receipt of the Irish National ICU Audit Annual Report 2017 incorporating The Paediatric Intensive Care Audit Network Annual Report 2018.

Following presentation to the NOCA Governance Board on the 9th of January and feedback garnered from our membership, we are delighted to endorse this report.

I wish to congratulate your own and your colleagues sustained efforts over several years in finalising this comprehensive first annual report.

Please accept this as formal endorsement from the NOCA Governance Board of Irish National ICU Audit Annual Report 2017

Yours sincerely,



Professor Conor O' Keane FFPath FRCPI
Chair
National Office of Clinical Audit Governance Board

FOREWORD

In 2008, the Department of Health and Children report, *Building a Culture of Patient Safety: Report of the Commission on Patient Safety and Quality Assurance* (known as the Madden Report), described the vision for patient safety and quality framework in Ireland. Dr Deirdre Madden defined this vision as "Knowledgeable patients receiving safe and effective care from skilled professionals in appropriate environments with assessed outcomes" (Department of Health and Children, 2008, p. 3).

This first Irish National Intensive Care Unit Audit Annual Report, published by the National Office of Clinical Audit, delivers on the Madden Report's vision.

By assessing outcome comparators, this report provides clear information and assurance so that patients and society know that safe and effective intensive care is delivered across Ireland.

The philosopher John Rawls sees society and the State in terms of 'social justice', where the "basic structure [of society and the State] is arranged to maximise the worth to the least advantaged" (Rawls, 2005).

This first Irish National Intensive Care Unit Audit Annual Report now shines a bright light on how the health system in Ireland works to care for the most vulnerable patients, both adult and paediatric.

Dr Michael Power, Clinical Lead
Critical Care Programme
Health Service Executive National Clinical Programmes

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EXECUTIVE SUMMARY

By the end of 2017, the Irish National Intensive Care Unit Audit (INICUA) run by the National Office of Clinical Audit (NOCA) covered 58% of Intensive Care Unit (ICU) activity in adult Health Service Executive (HSE) funded hospitals (12 Units in nine hospitals) and all ICU activity in both specialist paediatric hospitals in the Republic of Ireland (ROI).

Both the adult and paediatric audits collaborate with audit organisations in England. The Intensive Care National Audit and Research Centre (ICNARC) (adults) and the Paediatric Intensive Care Audit Network (PICANet) (paediatrics) advise NOCA, monitor the quality of data, and analyse the data in order to provide quarterly (adult) and annual (adult and paediatric) reports on activity and on the quality of care in ICUs. These reports benchmark Irish data against all comparable Units in the United Kingdom (UK). This first annual report summarises the data from the INICUA Network Quality Report 2017 (from ICNARC) and the *Paediatric Intensive Care Audit Network Annual Report 2018: Summary Report: Data collection period January 2015–December 2017* (Paediatric Intensive Care Audit Network, 2018a).

A NOCA review has confirmed that the Audit datasets and data quality assurance processes are aligned with Health Information and Quality Authority (HIQA) guidelines. National governance of INICUA is provided by the NOCA ICU Audit Governance Committee. The NOCA ICU Audit Governance Committee refers any outlier findings to the applicable hospital's chief executive officer (CEO), who will investigate the reasons for outlier data. The hospital then liaises with NOCA to outline the outcome of its investigation and to confirm that actions are being taken to resolve the issues identified.

Patient experience and outcomes are at the heart of the Audit, and this report includes a patient story from a patient who survived a life-threatening illness in ICU.

The Units included were heterogeneous and included general ICUs in major tertiary referral hospitals, High Dependency Units (HDUs), mixed HDU/ICUs, specialist Units, and Units in smaller regional hospitals. This report provides comprehensive data on activity in each participating Unit, including demographics, case mix, illness severity, requirements for organ support, bed occupancy, length of stay, and outcome. Quality Indicators (QIs) reported on include numbers of high-risk admissions from the ward, out-of-hours discharges, delayed discharges, unplanned readmissions, and risk-adjusted mortality rates.

ICU ADULT UNITS
KEY FINDINGS

- There was considerable variability between Units in the number of admissions, source of admissions, case mix, severity of illness, complexity of care required, and resources utilised in each Unit.
- Irish Units are very busy; mean bed occupancy (calculated from the exact number of hours the bed was physically occupied) was 91% (ranging from 82% to 99%). Standard recommendations are for occupancy rates of 70% to 80%.
- Illness severity on admission to the Unit was greater in Irish Units than in UK Units; the mean Acute Physiology and Chronic Health Evaluation (APACHE) II score for Ireland was 15.9 compared with 14.8 for the UK. The levels of cardiovascular, respiratory and renal support required were also greater for Irish patients.
- Despite higher markers of illness severity, mean length of stay was the same in Ireland and the UK (five days).
- The rate of unplanned out-of-hours discharges to the ward was greater in Irish Units (6% versus 2% in the UK).
- These data indicate that compared with UK patients, Irish patients need to be sicker to be admitted to ICU. For a given illness severity, they spend less time in ICU before discharge back to the ward, which is more likely to happen at night.
- Mortality is high in patients requiring admission to critical care (ICU or HDU); 13% of admitted patients died in ICU/HDU nationally, and a further 6% died after discharge from the Unit, before discharge from hospital.
- Outcome measures in Irish Units were comparable to UK Units, including risk-adjusted hospital mortality rates (standardised mortality ratio (SMR) of 1.07 for Ireland versus the expected value of 1.0) and rates of unanticipated readmission to the Unit (1.1% versus 1.1%). This is reassuring and suggests that, despite the strains placed on them, Irish Units provide a high quality of care for patients and are a relatively safe environment for critically ill patients.
- It should be noted that the Audit has no way of identifying patients who should be in ICU or HDU based on clinical criteria but are not because of limited Unit bed capacity. The scale of this 'unmet need' and the effects on patient outcomes are not known.
- One Unit, Beaumont Hospital General ICU had outlier data for risk-adjusted hospital mortality. The SMR for the Unit for 2017 was 1.27 which was more than two standard deviations (SDs) above the expected value of 1.0.

- Data from the Beaumont Hospital General ICU provide compelling evidence of the effect on mortality of admitting increased numbers of patients; Unit admissions in the final quarter (Q4) of 2017 were 21% higher than the rate of admission for 2016 (and 67% higher than the rate of admissions in 2001). The number of open staffed beds in the Unit was unchanged during this time. Illness severity in this Unit on admission was increased and levels of cardiovascular, respiratory and renal support required were increased, but length of stay was decreased. The risk-adjusted mortality (SMR) was increased for 2017 overall after a sharp increase in SMR in Q4 2017 (SMR from Q1 to Q3 had been within acceptable limits). The rates of unplanned readmissions to the Unit after discharge also increased in Q4 2017. These data convincingly demonstrate the outcome when demand increases beyond the available ICU bed capacity.

- It should be noted that mortality in the Beaumont Hospital General ICU was only marginally outside the acceptable limits in 2017. The Unit has had a mortality rate within the acceptable limits for Quarterly Quality Reports to date in 2018.

- The Mater Misericordiae University Hospital HDU and the University Hospital Galway ICU were outliers for unplanned discharges from the Unit to the ward at night (which is recognised to increase patient risk).

- Both of these hospitals noted that other indicators of patient outcomes had not been adversely affected. Both identified improved documentation of decisions to clear patients for discharge as a way to improve performance for this QI. In addition, Mater Misericordiae University Hospital noted a requirement for increased critical care capacity.

- Some Units have a problem with delayed discharges, presumably because of ward bed shortages. Facilitation of discharges from ICU would reduce ICU bed occupancy, reduce discharges out-of-hours, reduce delays in admission to ICU for critically ill patients, and could make beds available for patients from other Units which are over capacity.

- Length of hospital stay after ICU discharge was considerably longer in Ireland than in the UK (the mean was 24 days in Ireland versus 15 days in the UK). This could be related to a lack of step-down or rehabilitation facilities in Ireland, or it could be because the patients in Ireland were sicker on ICU admission than patients in the UK.

- The Audit covered only 58% of ICU activity, but a fuller picture will be available in the 2018 report, which will have 78% coverage.

- Preparation of this report identified anomalies due to issues with data quality and interpretation of ICNARC definitions. These have been addressed in audit coordinator workshops, which will lead to greater uniformity in data entry in future.

ICU ADULT UNITS
KEY RECOMMENDATIONS

FOR THE HSE

1. The HSE should prioritise measures to bring ICU/HDU bed capacity in Ireland up to levels which can deal comfortably with day-to-day requirements and to provide some reserve capacity in order to cope with surges in demand or with a major disaster. ICUs must be resourced to deal with peak demand rather than average demand, as patients cannot wait for admission.

The Health Service Capacity Review 2018 (Department of Health, 2018) recommended an increase of 190 beds in critical care capacity by 2031; the data in this Report support this recommendation.

2. The HSE should use the data in this report regarding occupancy, case complexity, requirements for organ support, out-of-hours discharges, and unanticipated ICU readmissions to identify the Units operating at or above capacity.

Increased critical care bed capacity should be provided to these Units. As these are predominantly 'hub' hospitals, this would be consistent with the *"Model of Care for Adult Critical Care (HSE Critical Care Programme, 2014).*

3. The HSE should take measures to facilitate transfers of critically ill patients between hospitals in order to make optimal use of scarce critical care beds and to facilitate transfers for specialist care. The INICUA database can support a live ICU Bed Information System (BIS) in order to provide data on bed capacity in participating Units, and this BIS could also be used to improve communication for referrals.

4. The HSE should ensure that the specialist retrieval service for critically ill patients, the Mobile Intensive Care Ambulance Service (MICAS), is resourced to provide a comprehensive service 24 hours per day, 365 days per year.

5. Identifying the unmet need for ICU care is difficult. The proposed BIS (see item 3 above) would have the capacity to document all referrals to ICU and to document whether these referrals were admitted or not. It would also document the reason for ICU referral. The HSE should fund implementation of the BIS nationally, and local clinicians should ensure that the relevant data on Unit referrals that are not accepted are inputted for all referrals.

FOR HOSPITAL MANAGERS, CLINICAL DIRECTORS, CLINICIANS AND ICU AUDIT COORDINATORS

6. Hospitals should prioritise discharges from ICU when patients are ready for discharge. Doctors should clearly identify those patients ready for Unit discharge, and bed managers in hospitals should expedite these discharges.

7. Hospitals should minimise ICU discharges during night-time by performing timely discharges during normal working hours. A discharge summary with details of ICU care and a therapeutic plan should be provided in order to ensure seamless transition from Unit care to ward care.

8. Hospital management should ensure that there are always adequate audit resources in place to collect data, in order to ensure comprehensive data reporting.

9. Local clinicians and managers should benchmark their audit data against data from other Units in order to identify variance in their own activity metrics compared with other Units. This should be used to promote improvements in practice.

10. Local clinicians and audit coordinators should ensure that full documentation of the 'time of decision to admit to ICU' is kept in order to make the new HSE key performance indicator (KPI) for time to access ICU an effective measure of timeliness of ICU admission.

FOR NOCA

11. Consider ways to get more information on unmet need – patients who are not admitted to ICU because of a lack of beds.

12. Consider ways to get more information on the large number of patients who die after ICU discharge.

13. Consider ways to introduce patient-reported (or family-reported) outcome measures (PROMs) into the ICU Audit.

14. Put in place a national database for INICUA in order to expand the range of data analyses which can be provided.

15. Promote the development of national surveillance of catheter-related bloodstream infection in ICUs.

16. Target education on ICNARC definitions and output interpretation for ICU audit coordinators in training workshops.

ICU PAEDIATRIC UNITS
KEY FINDINGS

- The number of bed days delivered in the ROI was approximately 10,000 annually from 2015–2017. Children under the age of one made up 57% of admissions to Our Lady's Children's Hospital, Crumlin (OLCHC) and 38% of admissions to Temple Street Children's University Hospital (TSCUH).
- Bed occupancy in both Irish paediatric ICUs (PICUs) was high in 2017 (97% in OLCHC and 86% in TSCUH). These are above the recommended levels for safe patient care and are likely to make staff retention more difficult.
- Quality metrics such as risk-adjusted mortality and emergency readmissions in both PICUs were within the expected range. These findings show that PICUs were safe places in the ROI in 2017.
- Clinical audit is a tool for improvement in patient care. In this report, both PICUs have shared their experiences of learning from previous PICANet Annual Reports to improve their prevention of unplanned extubation.
- There was an improvement in journey commencement times in 2017 for the Irish Paediatric Acute Transport Service (IPATS). Transfer commencement times of less than one hour increased from about 40% in 2015 and 2016 to around 70% in 2017. However, IPATS only operates on weekdays during the daytime, leaving a major gap in service provision outside of normal working hours.
- There was considerable variability in nursing staffing levels between participating Units in the PICANet Annual Report 2018. There were also considerable numbers of nursing vacancies in both OLCHC and TSCUH.

ICU PAEDIATRIC UNITS
KEY RECOMMENDATIONS

FOR THE HSE

1. The paediatric hospitals should increase bed capacity in PICUs as evidenced by the 94% bed occupancy across both Units in 2017. Increased bed capacity could be achieved by retention and recruitment of staff in order to open all available ICU capacity (31 beds), avoiding the need for an increase in structural bed capacity.

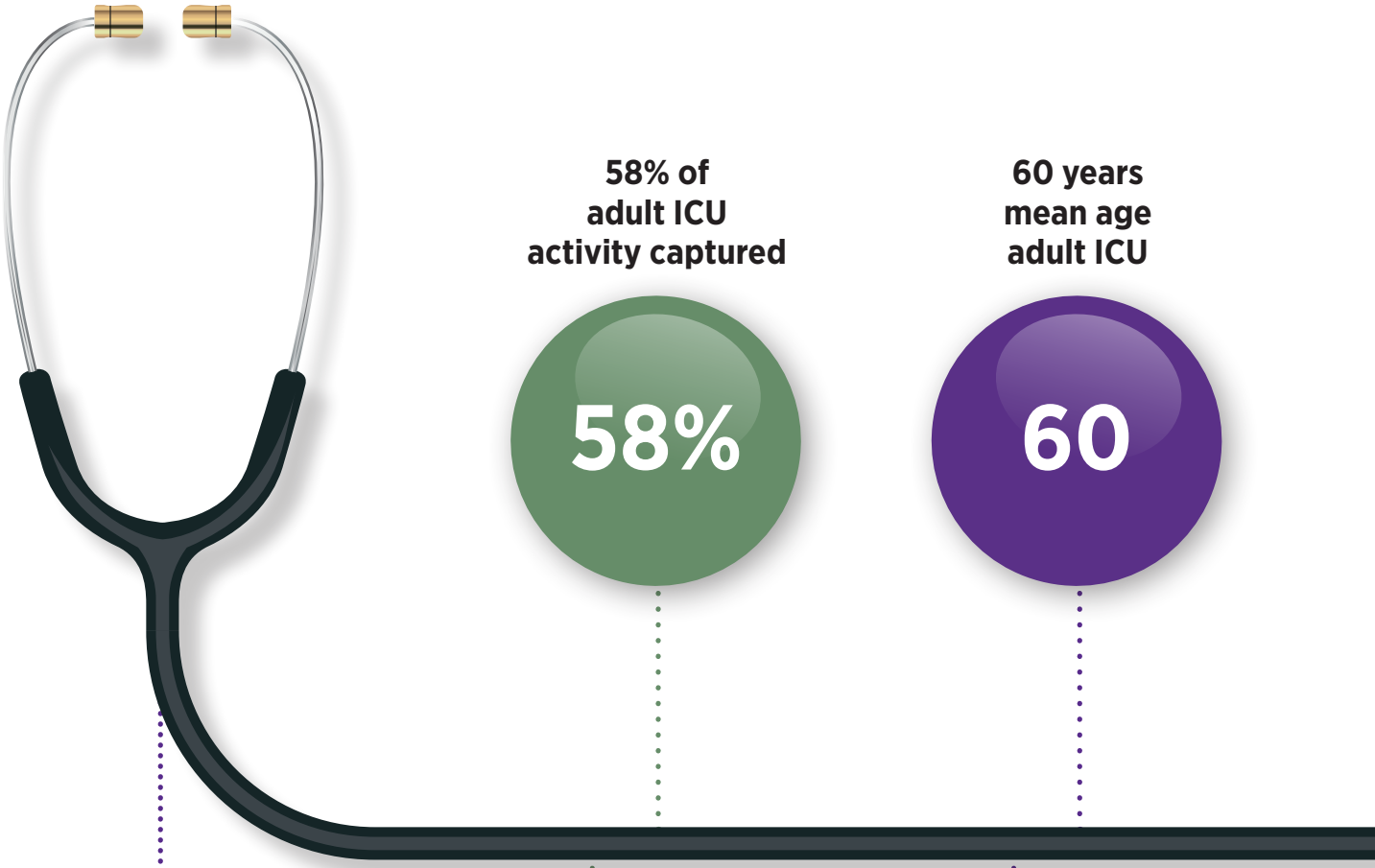
2. The HSE should prioritise the expansion of IPATS to a 24 hour / 7 day centralised transport service (CTS) in order to ensure safe transfer of all children to specialist PICU care in a timely manner; this requires investment in recruitment and retention of nurses and doctors.

FOR NOCA

3. Prioritise a national database for audit of adult ICUs, which will facilitate data collection and reporting on all children who are cared for in adult critical care. This information is critical to the health service for future planning of paediatric bed capacity and transport services.

4. Consider developing a dataset for rates of medical staffing per ICU bed for Ireland in consultation with PICANet.

KEY HIGHLIGHTS 2017



58% of adult ICU activity captured

58%

60 years mean age adult ICU

60

91%

Overall bed occupancy in adult ICU

(recommended levels are 70-80%)

5

5 Days
The mean length of stay in adult ICU is the same as in the UK

1.07

1.07 Standardised mortality ratio (expected value 1.0) adult ICU

Unplanned discharges out of hours from adult ICU; 6% in Ireland v 2% in UK

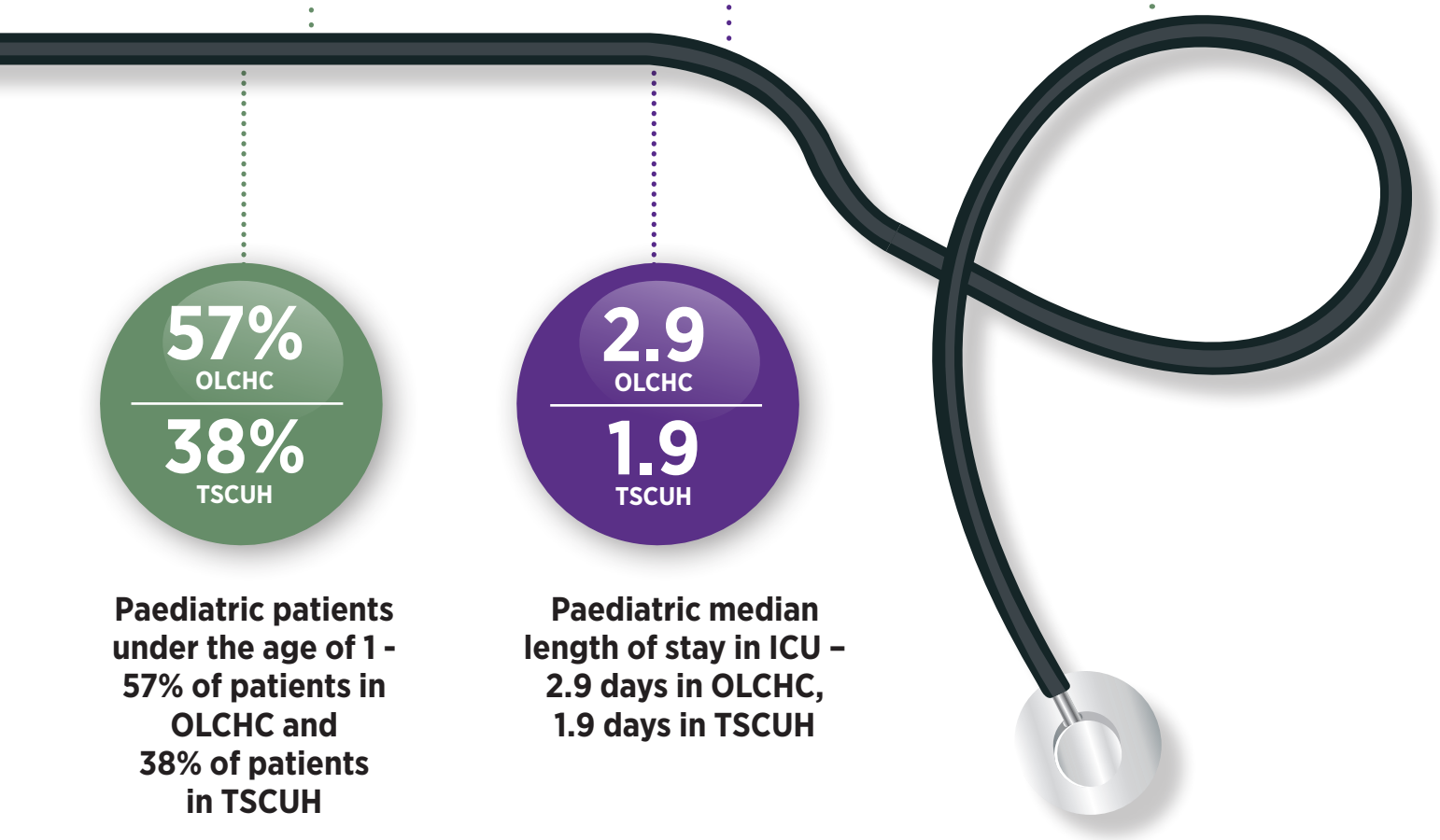
6%
IRELAND
2%
UK

Mean length of stay in hospital after adult ICU discharge for hospital survivors was 24 days inIreland v 15 days in UK

24
IRELAND
15
UK

94% The overall bed occupancy in paediatric ICU

94%



57%
OLCHC
38%
TSCUH

Paediatric patients under the age of 1 - 57% of patients in OLCHC and 38% of patients in TSCUH

2.9
OLCHC
1.9
TSCUH

Paediatric median length of stay in ICU – 2.9 days in OLCHC, 1.9 days in TSCUH

CHAPTER 1

IRISH NATIONAL INTENSIVE CARE UNIT AUDIT

CHAPTER 1: **IRISH NATIONAL INTENSIVE CARE UNIT AUDIT**

INTRODUCTION

The importance of audit in intensive care units (ICUs) was highlighted in *Towards Excellence in Critical Care: Review of Adult Critical Care Services in the Republic of Ireland* (Prospectus, 2009). Two recommendations made within this report were:

- "R37 The collection of a national, standard clinical dataset on the case mix, outcome and activity of adult critical care on all admissions to all adult Critical Care Units should be developed and implemented.
- R38 A national audit system to foster improvements in the organisation and practice of critical care, through national benchmarking, reviewing trends and continuous comparative audit, should be implemented" (Prospectus, 2009, p. 19).

In fulfilment of key objectives of the Health Service Executive (HSE) Critical Care Programme and the Joint Faculty of Intensive Care Medicine of Ireland (JFICMI), the National Office of Clinical Audit (NOCA) has established the Irish National Intensive Care Unit Audit (INICUA). NOCA is implementing the National ICU Audit in 22 acute hospitals with adult ICUs in Ireland (this deployment will continue into 2019). At the time of writing this report (November 2018), 15 hospitals are participating, with 18 Units collecting live data. This report focuses on 12 adult Units across nine hospitals that have data for 2017, and two paediatric ICUs (PICUs) that have data for the period 2015–2017.

The Paediatric Intensive Care units at Temple Street Children's University Hospital (TSCUH) and Our Lady's Children's Hospital, Crumlin (OLCHC) has been collecting data since 2009 and started submitting anonymised data to PICANet in 2010

NATIONAL OFFICE OF CLINICAL AUDIT

NOCA works to promote an open culture of shared learning from national clinical audits in order to improve clinical outcomes and patient safety. NOCA is committed to meeting best practice standards in how clinical audit is governed.

NOCA works with the Intensive Care National Audit and Research Centre (ICNARC) and with the Paediatric Intensive Care Audit Network (PICANet) in the UK for data validation, data analysis, and the generation of reports on activity in ICUs and PICUs and on (QIs, which are benchmarked against all other participating Units). The NOCA ICU Audit Governance Committee governs the output from both audits.

PURPOSE OF THIS REPORT

This national report by the NOCA Irish National Audit Governance Committee, includes data collected on Unit admissions during 2017 for adult ICUs and data on Unit admissions from 2015–2017 for PICUs.

Information on the adult ICU audit findings is available in Chapter 5, and information on the PICU audit findings is available in Chapter 6.

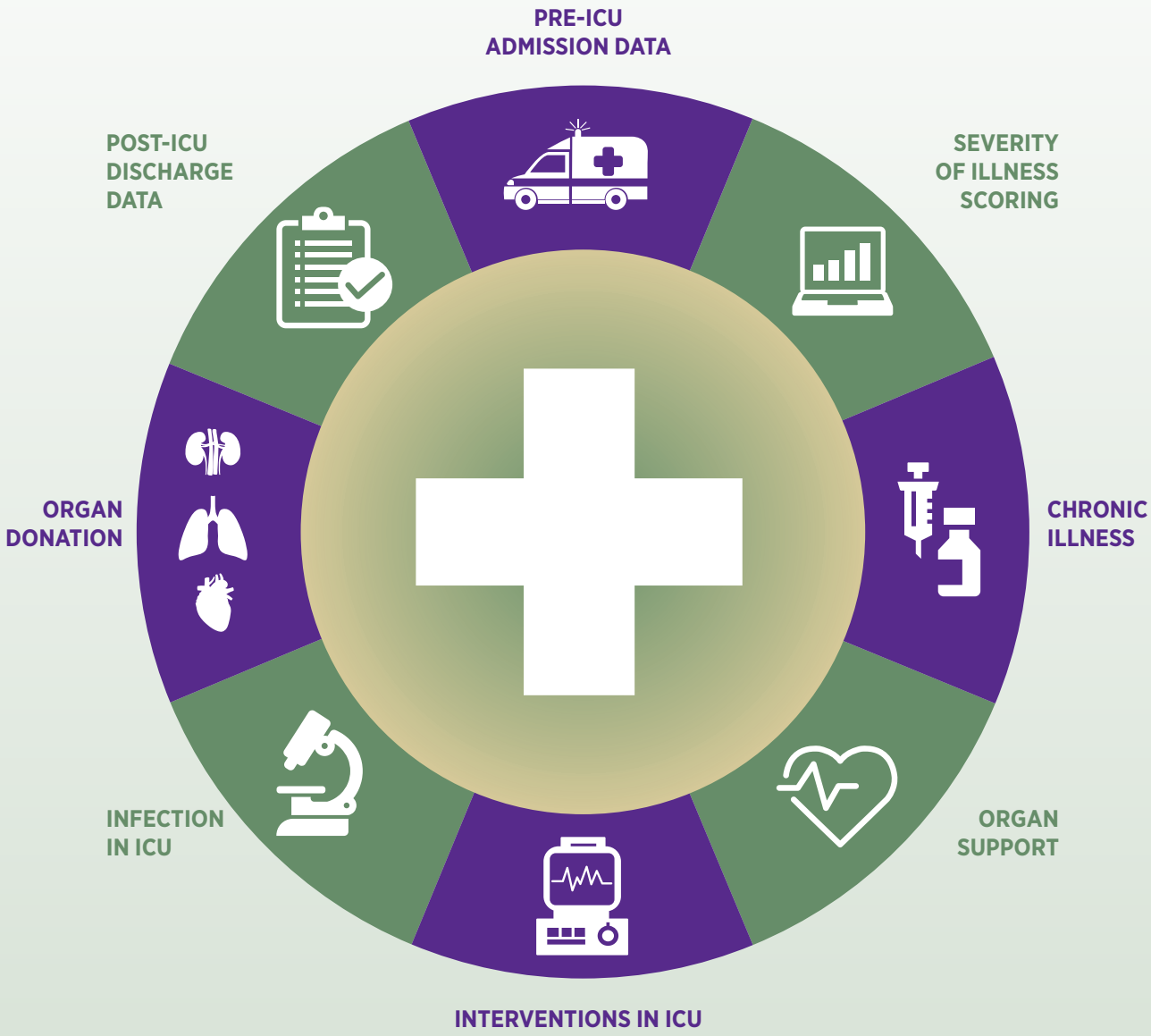
At the heart of this audit report are the patients who have been cared for in ICU and their families. This report includes a perspective from Barbara, a patient who received care in an adult ICU (see Chapter 4). Her story is called Perceptions of vulnerability: Barbara's experience of ICU and recovery.

Capturing this perspective allows a thorough understanding of the whole hospital experience of a patient who was admitted to ICU. The inclusion of this personal account seeks to ground this NOCA report in the lived patient experience and the impact on patients' lives.

This report is aimed at the multidisciplinary teams caring for patients in ICUs, at the hospital managers who support them, at the national structures for administration of the health service, and at the users of the intensive care services in the Republic of Ireland. It is accompanied by a summary report which is aimed at patients, patient organisations and the public.

CHAPTER 2

METHODOLOGY FOR IRISH NATIONAL ICU AUDIT



CHAPTER 2: METHODOLOGY FOR IRISH NATIONAL ICU ADUDIT

IRISH NATIONAL ICU AUDIT AIM

The overall purpose of INICUA is to benchmark the quality of care across ICUs in Ireland and to drive improvements in the quality of care.

IRISH NATIONAL ICU AUDIT OBJECTIVES

The objectives of INICUA include the following:

- Measure the quality of care in ICU by benchmarking outcomes
- Use the Audit to drive improvements in the quality of care
- Measure activity to inform the configuration of critical care
- Provide data to support the Hospital In-Patient Enquiry (HIPE) system and activity-based funding (ABF)
- Audit healthcare-associated infection (HCAI), and
- Audit potential organ donors and organ donation.

GOVERNANCE AND MANAGEMENT STRUCTURE

The NOCA Governance Board was convened to oversee and guide NOCA's strategic direction. The NOCA Governance Board has the authority to issue directions to NOCA management with regard to the various clinical audit streams.

INICUA is governed by a Governance Committee, which makes strategic decisions in relation to the Audit and oversees operational plans. The Governance Committee comprises relevant clinical and management stakeholders and two public/patient interest (PPI) representatives.

The operation of the Audit is managed by the clinical audit team of audit managers and clinical leads, who are responsible for the development and implementation of, and reporting from, the Audit. This team is supported by the NOCA executive team, who provide expertise in statistical analysis, data quality and security, information technology (IT), communications, and quality standards.

NOCA IRISH NATIONAL ICU AUDIT GOVERNANCE COMMITTEE

The primary role of the Governance Committee is to monitor the ICNARC reports of the quality of care provided in each Critical Care Unit. The Governance Committee supports and advises the ICU Audit Clinical Lead on the operation of the Audit and is the link to the NOCA Governance Board. In addition, the Governance Committee provides guidance on the strategic direction of the ICU Audit programme. Membership includes professional organisations, two public/patient interest (PPI) representatives, a senior accountable healthcare manager, the NOCA Clinical Lead for ICU Audit, the NOCA Executive Director, and ICU audit managers. Membership is on a three-year staggered term; please refer to Appendix 1 for a list of Governance Committee members in 2017.

The Governance Committee meets quarterly, with additional meetings when necessary. A record of attendance is included in this report. The Governance Committee requires 50% plus one member to be in attendance in order to establish a quorum. The Clinical Lead and ICU Audit Manager attend and report at all Governance Committee meetings. Governance Committee members are asked to declare any potential conflict of interest with regard to agenda items to the Chair.

The Governance Committee is accountable to the NOCA Governance Board. The NOCA executive team furnishes regular status reports to the NOCA Governance Board on behalf of the Governance Committee.

IRISH NATIONAL ICU ADUDIT CLINICAL LEAD

The National ICU Audit Clinical Lead provides clinical leadership for the successful implementation and management of the ICU Audit. The National ICU Audit Clinical Lead is accountable to the Director of the HSE's Quality Improvement Division and to the NOCA Governance Board.

This role requires a commitment of one day per week. This post is renewable every three years, subject to agreement between the Director of the HSE's Quality Improvement Division, NOCA's Clinical Director, and the Clinical Lead.

KEY RESPONSIBILITIES OF THE IRISH NATIONAL ICU AUDIT CLINICAL LEAD

The INICUA clinical lead is responsible for:

- Promoting the value of the national clinical audit
- Provide clinical leadership to the project team for audit development and implementation
- Engage with the healthcare community to garner support for audit implementation, and
- Provide ongoing leadership of the Audit by establishing effective working relationships with key stakeholders such as the HSE National Clinical Programmes, specialty bodies, the Department of Health and Children, and other key stakeholders in service delivery.

IRISH NATIONAL ICU ADUDIT MANAGER

The National ICU Audit Manager works as part of the NOCA team to provide clinical support and expertise for the successful implementation and management of the ICU Audit. The Audit Manager is accountable to the National ICU Audit Clinical Lead, NOCA's Executive Director, the ICU Audit Governance Committee, and the NOCA Governance Board.

KEY RESPONSIBILITIES OF THE IRISH NATIONAL ICU AUDIT MANAGER

The National ICU Audit Manager has a pivotal role in the coordination and management of activities and resources in order to implement the ICU Audit nationally. The National ICU Audit Manager provides clinical expertise and delivers training throughout the implementation process. Following implementation, the National ICU Audit Manager is the go-to person for ongoing support and training, and facilitates communication across healthcare teams. The National ICU Audit Manager participates in ongoing developments in ICU audit and national clinical audit, supporting the Clinical Lead and the ICU Audit Governance Committee.

IRISH NATIONAL ICU AUDIT GEOGRAPHICAL SCOPE

The geographical scope of the ICU Audit is national, deploying a common IT system and business process for the collection of audit data across all ICUs. The scope of the project includes the following HSE and voluntary hospitals:

PHASE 1

- Mater Misericordiae University Hospital: **live in 2015**
- University Hospital Limerick: **live in 2015**
- Our Lady of Lourdes Hospital, Drogheda: **live in 2015**
- Beaumont Hospital: **live in 2016**
- Tallaght University Hospital: **live in 2016**
- University Hospital Galway: **live in 2017**
- St James's Hospital: **live in 2017**
- University Hospital Waterford: **live in 2017**
- St Vincent's University Hospital: **live in 2018**
- Cork University Hospital: **in implementation**

PHASE 2

- Regional Hospital Mullingar: **live in 2018**
- Wexford General Hospital: **live in 2018**
- St Luke's General Hospital, Kilkenny: **live in 2018**
- Connolly Hospital: **live in 2018**
- Naas General Hospital: **live in 2018**
- Midland Regional Hospital, Tullamore: **live in 2018**

REMAINING HOSPITALS: LIVE BY END OF 2019

- Cavan General Hospital
- Mercy University Hospital
- University Hospital Kerry
- Sligo University Hospital
- Letterkenny University Hospital
- South Tipperary General Hospital

- SAOLTA UNIVERSITY HEALTH CARE GROUP
- RCSI HOSPITALS
- DUBLIN MIDLANDS HOSPITAL GROUP
- IRELAND EAST HOSPITAL GROUP
- THE CHILDREN'S HOSPITAL GROUP
- UL HOSPITAL GROUP
- SOUTH/SOUTH WEST HOSPITAL GROUP

UNIVERSITY HOSPITAL GALWAY

CLINICAL LEAD: Dr John Bates
AUDIT COORDINATOR: Una Folan
AUDIT COORDINATOR: Anita McGlynn

UNIVERSITY HOSPITAL LIMERICK

CLINICAL LEAD: Dr John O Dea
AUDIT COORDINATOR: Fionnuala O'Brien
AUDIT COORDINATOR: Amy Walsh

UNIVERSITY HOSPITAL WATERFORD

CLINICAL LEAD: Dr Wahid Altaf
CLINICAL LEAD: Dr Vida Hamilton
AUDIT COORDINATOR: Chris Gallagher

ST JAMES'S HOSPITAL KEITH SHAW UNIT (CT ICU)

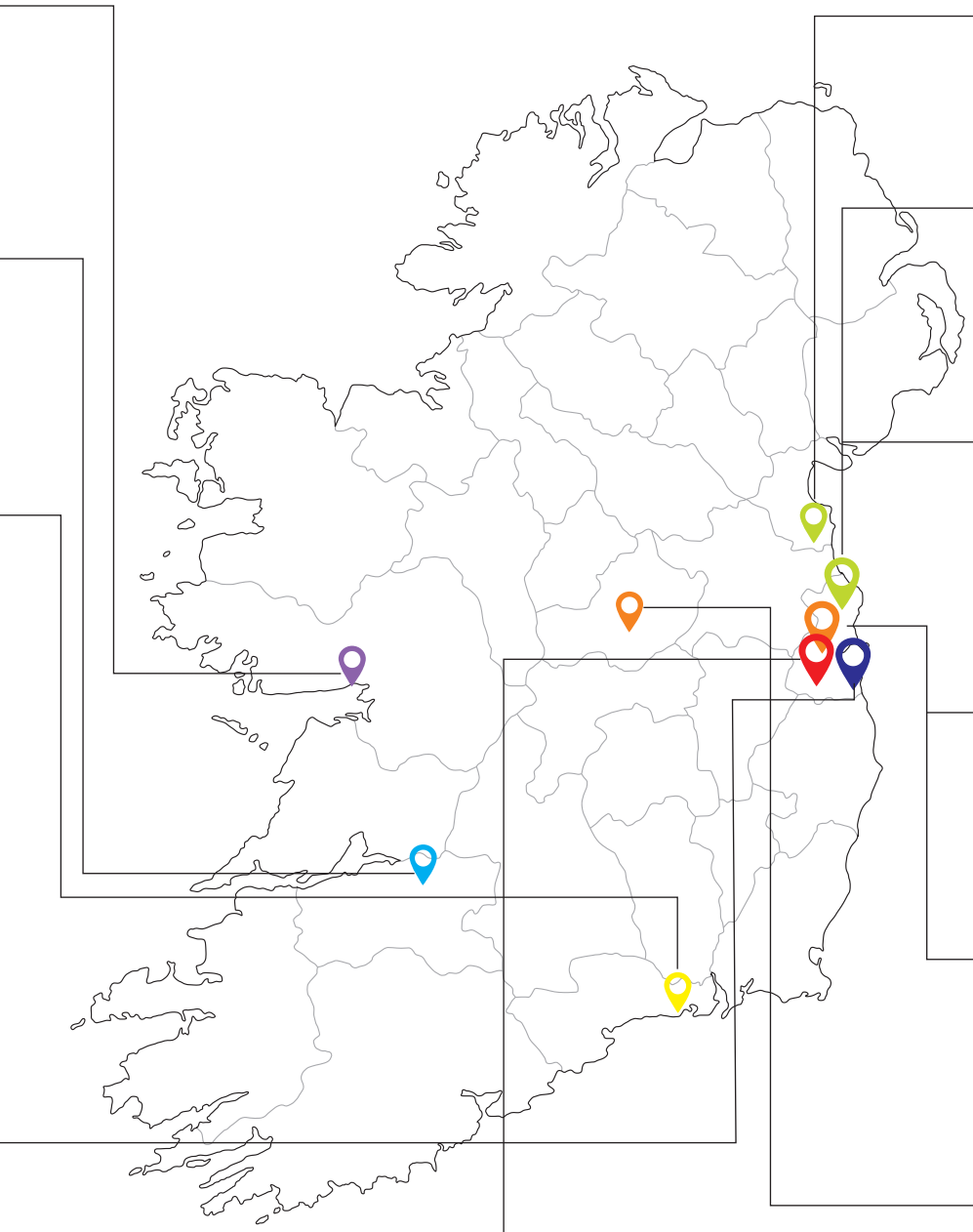
CLINICAL LEAD: Dr Elizabeth Connolly
CLINICAL LEAD: Dr Tom Ryan
AUDIT COORDINATOR: Emily Naylor
AUDIT COORDINATOR: Michelle Pacturanan

ST JAMES'S HOSPITAL GICU

CLINICAL LEAD: Dr Elizabeth Connolly
CLINICAL LEAD: Dr Tom Ryan
AUDIT COORDINATOR: Zieta O'Hagan

TALLAGHT UNIVERSITY HOSPITAL

CLINICAL LEAD: Dr Maria Donnelly
CLINICAL LEAD: Dr Gerard Fitzpatrick
AUDIT COORDINATOR: Lilly Mathew



OUR LADY OF LOURDES HOSPITAL, DROGHEDA

CLINICAL LEAD: Dr Rosemary Moriarty
AUDIT COORDINATOR: Fionnuala Monaghan

BEAUMONT HOSPITAL GENERAL ICU

CLINICAL LEAD: Dr Alan Gaffney
CLINICAL LEAD: Dr Rory Dwyer
AUDIT COORDINATOR: Joanne Mulvihill

BEAUMONT HOSPITAL RICHMOND ICU

CLINICAL LEAD: Dr Alan Gaffney
CLINICAL LEAD: Dr Rory Dwyer
AUDIT COORDINATOR: Magdalena Pecak

MATER MISERICORDIAE UNIVERSITY HOSPITAL ICU

CLINICAL LEAD: Dr Brian Marsh
AUDIT COORDINATOR: Minu Josy
AUDIT COORDINATOR: Elizabeth Goode

MATER MISERICORDIAE UNIVERSITY HOSPITAL HDU

CLINICAL LEAD: Dr Brian Marsh
AUDIT COORDINATOR: Caroline Quinn
AUDIT COORDINATOR: Maeve O Reilly

REGIONAL HOSPITAL MULLINGAR

CLINICAL LEAD: Dr Mohammad Faheem
AUDIT COORDINATOR: Roseanne Smith

TEMPLE STREET CHILDREN'S UNIVERSITY HOSPITAL

CLINICAL LEAD: Dr Dermot Doherty
AUDIT COORDINATOR: Marie Lawlor

OUR LADY'S CHILDREN'S HOSPITAL, CRUMLIN

CLINICAL LEAD: Dr Martina Healy
AUDIT COORDINATOR: Linda O'Connor

IRISH NATIONAL ICU AUDIT DATA SET (ADULT)

The dataset outlined in Table 2.1 covers the patient journey before and after admission to ICU.

TABLE 2.1: INICUA DATASET

Dataset	Examples
Pre-ICU admission data	Demographic data, hospital transfer details, length of stay in hospital prior to ICU admission
Severity of illness scoring systems	Acute Physiology and Chronic Health Evaluation (APACHE II), ICNARC, Sequential Organ Failure Assessment (SOFA) score
Chronic illness	Metastatic, cardiovascular, other chronic disease
Interventions in ICU	Ventilation, invasive monitoring, dialysis, nutrition, transfers to theatre.
Organ support	Respiratory, cardiovascular, renal and gastrointestinal support
Data to support HIPE coding	Diagnosis (current) during ICU stay, hours of ventilation
Infection in ICU	Unit- and hospital-acquired infection
Organ donation	Potential and actual organ donation
Post-ICU discharge data	Outcome and length of stay in unit, ward and hospital; patient journey details

THE IT INFRASTRUCTURE FOR IRISH NATIONAL ICU AUDIT (ADULT)

NOCA is working as a partner with the HSE, which procured and funded a system for the ICU Audit that is suitable for the Irish healthcare system. This system can interface with existing hospital systems and data can be extracted for analysis by ICNARC. The system will support the establishment of a national database for ICU Audit.

INFOFLEX (ADULT ICU AUDIT SOFTWARE) AND HOW IT IS USED

InfoFlex has the following functionality and features

- National ICU Audit data are stored within InfoFlex.
- Patient-identifiable information is held on the hospital database and stored on a HSE server.
- Access by hospital is restricted to data from that hospital only.
- Access is restricted by user, and all users of the system must adhere to their local hospital's data protection policy.
- IT security safeguards are in place to protect the data.
- InfoFlex interfaces with existing hospital IT systems.
- The software exports anonymised data to ICNARC every quarter (no patient-identifiable information is sent).
- InfoFlex generates a suite of local reports.
- InfoFlex can be interrogated to answer local queries.
- The software provides a platform for a future INICUA database on critical care activity.

DATA PROTECTION AND INFORMATION MANAGEMENT

NOCA and the ICU Audit Governance Committee recognise the importance of maintaining privacy and confidentiality at all times, and are committed to the highest standards of data management.

- Patient-identifiable information is stored on a HSE server but is only accessible to staff from the relevant hospital. IT security safeguards have been put in place in order to protect the data. No patient-identifiable information is shared with ICNARC, NOCA or anyone else outside the relevant hospital.
- Users must keep data secure and confidential in accordance with the General Data Protection Regulation (GDPR) that came into effect in 2018, the *Guide to Professional Conduct and Ethics for Registered Medical Practitioners: 8th Edition 2016* (Medical Council, 2016), and the *Code of Professional Conduct and Ethics for Registered Nurses and Registered Midwives* (Nursing and Midwifery Board of Ireland, 2014), as well as with national standards and guidance (Health Information and Quality Authority, 2018; 2017). Users must also comply with their local hospital's data protection policies and procedures.
- At hospital level, the ICU Audit Local Clinical Lead takes overall responsibility for ICU Audit data management.
- Access to the ICU database is restricted to the ICU Audit Coordinator and the Local Clinical Lead in order to ensure compliance with the GDPR.

Data protection of PICANet data is outlined in Chapter 6, page 103

REPORTING ON BENCHMARKED OUTCOMES

The Irish National ICU Audit, in partnership with ICNARC, provides reporting on benchmarked outcomes and activity measures in order to facilitate quality improvement.

ICNARC provided validation of data and benchmarking of outcomes and key performance indicators (KPIs) for INICUA. This is provided in the form of Quarterly Quality Reports (QQRs) and the output is displayed in a dashboard format for ease of viewing (Figure 2.1).

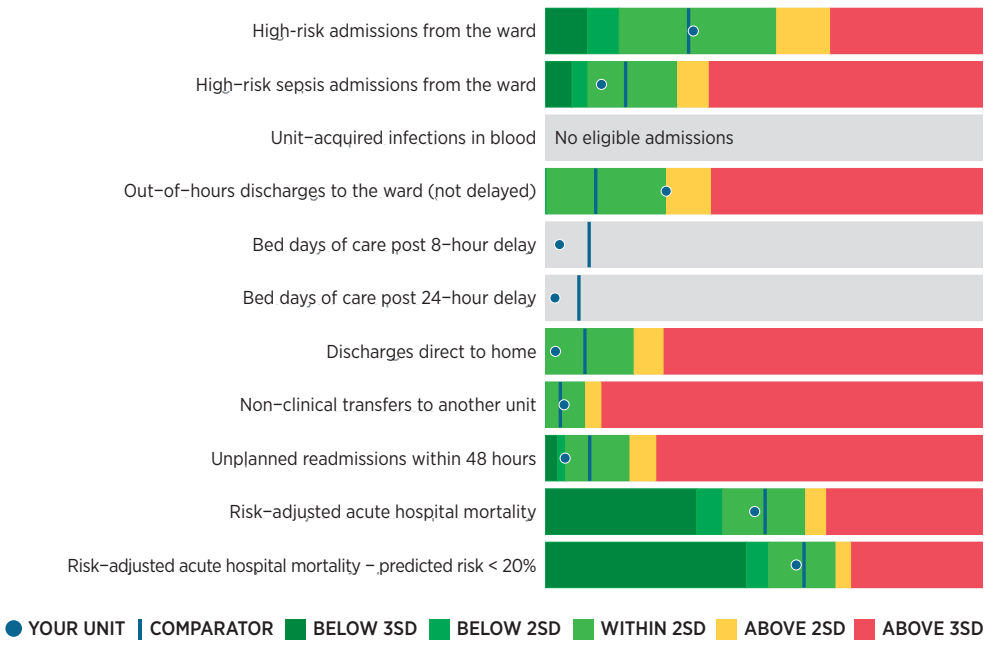


FIGURE 2.1: QQRs FROM ICNARC

IRISH NATIONAL ICU AUDIT IN THE ADULT HOSPITALS

The National ICU Audit is supported in each hospital by the Local Clinical Lead for the ICU Audit and by the ICU Audit Coordinator (ICU Audit Nurse).

Local Clinical Lead for the ICU Audit

The Local Clinical Lead is usually either the ICU Director or their nominee from the ICU consultant group. They have a key role in leading the ICU Audit, in ensuring that resources are provided locally, in supporting the Audit Coordinator on logistic and data quality issues, in reviewing and responding to audit findings, in maintaining links with hospital governance issues, and as a central figure in linking with NOCA. They take ultimate responsibility for issues relating to data quality and for responding to outlier findings for QIs.

ICU Audit Coordinator

For clarity and consistency, NOCA will refer to the local hospital ICU Audit Nurse as the ICU Audit Coordinator.

The role of the ICU Audit Coordinator at hospital level is directed by the ICU Audit Clinical Lead and supported by the NOCA ICU Audit Manager. The key responsibilities of this role involve supporting the implementation of the National ICU Audit in their Unit and the ongoing collection and input of validated ICU Audit data. The Audit Coordinator is responsible for the security of all patient data and must be aware of and comply with data protection legislation.

The Audit Coordinator works closely with their Clinical Lead on the operation of the Audit and management of the Audit output. They have an in-depth understanding of their specific audit, attend training programmes given by NOCA and deliver Audit-specific training within their local hospital where required. They are responsible for ensuring data quality and for monitoring and communicating the Audit output with the support of the local Audit Clinical Lead and NOCA. The Audit Coordinator attends local hospital governance committee meetings and supports local quality initiatives associated with the ICU Audit.

Local hospital governance committee meetings

The local hospital governance structure for the ICU Audit is normally led by the local ICU Audit Clinical Lead. The local ICU Audit Clinical Lead is usually either the ICU Director or their nominee, and is supported by the ICU Audit Coordinator (ICU Audit Nurse).

Local hospital governance committee is responsible for:

- Maintenance of data quality
- Procedures for data protection
- Ensuring that deadlines for data submission are met
- Review of quarterly ICNARC reports, supported by the clinicians involved in the Unit both nursing and medical
- Circulation of the outcome of local ICU MDT meetings to local hospital governance structures, i.e. Quality Assurance Committees, the hospital Lead clinician, the Chief Executive Officer (CEO), etc.

Further information on Local hospital governance committee is available in Appendix 2.

Review of ICU Audit QQRs based on the ICNARC QIs

When each QQR is available from ICNARC there is a local hospital review and a NOCA review.

LOCAL HOSPITAL REVIEW
- Unit and Directorate level
- Local hospital governance committee meetings

NOCA REVIEW
- ICU Audit Clinical Lead and ICU Audit Manager review all QQR's
- ICU Audit Governance Committee – overview of outcomes and decisions regarding actions
- NOCA Governance Board oversees the full process of review

Where there is a statistical outlier identified within the review of ICU Audit QQRs, data quality is the first checkpoint. The NOCA Audit Manager and Clinical Lead work with the hospital audit team to resolve data quality issues. If issues do not relate to data quality, a more detailed review of the statistical outlier is undertaken.

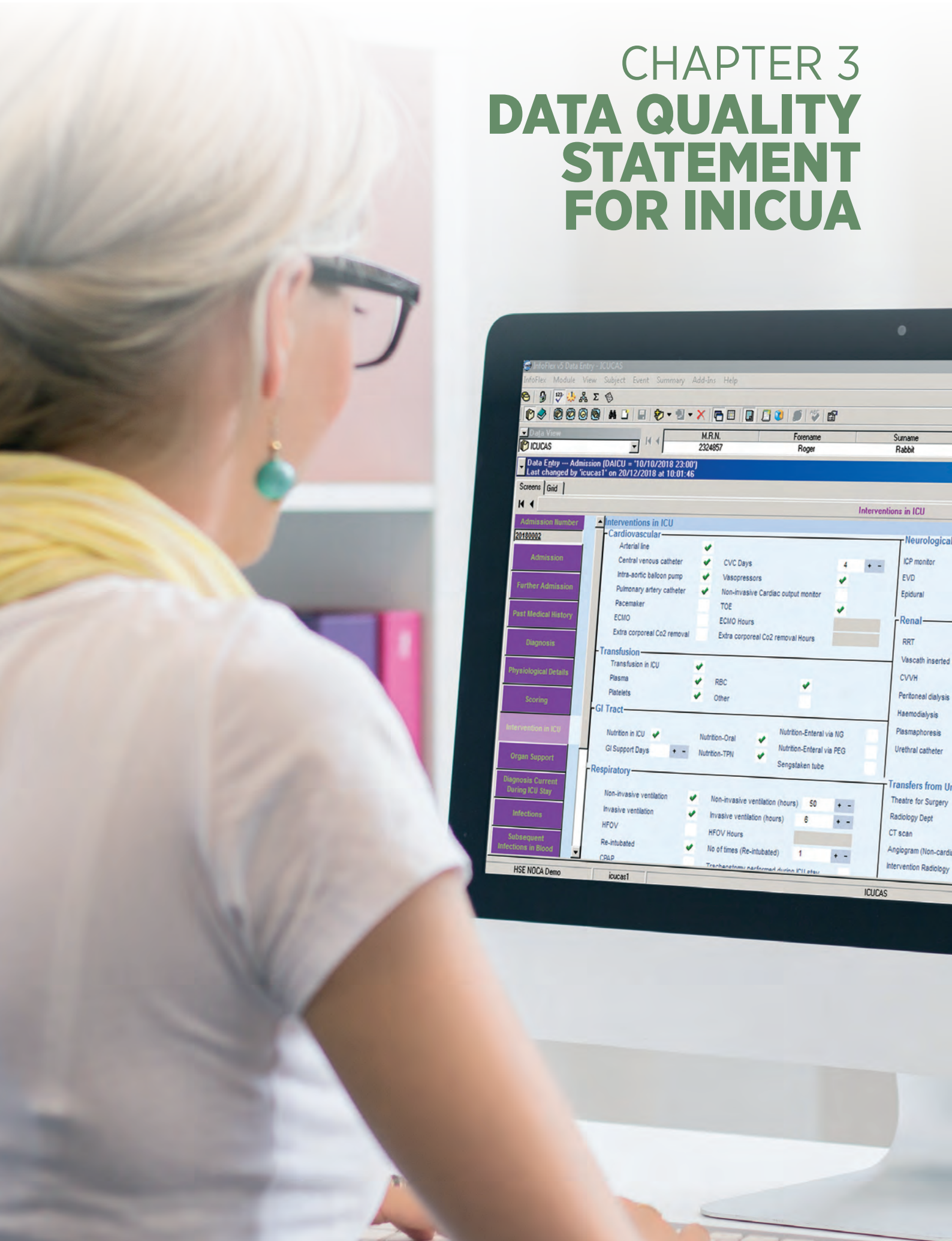
The NOCA Audit Clinical Lead notifies the hospital CEO and key stakeholders of the occurrence of a statistical outlier. The hospital CEO appoints a senior accountable person to lead a review and develop an action plan to address the outlier. The output of this process is included in national reports, sharing learning more broadly in the healthcare system. Outliers for INICUA for the 2017 reporting year are included in this report.

'Outlier' definition

Statistical outliers are defined as results that are:
- > 2 standard deviations (SDs) outside the expected value for 2 consecutive quarters, or
- > 3 SDs outside the expected value for 1 quarter.

The *NOCA Monitoring and Escalation Policy* for statistical outliers is available on the NOCA website (NOCA, 2017).

CHAPTER 3
DATA QUALITY STATEMENT FOR INICUA



CHAPTER 3: **DATA QUALITY STATEMENT FOR INICUA**

The overall objectives of INICUA are to benchmark quality of care and outcomes across ICUs in Ireland and to drive improvements in quality of care. This is done in partnership with ICNARC in the UK. The purpose of this data quality statement is to support the interpretation and judgement of the information contained in this report.

INICUA data for the reporting time period from 1 January to 31 December 2017 were submitted by ICU Audit Coordinators to ICNARC. This included demographic, clinical and administrative data relating to all patients admitted to participating ICUs during the reporting period. Following a robust process of data validation in order to ensure data quality, QQRs were issued to hospital units. These reports included information on data completeness, the demographic profile of patients, activity in units, and clinical information on ICU QIs:

- **QI 1:** High-risk admissions from the ward
- **QI 2:** High-risk sepsis admissions from the ward
- **QI 3:** Out-of-hours discharge to the ward not delayed
- **QI 4:** Discharges direct to home
- **QI 5:** Non-clinical transfers to another unit
- **QI 6:** Unplanned readmissions within 48 hours
- **QI 7:** Risk-adjusted acute hospital mortality, and
- **QI 8:** Risk-adjusted acute hospital mortality predicted risk <20%.

This is the first data quality assessment of the INICUA dataset, which is carried out in line with the Health Information and Quality Authority's (HIQA's) *Guidance on a data quality framework for health and social care* (Health Information and Quality Authority, 2018). This assessment of the dimensions of data quality highlights strengths and areas for improvement. The data quality of the PICANet dataset is evaluated in Chapter 6 (page 103).

Key findings of this assessment identified the value of the ICU Audit to hospitals and at a national level. The findings highlight the data quality and coverage of the Units that participated in INICUA in 2017. Implementation of INICUA in the remaining ICUs in Ireland will provide complete coverage and comparative data for all Units in HSE-funded hospitals.

TABLE 3.1: DATA QUALITY ASSESSMENT, 2017

Dimensions of data quality	Definition (HIQA Guidance, 2018)	Assessment of National ICU Audit dimensions of data quality
Relevance	**Relevant data meet the current and potential future needs of users.**	**Relevance of the National ICU Audit data for 2017 is assessed by the following characteristics:** • Release and use of the data • Value of the data, and • Adaptability of the data source. **RELEASE AND USE OF THE DATA** • Participating hospitals each receive a QQR that reports on all INICUA data fields. • Each hospital has a local governance process in place to review its QQR and use this report to drive local quality improvements. • Together with the QQR, there is also a Microsoft Excel data appendix file. This file can be used for further investigation of the data contained in the QQR. • There is a suite of pre-formatted reports within the local ICU Audit database. • All data can be exported into Excel locally for further analysis. **VALUE OF THE DATA** • The data can measure quality of care in the ICU by benchmarking outcomes. • Hospitals can use audit data to drive improvements in quality of care. • Unit staff can use the QQRs to review practices and KPIs within their hospital to drive quality improvements, e.g. high-risk sepsis admissions to the ICU, readmissions within 48 hours. • The data provide valuable information to Unit staff – including hospital consultants, intensivists, clinical nurse managers in the ICU, hospital managers/ CEOs, quality and safety leads and infection control leads – and to Organ Donation and Transplant Ireland staff. • Accurate, comparative data are provided in order to facilitate national performance management and quality improvement initiatives. • The data inform both the HSE and the Department of Health, and measure activity in order to inform the configuration of critical care beds and resources for the Critical Care Programme (CCP). • Provided data support the HIPE system and ABF. • Data enable the audit of HCAI. • The data enable the audit of potential organ donors and organ donation. • The data allow the potential to facilitate targeted audit and research into ICU care. **ADAPTABILITY OF THE DATA SOURCE** • The National ICU Clinical Lead and Audit Manager work closely with ICNARC to consider the dataset, with governance from the National ICU Audit Governance Committee. • The dataset is developed to support the aims of the National ICU Audit and to follow a process guide for data collection and input into the database, e.g. the dataset on infection acquired in the hospital and unit supports the Audit of Healthcare Associated Infection (HCAI). • The report on organ donation was reviewed in 2017 and a new report formatted in order to facilitate national planning for Organ Donation and Transplant Ireland. In 2018, a gap analysis was carried out in order to assess if this meets the needs of Organ Donation and Transplant Ireland, and of the organ donor nurse managers in six lead hospitals attached to each Hospital Group. • A review of the dataset was carried out in 2017 and the plan is to update clinical data terminology in line with best clinical practice and clarity, e.g. 'Cardiovascular accident' will be changed to 'Stroke'. • In 2018, a new field was added to the dataset, 'Date and time of decision to admit', in order to support ICU Access Key Performance Indicator (KPI). • Data retrieval from the database through ad hoc queries is possible locally. • In 2018, NOCA planned to develop a National ICU database that will be available at NOCA. This will include the full Irish National ICU Audit dataset.

TABLE 3.1: DATA QUALITY ASSESSMENT, 2017 *(CONTINUED)*

Dimensions of data quality	Definition (HIQA Guidance, 2018)	Assessment of National ICU Audit dimensions of data quality
Accuracy and reliability	**The accuracy of data refers to how closely the data correctly describe what they were designed to measure. Reliability refers to whether, over time, those data consistently measure the reality that they were designed to represent.**	**The accuracy and reliability of the National ICU Audit data for 2017 is assessed by the following characteristics:** • Coverage • Data capture and collection • Data processing, and • Data completeness and validity. **COVERAGE** The ***Irish National ICU Audit Annual Report 2017*** has coverage of 12 participating Units across nine hospitals, as outlined in Table 3.1.1: • Seven Units have provided one complete year of data. • Three Units have provided six months of data. • Two Units have provided one month of data. This deployment of the ICU Audit will continue into 2019 until all 22 Units initially identified for inclusion are collecting and forwarding data to ICNARC for analysis and reporting. This will progress towards complete national coverage. The phased roll-out of the National ICU Audit is described in Chapter 2 (page 30). **DATA CAPTURE AND COLLECTION** • In order to assist with accurate data entry, the dataset items specific to Ireland are defined in the NOCA National ICU Audit Data Definition Manual (National Office of Clinical Audit, 2017). • There is built-in data entry support and validation functionality to support data collection within the National ICU Audit software. • Definitions are accessed by the ICU Audit Coordinator within the software at the data entry point. • The data are reported on for each individual hospital quarterly in the QQR. The National ICU Audit Manager and the National Clinical Lead get a copy of each hospital's QQR. Outliers are identified in each report. • Risk-prediction models that give standardised mortality ratios (SMRs) are regularly recalibrated by ICNARC, e.g. the ICNARC and APACHE II critical illness score models.

TABLE 3.1.1: COMPLETE DATA COVERAGE IN PARTICIPATING ICUS, 2017

Key	Hospital	Critical care unit	Quater 1	Quater 2	Quater 3	Quater 4
A	Beaumont Hospital	General Intensive Care Unit	■	■	■	■
B	Beaumont Hospital	Richmond Intensive Care Unit	■	■	■	■
C	Mater Misericordiae University Hospital	High Dependency Unit	■	■	■	■
D	Mater Misericordiae University Hospital	Intensive Care Unit	■	■	■	■
E	Our Lady of Lourdes Hospital, Drogheda	Intensive Care Unit	■	■	■	■
F	St James's Hospital	Keith Shaw Cardiothoracic Intensive Care Unit	■	■	■	■
G	St James's Hospital	General Intensive Care Unit	□	□	■	■
H	Tallaght University Hospital	Intensive Care Unit	■	■	□	□
I	University Hospital Galway	General Intensive Care Unit	■	■	□	□
J	University Hospital Limerick	Intensive Care Unit	■	■	■	■
K	University Hospital Waterford	Intensive Care Unit	□	□	□	■
L	Regional Hospital Mullingar	Intensive Care Unit	□	□	□	■

■ Data included □ Data not included

TABLE 3.1: DATA QUALITY ASSESSMENT, 2017 *(CONTINUED)*

Dimensions of data quality	Definition (HIQA Guidance, 2018)	Assessment of National ICU Audit dimensions of data quality
Accuracy and reliability *(Continued)*	**The accuracy of data refers to how closely the data correctly describe what they were designed to measure. Reliability refers to whether, over time, those data consistently measure the reality that they were designed to represent.**	**DATA PROCESSING** Validation processes are in place both at the time of data entry and when data are reviewed by ICNARC. This process includes the following steps: • Data are collected for all admissions to the participating unit. The data are then entered on the local software system and anonymised data are submitted to ICNARC. • A validation process is carried out by ICNARC to check for completeness, reliability and accuracy. • A Data Validation Report (DVR) is sent back to the unit identifying data validation questions. Multiple DVRs can be received by participating Units, and provide assurance on the data quality. These are presented in Table 3.1.2. • This process continues until ICNARC is satisfied with the data quality. Following this process, a QQR is issued to the Unit. **DATA COMPLETENESS AND VALIDITY** • Each QQR has a section on data completeness for the INICUA data fields. • Any new INICUA unit requires time for 'bedding in' for data quality. NOCA provides on-site support during this time. • Data quality is always the first point of analysis and review in the occurrence of a potential statistical outlier.

TABLE 3.1.2: NUMBER OF DATA VALIDATION PROCESSES IN PARTICIPATING ICUs, 2017

Key	Hospital	Critical care unit	Quater 1	Quater 2	Quater 3	Quater 4
A	Beaumont Hospital	General Intensive Care Unit	2	3	3	2
B	Beaumont Hospital	Neurosurgical	2	2	1	2
C	Mater Misericordiae University Hospital	High Dependency Unit	3	3	2	3
D	Mater Misericordiae University Hospital	Intensive Care Unit	3	2	4	2
E	Our Lady of Lourdes Hospital, Drogheda	Intensive Care Unit	3	1	1	1
F	St James's Hospital	Keith Shaw Cardiothoracic Intensive Care Unit	2	2	2	2
G	St James's Hospital	General Intensive Care Unit			4	2
H	Tallaght University Hospital	Intensive Care Unit	1	1		
I	University Hospital Galway	Intensive Care Unit	4	4		
J	University Hospital Limerick	Intensive Care Unit	2	2	2	2
K	University Hospital Waterford	Intensive Care Unit				2
L	Regional Hospital Mullingar	Intensive Care Unit				2

TABLE 3.1: DATA QUALITY ASSESSMENT, 2017 *(CONTINUED)*

Dimensions of data quality	Definition (HIQA Guidance, 2018)	Assessment of National ICU Audit dimensions of data quality
Coherence and comparability	**Coherent and comparable data are consistent over time and across providers and can be easily combined with other sources.**	**The coherence and comparability of the National ICU Audit data for 2017 is assessed on the following characteristics:** • Standardisation • Coherence, and • Comparability. **STANDARDISATION** • A data dictionary is used by ICU Audit Coordinators and can be found on the NOCA website (NOCA 2018). This will be updated in line with HIQA's ***Guidance on a data quality framework for health and social care*** (Health Information and Quality Authority, 2018). All ICU Audit Coordinators are trained using the same dataset so that the definitions and coding are consistent. **COHERENCE** • Sources of data for the ICU Audit dataset include the patient chart and both the patient administration system and the clinical information system, where applicable. • The National ICU Audit dataset on InfoFlex contains the INICUA dataset and the extended local dataset defined in the ***NOCA National ICU Audit Data Definition Manual*** (NOCA 2017). **COMPARABILITY** • ICNARC coding is a structured system for uniform numeric coding of the reason(s) for admission to critical care. ICNARC reviews and updates this coding method periodically and the terminology is consistent. • The INICUA dataset is consistent with the ICNARC Case Mix Programme (CMP) dataset and enables benchmarking of all units participating in the audit from Ireland and across the UK.

TABLE 3.1: DATA QUALITY ASSESSMENT, 2017 *(CONTINUED)*

Dimensions of data quality	Definition (HIQA Guidance, 2018)	Assessment of National ICU Audit dimensions of data quality
Accessibility and clarity	**Data are easily obtainable and clearly presented in a way that can be understood.**	**The accessibility and clarity of the National ICU Audit data for 2017 is assessed based on the following characteristics:** • Accessibility, and • Interpretability. **ACCESSIBILITY** • Once the data have been validated and are clean, a QQR is made available for download from the INICUA web portal. This provides information on the performance of the unit against key quality standards pertinent to good care delivery in ICU. • NOCA has a process in place for ICU Audit QQR review. • Each participating unit also has a process in place locally for the review and dissemination of its QQRs. The hospital ICU Audit Coordinator has the ability to run reports from a suite of pre-formatted reports within the software. These can be shared locally and, by comparing the same reports generated at different points in time, can show trends within certain practices. • There is a process in place at local hospital level for access to the data. A data request form must be completed and signed off by the Clinical Lead for the ICU Audit (this form is provided in Appendix 3). **INTERPRETABILITY** • NOCA has developed a data dictionary (NOCA 2018) and the National ICU Audit Dataset Frequently Asked Questions (FAQ's) manual (NOCA, 2017) for the ICU Audit Coordinators and other data users. • Each QQR has a page at the beginning for the reader titled 'Understanding the report' to support report readers. • NOCA provides training and support in order to aid interpretation of reports. This takes the following forms: - Each ICU Audit Coordinator attends an ICNARC training workshop on the CMP dataset. - A preceptorship programme is in place for new ICU Audit Coordinators. This encompasses on average three days of training, which is followed by 'at-the-elbow support' until the ICU Audit Coordinator is proficient and feels confident with the data collection process and the use of the InfoFlex software. - Monthly telephone conferences or webinars are held in order to support data collection and validation, and the interpretation of data definitions and audit output. These are led by NOCA, but peer-to-peer support is also an integral aspect of this learning. - Telephone and email support is available from ICNARC and NOCA. • ICNARC and NOCA workshops were held in March and November 2018 to support the ICU Audit Coordinators with their data collection and reporting.

RECOMMENDATION ARISING FROM DATA QUALITY ASSESSMENT

The aim of the National ICU Audit is to improve clinical outcomes and patient safety. This is achieved through the provision of high-quality, comparative data and reports in order to facilitate local and national performance management and quality improvement initiatives. Where units do not actively participate in the ICU Audit (i.e. due to delay in implementation, not having timely and accurate data collection and validation), the usefulness of the audit is diminished. Hospital management needs to ensure that local resources are in place for full participation in this audit.

CHAPTER 4

‘PERCEPTIONS OF VULNERABILITY: BARBARA’S EXPERIENCE OF ICU AND RECOVERY’

CHAPTER 4: **PERCEPTIONS OF VULNERABILITY: BARBARA'S EXPERIENCE OF ICU AND RECOVERY**

At 38, Barbara was a young, fit and active mother of two young boys preparing for an upcoming family holiday when she was struck down with a sudden illness. Barbara thought she was coming down with a winter dose, but it quickly progressed to a chest and kidney infection. Her general practitioner (GP), concerned at her lack of response to strong antibiotics and her rapid deterioration, advised her husband Jimmy to bring her to accident and emergency (A&E). Barbara was admitted quickly, and over the following four days her condition progressively worsened. Unsure of where the infection was coming from, her medical team conducted numerous tests and increased her antibiotics, but Barbara's deterioration continued as she began to struggle for breath and became bloated. She felt like she was being poisoned and told her husband that she thought she was going to die.

On her fourth day in the hospital, feeling increasingly frightened and beginning to become delirious and confused, Barbara remembers an anaesthetist coming to her bed to tell her that they were going to put her to sleep for a while, that her lungs were really tired and needed a rest. She recalls the kindness of the anaesthetist: that she held her hand, was really nice and reassuring, and that Barbara instinctively trusted her. Barbara felt so sick that she had no energy left to fight, and the anaesthetist truly seemed to be in control and know what was going on. Barbara recalls being frantically rushed down the corridor, seeing the strobe lights passing one after the other above her, but not realising that the hurry was for her. She was aware that her parents and husband were there. She was told that she would be put to sleep and that a tube would be inserted down her throat in order to help her breathe through a ventilator.

ICU EXPERIENCE

When Barbara woke up, Jimmy was sitting beside her. She thought she had been asleep for an hour or so, but it was in fact 13 days later. She recalls how gaunt and afraid Jimmy looked and wondered what was happening, not realising that his appearance had anything to do with her situation. She realised that she could not speak but had so many questions: Where was she? What had happened? She was in a different room (general ICU) and was surrounded by some very ill looking people. She felt scared and isolated and was not even able to hold a pen to write questions. She felt frightened, hemmed in, surrounded by bars on her bed, her hands weighed down with heavy gloves, and she was experiencing nightmares and hallucinations. She was embarrassed to discover that the nurses had to change her nappy and clean up after her. To add to her sense of shame and helplessness, she was terrified when the medical staff suctioned her lungs, and when they turned her from side to side to change her bedclothes she sensed that she was going to fall, but was unable to communicate her feelings. She felt that she had no control over her body.

Jimmy and the staff began to piece together and explain what had happened. They told Barbara that she was in ICU and that she had been there for 13 days. They told her that she was very ill with septic shock and pneumonia, but that she was over the worst of it and would be moving out of ICU soon. They told her she was safe now, which reassured Barbara.

Her immediate thoughts turned to her boys and husband; what had they been doing for 13 days when she was in a coma in ICU? Her sense of safety was reconfirmed every time she opened her eyes and saw a nurse or doctor beside her, talking to her, reassuring her, updating her on Jimmy and her family's whereabouts. The nurses spoke to her as though they knew her family really well, and she discovered that Jimmy had brought in a photo album to bring her to life for the medical staff. He had told them all about Barbara, about the things she loved, wanting them to build a relationship with her even though she was asleep. The nurses came to call him Nurse Jimmy, seeing that his presence and his holding Barbara's hand calmed her. Barbara discovered that while she was in a coma the nurses had shaved her legs, massaged her, and applied expensive oils that Jimmy had been sent to purchase. Seventeen days after last seeing their mum, Barbara's sons, aged 10 and 12, came to see her on her last day in ICU. Jimmy had protected them from seeing how sick Barbara was. She recalls the looks of horror on their faces and her attempts to reassure them that she was getting better and would be home soon.

AFTER ICU

After being extubated, Barbara was transferred to the HDU one day after she woke up from her coma. This move coincided with a change in her experience. Barbara felt that the HDU was hectic and fast moving, like Piccadilly Circus. Like the ICU, the lights were on 24 hours a day, making it difficult to tell night from day. Barbara began to realise how sick she was: she could not lift herself or use her hands, she noticed sores on parts of her body, and describes feeling like she was just a shell of her former self. She had tingling in her hands and feet, and she struggled to speak as her voice was so weak. The nurses had several other people to look after, so Barbara had to wait a bit longer for their assistance and care. But she felt that moving to HDU meant that going home was getting closer.

Two days later, Barbara was told that there was a bed in a geriatric ward for her. She was told it would be quiet and that she would be able to rest there, that she was lucky to get the bed. Even though Barbara was experiencing a lot of pain in her back and throat, she initially thought that moving to a ward was a positive step, that all she needed to do was rest and then she would get to go home. But Barbara's experience changed for the worse. Suddenly, she was spending an awful lot of time on her own and felt constantly afraid. The ward nurse told her that she was well enough to be on the ward, but Barbara believes that the ward nurses did not understand the vulnerability and needs of patients discharged from ICU. She still needed assistance to use the commode or toilet, but would be left sitting on the commode until the nurses had time to come back to assist her back to bed. Her experience of care on the ward was in sharp contrast to what she had experienced in ICU. Her family, only allowed to visit during visiting hours, would help her while they were there. She began to feel like a nuisance and felt isolated, abandoned, terrified and unsafe. Her husband helped her wash and brush her teeth, reassuring her constantly that she was improving. Barbara gradually started to make small steps towards recovery, determined to get home as soon as possible and be seen as a good patient. She began using a Zimmer frame and was soon outpacing the other geriatric patients on the corridors. Holding cutlery was a major challenge, so she focused on using plastic cutlery and eating yogurts, as other food was too difficult. Seeing her haunted reflection for the first time in the mirror was also difficult, as she struggled to recognise herself.

Barbara went home five days later into the care of her family, friends and neighbours, who nursed her back to health. Despite their lack of medical knowledge, her family was given no advice on what to expect, simply a time and date for an outpatient respiratory clinic appointment that was six weeks later and advised to go to their GP if they were worried about anything.

Barbara felt that her GP did not know what to expect either. With no explanation as to how she got so ill so quickly, Barbara feared that it could happen again. Barbara's physical and emotional recovery was slower than expected, and Barbara was haunted by nightly nightmares. But with the constant attention of her family and friends, Barbara, though weak and anxious, felt safe and cared for. It took six weeks for her to be able to get downstairs for short periods of time, her concentration and memory were poor, she could not recall people's names, and she was concerned that she would never properly recover. Barbara's friend made her a diary of her 'missing days', and Barbara found this very helpful in making sense of her ICU experience, although it took some time before she could read it. She sought private help for her emotional and physical recovery over the coming years. It was a full 18 months later that Barbara began to feel more like herself, and it took more than two years to return to normality.

Barbara now works as a patient representative, determined to improve the experience of others that come after her. She emphasises the need for effective step-down care for ICU patients within the hospital and for outreach when they return home. Barbara believes that information on discharge from ICU outlining what to expect in recovery would have made her life after ICU more manageable. Barbara and her husband, along with some ICU nurses, set up ICU Steps Dublin, a support group for ICU patients and their families. ICU Steps Dublin provides patient information leaflets to ICUs outlining physical, emotional and cognitive challenges, along with a drop-in service.

CHAPTER 5

FINDINGS FROM INICUA (ADULT)

CHAPTER 5: **FINDINGS FROM INICUA (ADULT)**

INTRODUCTION

With 12 Units in nine hospitals participating, the Irish National ICU Audit now has enough critical mass to produce its first annual report although 42% of national ICU activity was not included. Nevertheless, this report contains many useful insights into the essential component of acute hospital care in Ireland that is critical care (ICU and HDU).

QQRS AVAILABLE FOR INDIVIDUAL HOSPITALS IN 2017

QQRs were available for participating hospitals as outlined in Chapter 3. Some hospitals have participated in the INICUA for a number of years and others began participating during 2017.

A number of the hospitals included in this report have provided data for only part of the year. Two hospitals (University Hospital Galway and Tallaght University Hospital) provided data for just Q1 and Q2 2017, but were unable to collect data for the last two quarters because of a backlog in data entry and because of difficulty filling the post of ICU Audit Coordinator, respectively. Three other Units commenced data collection during 2017 and have data for only six months (St James's Hospital ICU) or three months (University Hospital Waterford and Regional Hospital Mullingar). We have made the assumption that the data available for three or six months is representative of activity over the whole 12-month period being examined, and we have extrapolated from the available data in order to report on an annualised basis.

ICNARC have collated the data from the QQRs sent to each Unit for 2017 into a Network Quality Report (NQR), which NOCA has adapted for this first national INICUA Report. This Annual Report displays data for each Irish Unit, allowing benchmarking against other Irish Units and against the Units in the ICNARC Case Mix Programme (CMP) for England, Wales, and Northern Ireland (Scotland runs its own ICU audit).

DESCRIPTION OF PARTICIPATING UNITS

There are major differences between the Units participating in the Irish National ICU Audit in size, case mix, hospital specialties and complexity of care provided.

We classify beds provided for critically ill patients as ICU beds (more complex care provided) or HDU beds (less complex care provided). The Units participating in the Audit vary in their bed designation, containing (i) all ICU beds, (ii) a mixture of ICU and HDU beds, or (iii) all HDU beds. This variation explains some of the wide variability in metrics in the Audit report.

A brief summary of the characteristics of participating Units is provided here.

A **Beaumont Hospital General ICU** is a general ICU for medical and surgical patients, staffed for nine beds. A high proportion of patients are neurosurgical, as they overflow from the hospital's Neurosurgical ICU.

B **Beaumont Hospital Richmond ICU (Neuro)** is a specialist Unit for neurosurgical and neuromedical patients, staffed for eight beds. A significant number of patients are general medical or surgical, as they overflow from the hospital's General ICU.

C **Mater Misericordiae University Hospital HDU** is a general HDU for medical and surgical patients, staffed for 12 beds.

D **Mater Misericordiae University Hospital ICU** is a general ICU for medical and surgical patients, staffed for 17 beds. Significant influences on case mix include cardiothoracic surgery, heart and lung transplantation, and extracorporeal life support.

E **Our Lady of Lourdes Hospital, Drogheda ICU** is a general Unit (mixed ICU/HDU) for medical and surgical patients, staffed for seven beds.

F **St James's Hospital Keith Shaw Unit (CT ICU)** is a specialist ICU for patients after cardiothoracic surgery, staffed for six beds.

G **St James's Hospital ICU** is a general ICU for medical and surgical patients, staffed for 15 beds. The Audit report also includes data from three HDU beds and two Burns Unit beds, so the report provides data for 20 critical care beds.

H **Tallaght University Hospital ICU** is a general ICU for medical and surgical patients, staffed for nine beds. The Audit report also includes data from three beds in the Post Anaesthesia Care Unit, so the report provides data for 12 critical care beds.

I **University Hospital Galway ICU** is a general ICU for medical, surgical, obstetric and paediatric patients, staffed for 11 beds. The Audit report includes data from a six-bed HDU, so the report provides data for 17 critical care beds.

J **University Hospital Limerick ICU** is a general ICU for medical and surgical patients, staffed for eight beds. University Hospital Limerick also has an eight-bed HDU, but this is not included in this report.

K **University Hospital Waterford ICU** is a general ICU for medical and surgical patients, staffed for five beds. University Hospital Waterford also has a four-bed HDU, but this is not included in this report.

L **Regional Hospital Mullingar ICU** is a general Unit (mixed ICU/HDU) for medical and surgical patients, staffed for six beds.

BED CAPACITY FOR CRITICAL CARE

There are 240 critical care (ICU or HDU) beds in HSE-funded hospitals in Ireland (Critical Care Programme, 2018). Private hospitals have an additional 43 critical care beds. For a population of 4.78 million, this gives a figure of 5.9 ICU/HDU beds per 100,000 population. This places Ireland below most other European countries for provision of critical care beds, with European values ranging from 29.2 beds to 4.2 beds per 100,000 population (Rhodes *et al.*, 2012).

It is clear from the data presented that there are variations in the severity of illness of the patients occupying these beds, with the larger tertiary referral Units in major hospitals, taking a large proportion of the more complex patients.

The small number of critical care beds per 100,000 population and the significant proportion of these beds in Units with lower levels of complexity is reflected in the significant pressure on the larger Units, which is evident in the data presented.

The *Health Service Capacity Review 2018* (Department of Health, 2018) identified a need to increase adult critical care capacity to 430 beds by 2031 (a 79% increase). The data presented in this report strongly support this conclusion.

The data suggest that the greatest pressure on critical care beds is in the larger 'hub' Units in tertiary referral hospitals. Allocation of additional critical care beds to these Units would do the most to improve patient care and would be in line with the 'hub-and-spoke' model of the Critical Care Programme (*Model of Care for Adult Critical Care*) (Health Service Executive, 2014).

ACTIVITY IN CRITICAL CARE

The Units participating in the Irish National ICU Audit in 2017 represented 58% of all critical care activity in HSE-funded hospitals (Critical Care Programme, 2018). All of these Units will have data for the full 12 months for 2018. In addition, we will have Audit data from a further five hospitals by the end of 2018, bringing Audit coverage up to 78% of all ICU activity in HSE-funded hospitals.

The Units reported on in this report are very heterogeneous; they vary considerably in volume of activity (Figure 5.1), in complexity of care delivered, and in the level of support provided to patients; some provide very specialised care, e.g. cardiothoracic, neurosurgical, burns etc.

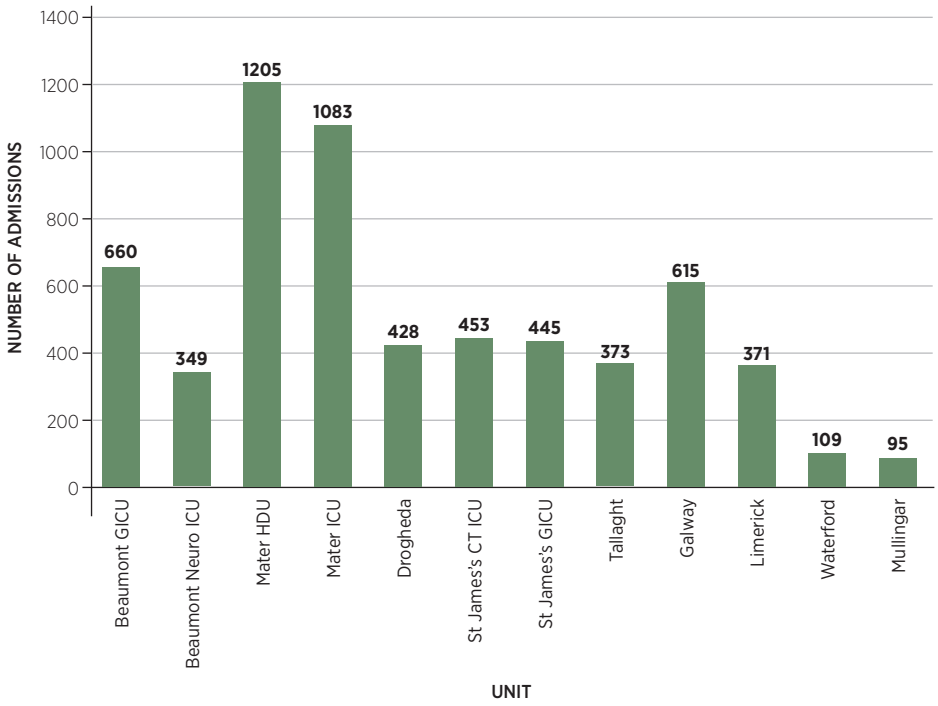


FIGURE 5.1: NUMBER OF ADMISSIONS TO EACH UNIT 2017 (N=6,186)*

NB: These data represent 3, 6 or 12 months of activity in different Units, depending on the duration of data collection, as per Table 3.1.1.

* Full hospital names are available within the frequency tables.

CASE MIX

ICNARC reports provide comprehensive information on the characteristics of patients admitted to critical care, including age, gender, source of admission, degree of organ failure, patients admitted with sepsis, illness severity, and predicted mortality.

AGE PROFILE

The mean age for patients in the Republic of Ireland (ROI) was 60 years, compared with 61 years for UK Units (England, Wales, and Northern Ireland).

The mean age of patients was similar across different Units, and was similar to the mean age on admission in the UK (Figure 5.2). The mean age was lower in the Beaumont Hospital Richmond ICU (Neuro), reflecting the different case mix, including younger patients with traumatic brain injury.

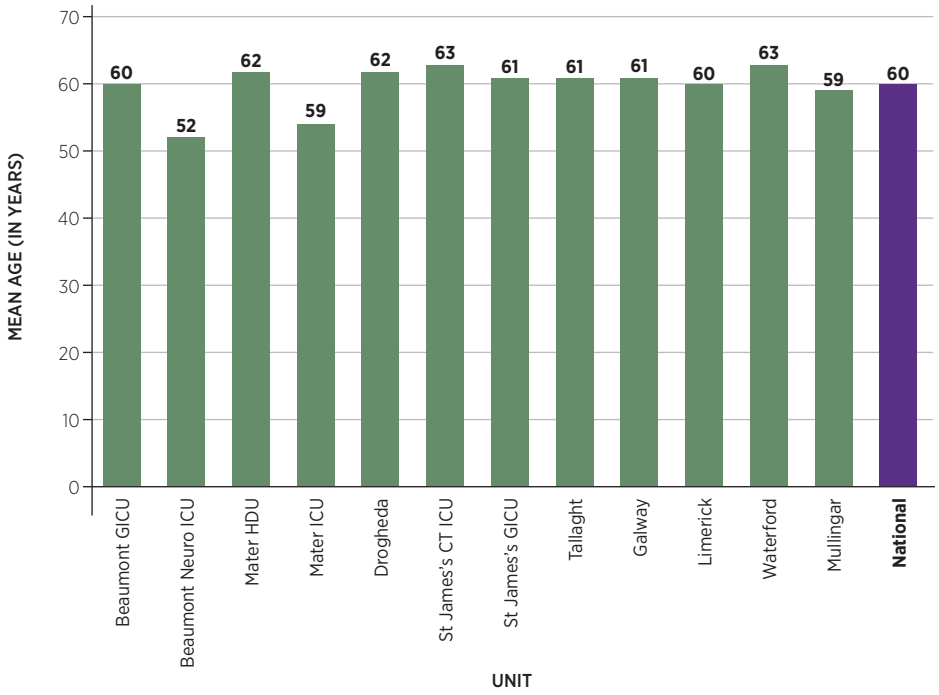


FIGURE 5.2: MEAN AGE OF PATIENTS (IN YEARS) ON ADMISSION TO EACH UNIT*

* Full hospital names are available within the frequency tables.

GENDER

The gender distribution showed a predominance of male patients, which is in line with international experience (Figure 5.3). Seventy-five per cent of admissions to St James's Hospital Keith Shaw Unit (CT ICU) were male, reflecting a characteristic of patients undergoing cardiac surgery.

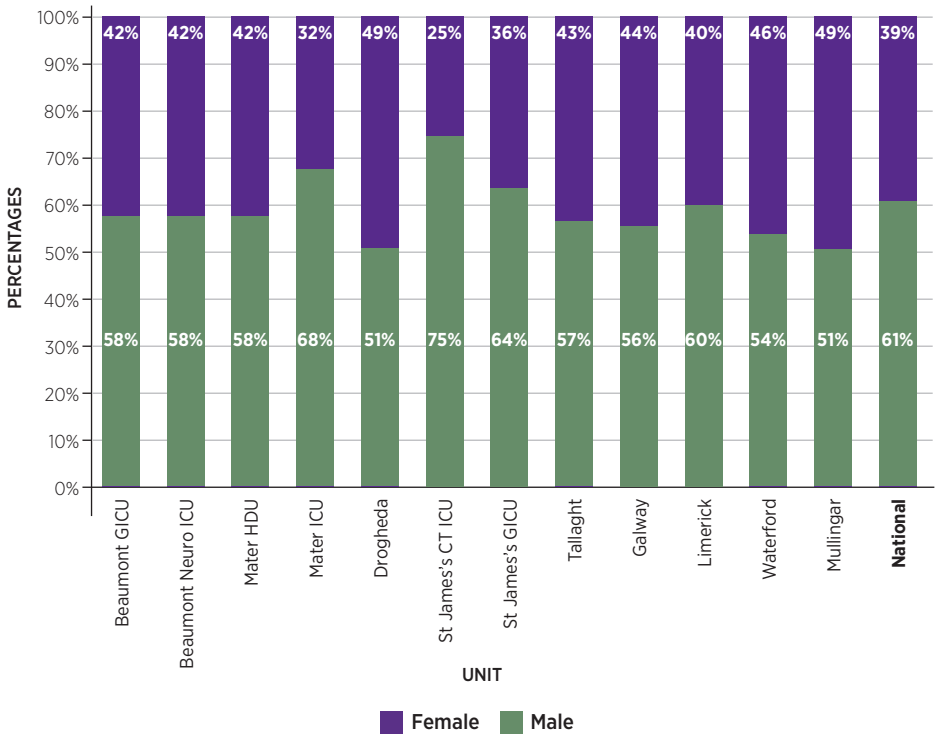


FIGURE 5.3: GENDER DISTRIBUTION IN EACH UNIT*

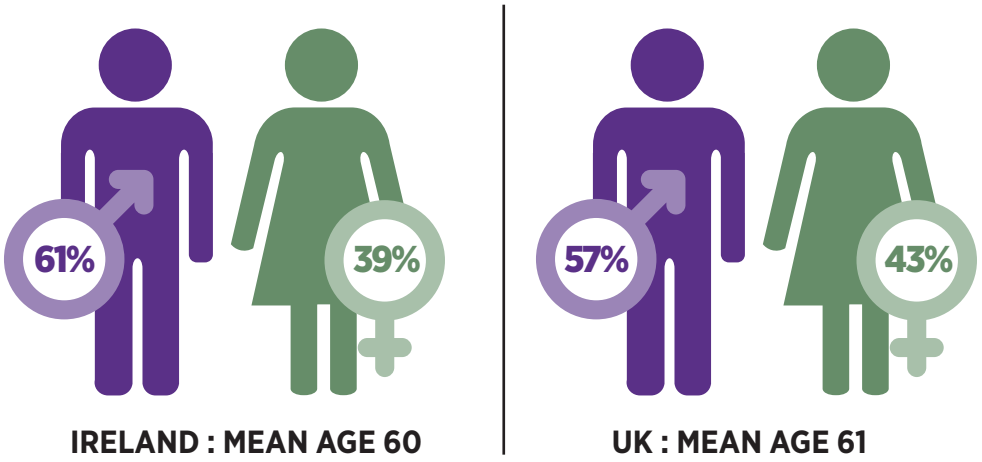
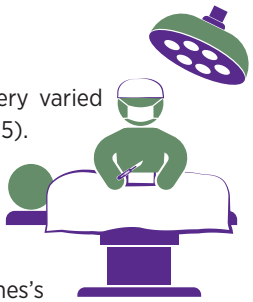


FIGURE 5.4: GENDER AND AGE (MEAN) OF IRISH AND UK ICU PATIENTS, 2017*

* Please note: Percentages may not sum to 100% due to rounding.
Full hospital names are available within the frequency tables.

ICU ADMISSIONS AFTER SURGERY



The percentage of patients who came directly to the Unit after surgery varied between Units, reflecting variations in case mix between Units (Figure 5.5).

ICU admission after emergency surgery is recognised as a risk factor for mortality in ICU (Thompson and Stonebridge, 2005). The percentage of admissions after emergency surgery varied from 41% in the Beaumont Hospital Richmond ICU (Neuro) to 4% in the St James's Hospital Keith Shaw Unit (CT ICU), reflecting the variation in clinical practice between these two specialties.

The patients admitted to ICU who are not included in the coloured bars in Figure 5.5 came to the Unit because of a non-surgical condition (e.g. sepsis, cardiac arrest, liver disease, haemorrhage, etc.) or could have been postoperative but did not come to ICU directly from the operating theatre. These patients vary hugely between Units as a proportion of total admissions.

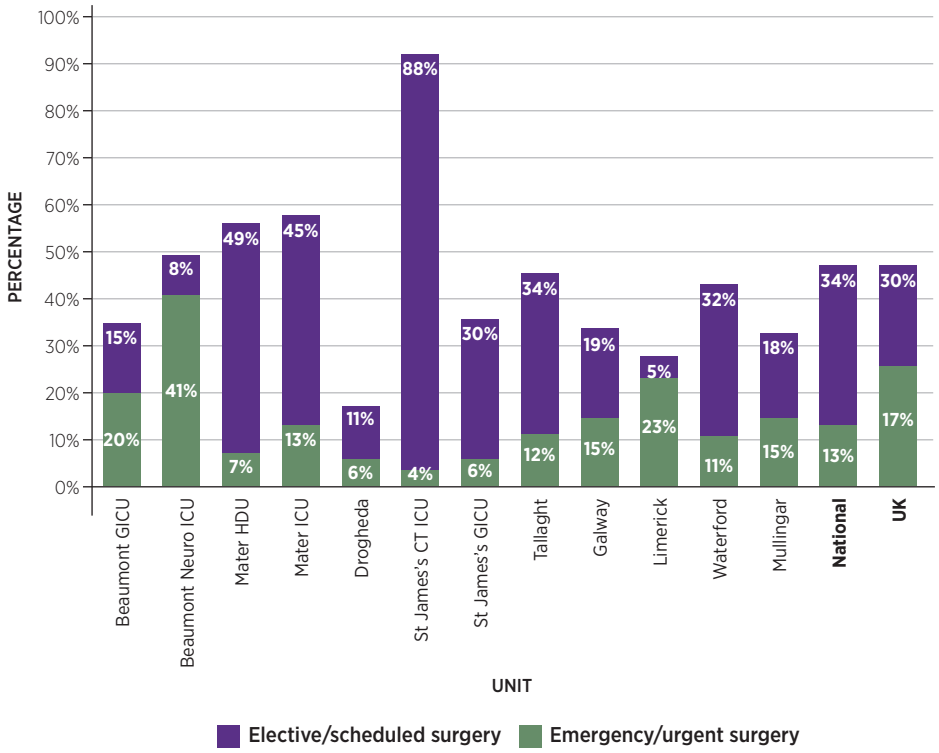


FIGURE 5.5: ADMISSIONS DIRECT TO THE UNIT AFTER EMERGENCY SURGERY AND AFTER ELECTIVE SURGERY (AS A PERCENTAGE OF ALL ADMISSIONS)*

* Full hospital names are available within the frequency tables.

ICU ADMISSIONS AFTER TRAUMA

Admissions after trauma ranged from 23% in the Beaumont Hospital Richmond ICU (Neuro) to 1% in the St James's Hospital Keith Shaw Unit (CT ICU) (Figure 5.6) – very predictable findings, as trauma is a leading cause of neurosurgical emergencies but rarely requires cardiothoracic intervention. In the general ICUs, the proportion of admissions after trauma was fairly consistent, hovering around the national average of 8%.

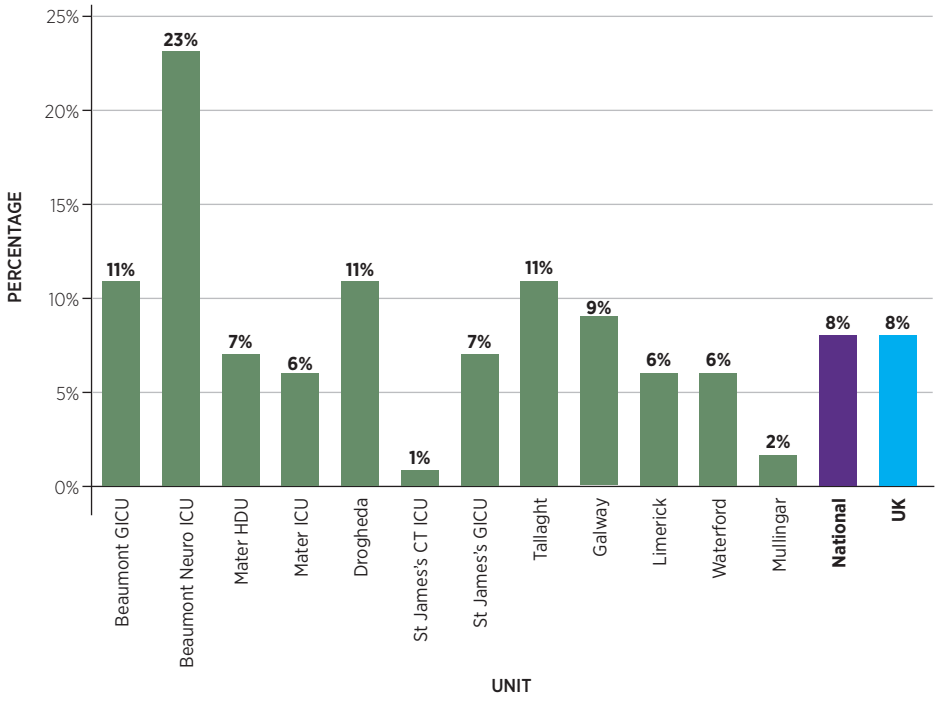


FIGURE 5.6: ADMISSIONS DIRECT TO THE UNIT AFTER TRAUMA (AS A PERCENTAGE OF ALL ADMISSIONS)*

* Full hospital names are available within the frequency tables.

ICU ADMISSIONS WITH ACUTE KIDNEY INJURY

Acute kidney injury (AKI) is common in critical illness (Figure 5.7). AKI is associated with increased mortality and morbidity, both in the short term and long term.

The Kidney Disease: Improving Global Outcomes (KDIGO) classification system is used to define severe AKI as KDIGO Stage 3. The proportion of patients with KDIGO Stage 3 ranged from 12% to 24% in the larger general ICUs, with lower rates in the specialist Units. The mean percentage of patients with Stage 3 AKI in participating Units in Ireland was similar to that in the UK, at 12%.

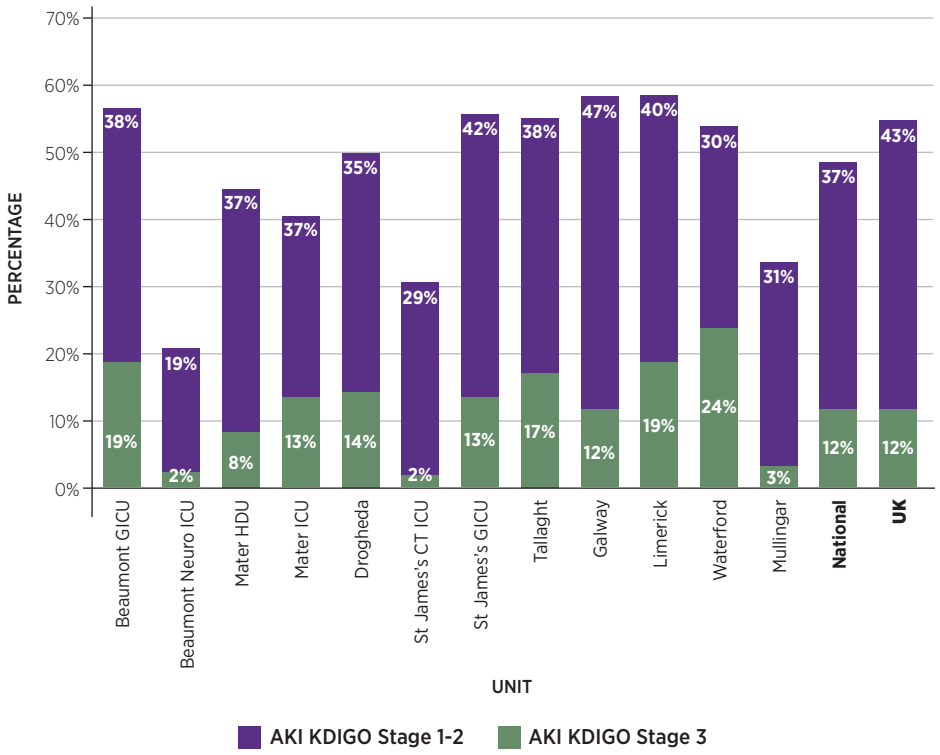


FIGURE 5.7: PATIENTS ADMITTED WITH AKI WITHIN 24 HOURS OF ADMISSION (KDIGO STAGE 1–3) (AS A PERCENTAGE OF ALL ADMISSIONS)*

* Full hospital names are available within the frequency tables.

DELAYED ADMISSION TO ICU

This Quality Indicator (QI) measures the proportion of patients who are very ill (i.e. dysfunction in four or more organ systems) within 24 hours after admission to ICU from a ward in the same hospital.

Some patients may be admitted to ICU with single- or two-organ failure and then deteriorate quickly to multi-organ failure, despite the organ support they receive in ICU. However, if there are excess numbers of patients developing multi-organ failure within 24 hours of admission, there is an assumption that patients became very ill on the ward when they should have been admitted to ICU earlier. This could indicate that admission to ICU was delayed.

The reasons why very sick patients were not admitted to ICU in a timely fashion could be that staff did not recognise the severity of their illness or that the severity of illness was recognised, but no ICU bed was available.

There were no outliers among participating Units for this QI in 2017 (Figure 5.8).

Note; CMP refers to data from the Case Mix Programme, i.e. all Units participating in England, Wales and Northern Ireland

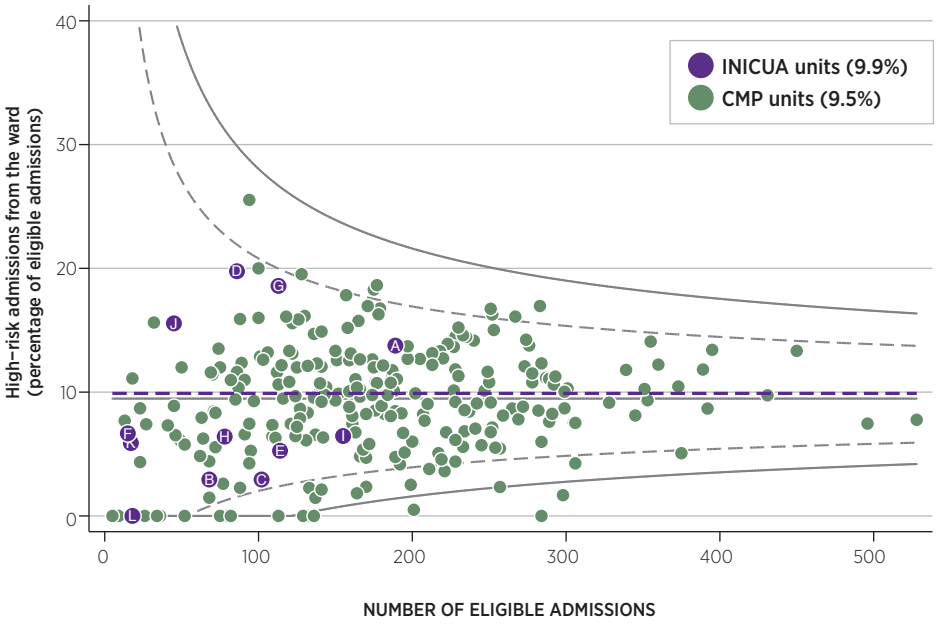
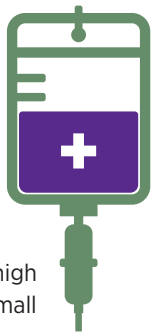


FIGURE 5.8: ADMISSIONS FROM THE WARD WITH ORGAN FAILURE IN 4 OR MORE ORGAN SYSTEMS WITHIN 24 HOURS OF UNIT ADMISSION (AS A PERCENTAGE OF ALL ADMISSIONS FROM A WARD IN THE SAME HOSPITAL)[1]

[1] Each purple circle marks an Irish Unit; the letter in the circle is linked to the relevant Unit in the list of Units on page 40

ICU ADMISSIONS WITH SEPSIS



Sepsis is a leading reason for admission to ICU, reflected in the consistently high percentage of admissions with sepsis shown in Figure 5.9. The incidence was much lower in the two specialist Units, Beaumont Hospital Richmond ICU (Neuro) and St James's Hospital Keith Shaw Unit (CT ICU), where the reasons for admission tend to be directly related to the relevant specialties and the patients are commonly postoperative. The mean percentage of admissions with sepsis for participating Units in Ireland was similar to that in the UK (27%).

Sepsis with dysfunction in four or more organ systems is associated with a high mortality rate and a high requirement for support in ICU. These cases made up a small but significant proportion of the caseload in the general ICUs in 2017.

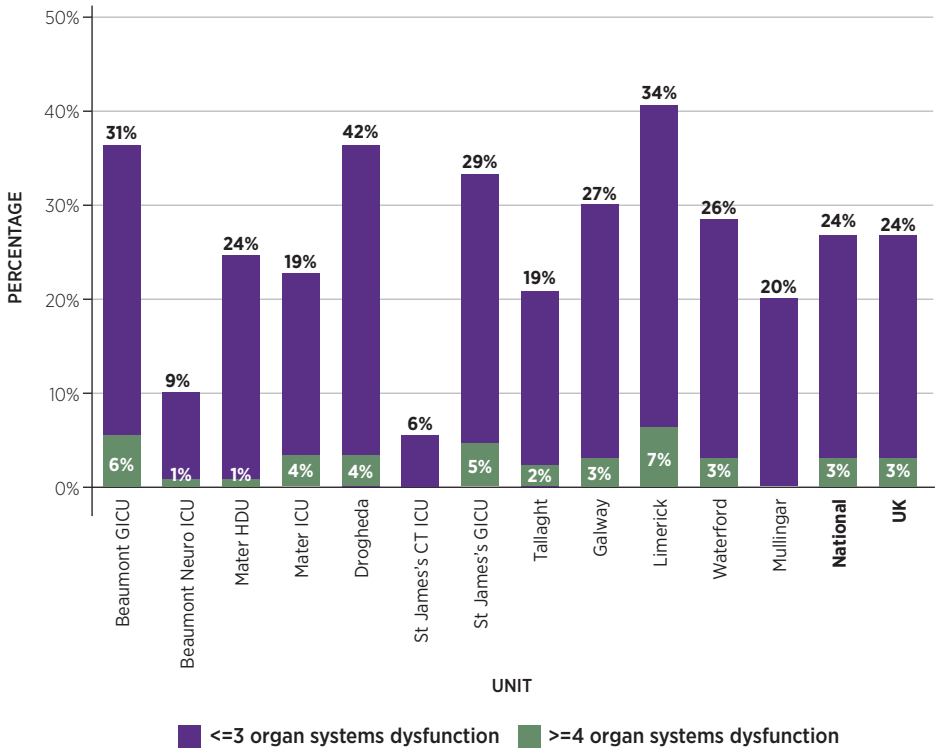


FIGURE 5.9: ADMISSIONS TO THE UNIT WITH A DIAGNOSIS OF SEPSIS (SEPSIS-2) WITH (I) 4 OR MORE ORGAN SYSTEMS DYSFUNCTION WITHIN 24 HOURS OF ADMISSION, AND (II) WITH 3 OR FEWER ORGAN SYSTEMS DYSFUNCTION (AS A PERCENTAGE OF ALL ADMISSIONS)*

* Full hospital names are available within the frequency tables.

The percentage of patients admitted with sepsis and with dysfunction in four or more organ systems within 24 hours is considered to be a measure of timeliness or delay in ICU admission (Figure 5.9). There was considerable variability between different Units in the rate of admissions with sepsis and four or more organ systems dysfunction, but no Units were outliers for this QI (Figure 5.10).

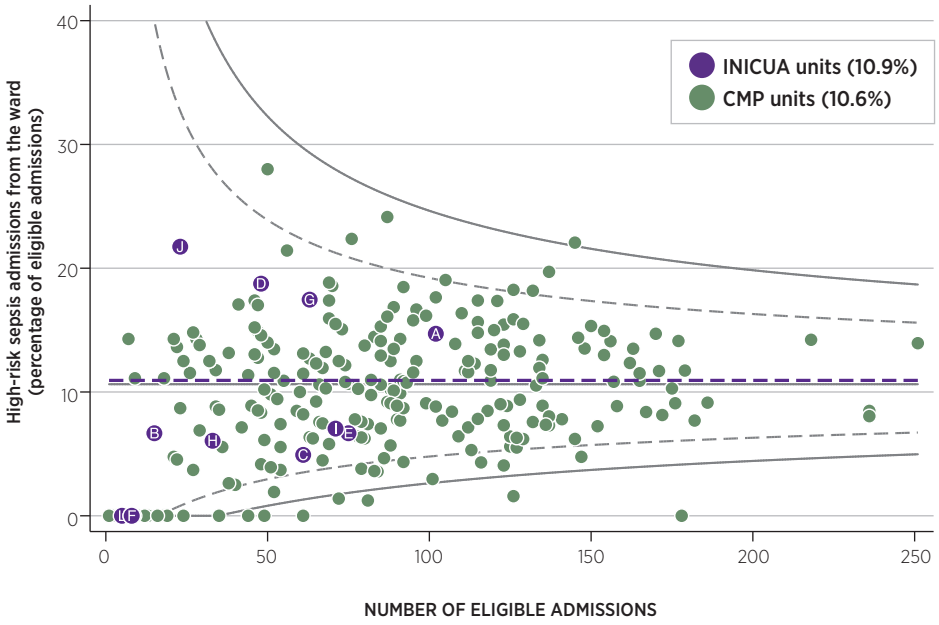


FIGURE 5.10: ADMISSIONS FROM THE WARD WITH A DIAGNOSIS OF SEPSIS (SEPSIS-2) AND 4 OR MORE ORGAN SYSTEMS DYSFUNCTION WITHIN 24 HOURS OF ADMISSION (AS A PERCENTAGE OF ALL ADMISSIONS FROM A WARD IN THE SAME HOSPITAL[2]

[2] Each purple circle marks an Irish Unit; the letter in the circle is linked to the relevant Unit in the list of Units on page 40

ILLNESS SEVERITY SCORES ON ADMISSION TO ICU

Acute Physiology and Chronic Health Evaluation (APACHE II) scores are the most widely used and best-known measure of illness severity in the critically ill. APACHE II scores varied widely across different Units, reflecting differing case mix between Units.

APACHE II scores were greater in the participating Irish Units than in UK Units (Figure 5.11). It is difficult to draw definite conclusions from this, because almost half of Irish ICU activity is not covered by this year's Audit. However, this finding suggests that patients admitted to Irish Units are sicker than those admitted to UK Units.

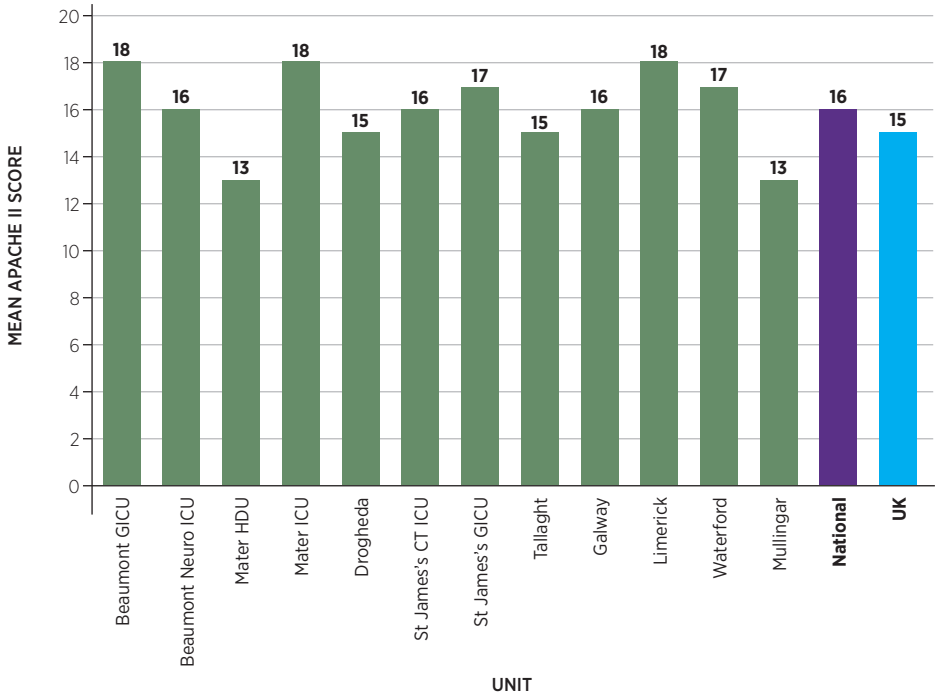


FIGURE 5.11: MEAN APACHE II SCORES FOR EACH UNIT*

* Full hospital names are available within the frequency tables.

PREDICTED RISK OF DEATH ON ADMISSION TO ICU

Mortality is predicted by the ICNARC$_{H\text{-}2015}$ model based on age, pre-existing conditions, admission diagnosis and acute physiology.

Predicted mortality is closely related to illness severity, and the data in Figure 5.12 correlate with the APACHE II scores in Figure 5.11. The variability in APACHE II scores and in predicted mortality between Units (Figures 5.11 and 5.12) reflects the heterogeneity in case mix between participating Units.

The median predicted mortality rate was 7% for Irish patients versus 5% for UK patients. While a statistical comparison has not been undertaken (as NOCA does not have access to the raw data), this suggests a real difference in illness severity between these two patient populations.

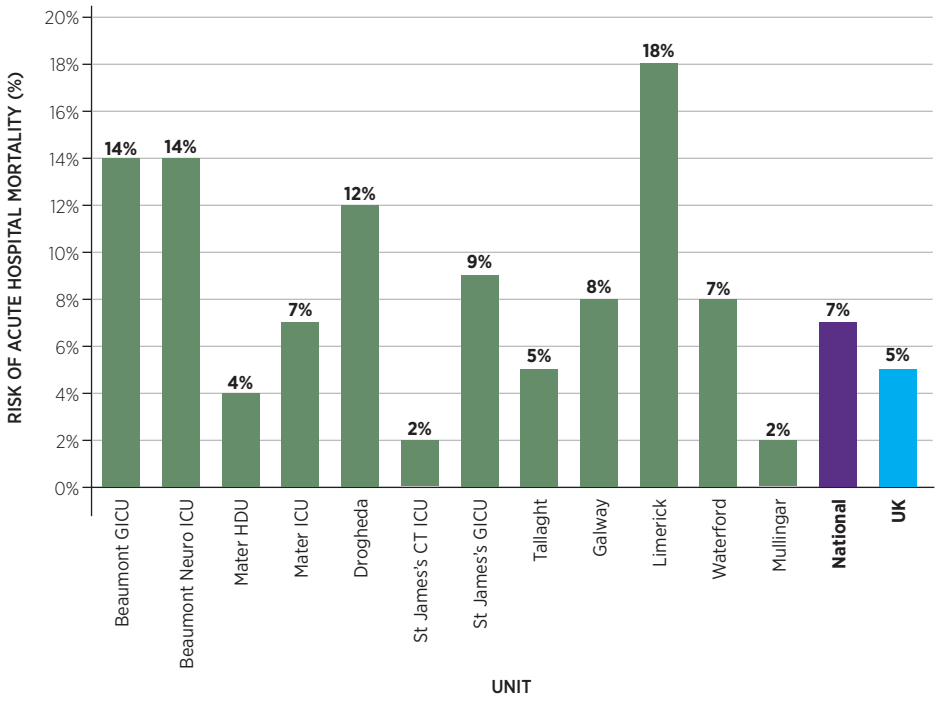
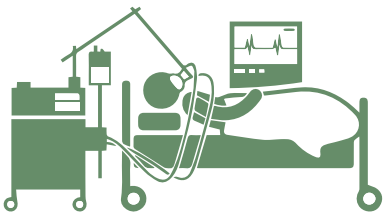


FIGURE 5.12: PREDICTED RISK OF ACUTE HOSPITAL MORTALITY (ICNARC$_{H\text{-}2015}$ MODEL) (MEDIAN)*

* Full hospital names are available within the frequency tables.

REQUIREMENT FOR MECHANICAL VENTILATION AFTER ADMISSION TO ICU

There was wide variability between Units in the percentage of patients who required mechanical ventilation within 24 hours of admission (Figure 5.13). These data include patients who underwent both invasive (e.g. an endotracheal tube or tracheostomy) and non-invasive ventilation. The variability in the rate of this intervention reflects the fact that some of the participating Units are HDUs or joint ICU/HDUs.



Notably, the percentage of patients ventilated was high in specialist Units; patients are normally ventilated for a short period after cardiac surgery to support them during recovery, and neurosurgical patients commonly need ventilation because of decreased levels of consciousness.

In keeping with other indicators of greater illness severity, the percentage of patients who received mechanical ventilation was greater for the Irish Units than the UK Units, although this could be related to the high proportion of specialty Units in the Irish Units studied.

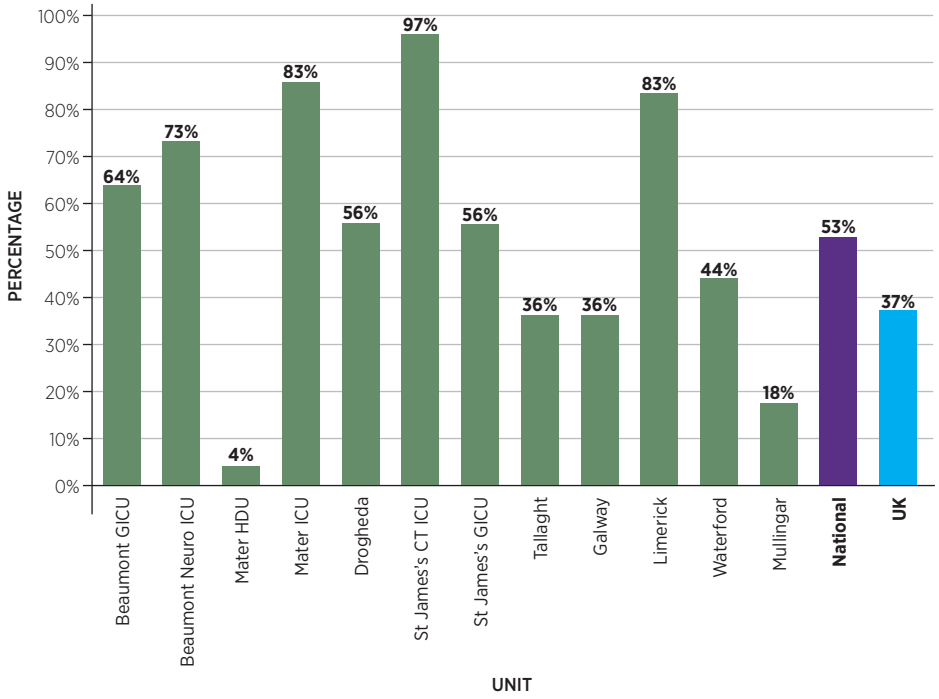


FIGURE 5.13: ADMISSIONS WHO UNDERWENT MECHANICAL VENTILATION WITHIN 24 HOURS OF ADMISSION (AS A PERCENTAGE OF ALL ADMISSIONS TO THE UNIT)*

* Full hospital names are available within the frequency tables.

RESPIRATORY SUPPORT AFTER ADMISSION TO ICU: ADVANCED AND BASIC

Advanced respiratory support (ARS) means mechanical ventilation via an invasive airway (endotracheal tube or tracheostomy). This is seen as the defining characteristic of intensive care, as it is a treatment which cannot be provided safely outside ICU.

There was wide variability in the percentage of patients receiving ARS, as might be expected with Units ranging from a pure HDU to mixed ICU/HDU to a specialist cardiothoracic ICU (Figure 5.14). These data give useful insight into the case mix across different Units in Ireland.

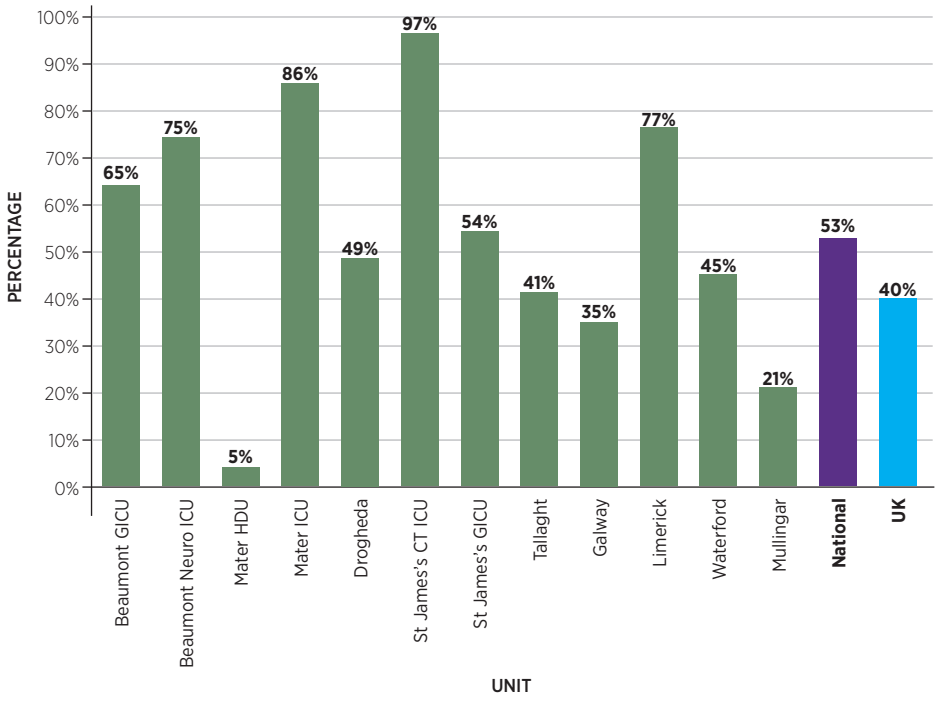


FIGURE 5.14: ADMISSIONS WHO RECEIVED ARS (AS A PERCENTAGE OF ALL ADMISSIONS)*

* Full hospital names are available within the frequency tables.

Basic respiratory support (BRS) includes patients requiring oxygen at a concentration greater than 50% or non-invasive mechanical ventilation (i.e. not via an endotracheal tube or tracheostomy). These patients do not necessarily need an ICU bed, but are considered to need a HDU bed.

ARS normally requires management in an ICU bed (although patients ventilated long term via a tracheostomy may be managed in less acute environments).

The data in Figure 5.14 provide useful insight into the relative requirements for ICU beds in different Units. Although a patient may need to be in ICU even if they are not receiving ARS, they cannot be managed outside ICU if they are receiving ARS.

In addition to the absolute requirement to be in ICU while a patient is receiving ARS, there is also likely to be a period before and after receipt of ARS when the patient must be cared for in an ICU environment, even if they are only receiving BRS.

There are also non-respiratory reasons why a patient must be in ICU, including basic or advanced cardiovascular support, renal support, invasive monitoring (e.g. intra-arterial pressure, intracranial pressure) or the overall complexity of care required. Although the requirement for bed days for ARS is the best single indicator of the relative requirements for ICU bed capacity, it is a significant underestimation of absolute requirements for the reasons outlined above.

In keeping with the other measures of complexity we have described, the percentage of bed days provided for ARS in Irish Units (49%) is considerably greater than the percentage provided by Units in the UK (38%) (Figure 5.15).

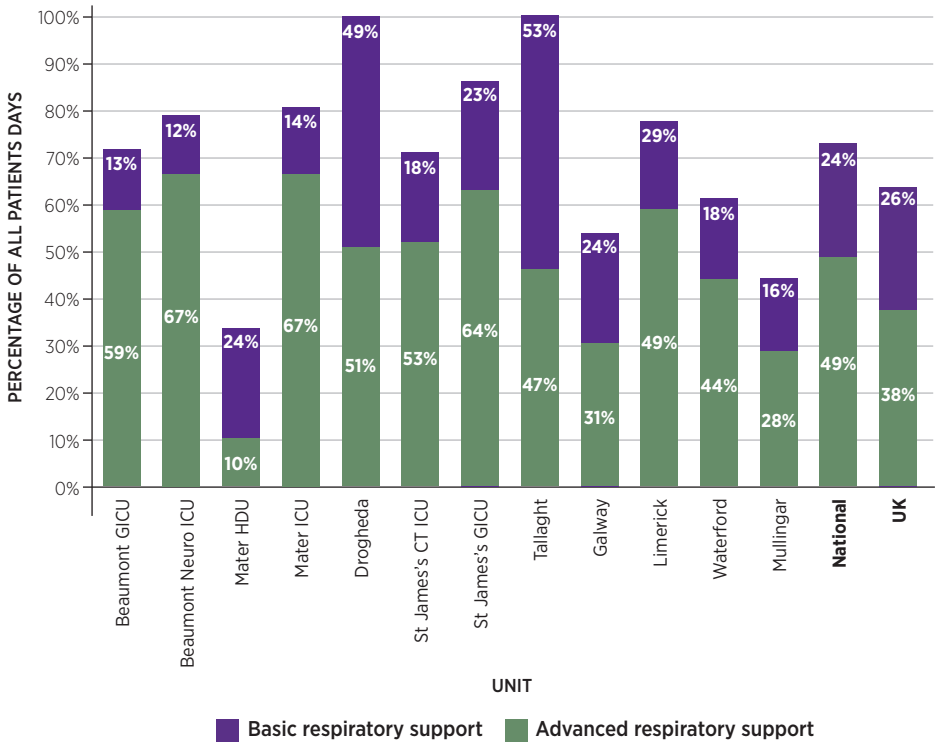


FIGURE 5.15: DAYS OF ARS AND BRS (AS A PERCENTAGE OF ALL PATIENT DAYS)*

* Full hospital names are available within the frequency tables.

CARDIOVASCULAR SUPPORT AFTER ADMISSION TO ICU

Advanced cardiovascular support means a high level of complex care for the cardiovascular system (CVS), e.g. a vasopressor and one other intravenous infusion acting on the CVS, an intra-aortic balloon pump, a temporary pacemaker, or continuous cardiac output measurement.

Not surprisingly, this correlates with other measures of complexity, such as APACHE II scores. Advanced CVS support is particularly frequent in Units that admit a high proportion of patients after cardiac surgery (Figure 5.16).

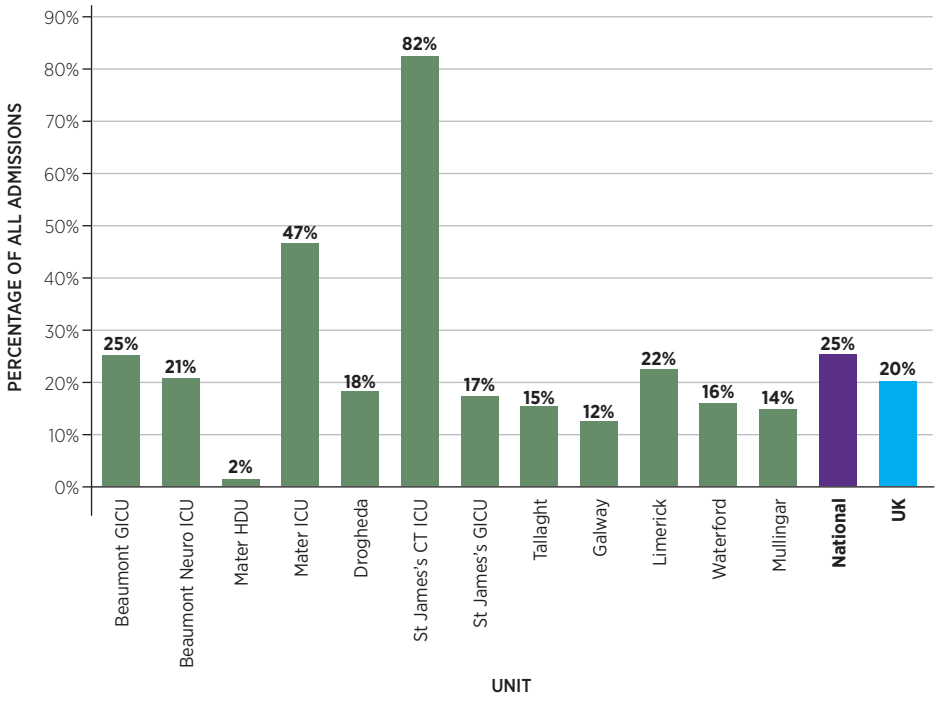


FIGURE 5.16: ADMISSIONS WHO RECEIVED ADVANCED CVS SUPPORT (AS A PERCENTAGE OF ALL ADMISSIONS)*

* Full hospital names are available within the frequency tables.

Patients requiring advanced CVS support normally require care in ICU. Commonly, patients who require advanced CVS support will also require ARS, as well as support for other organ systems.

The number of bed days on advanced CVS support was greater in Units with a high proportion of patients who were admitted postoperatively after cardiac surgery (Figure 5.17) . In other Units, the number of bed days on advanced CVS support tends to correlate with illness severity scores, such as APACHE II.

Basic CVS support means a lower level of CVS support, e.g. one vasopressor, invasive vascular monitoring, etc. See Appendix 6 for full definitions of organ support. Some patients in this category can be managed in a coronary care unit (CCU) or in a HDU. However, if the patients are complex (e.g. with coexisting sepsis), if the CCU does not take non-cardiology patients, or if there is no HDU, patients receiving basic CVS support must be managed in ICU, as these interventions cannot be managed safely on an ordinary ward. The requirement for basic CVS support was very high in patients managed in participating Units (Figure 5.17).

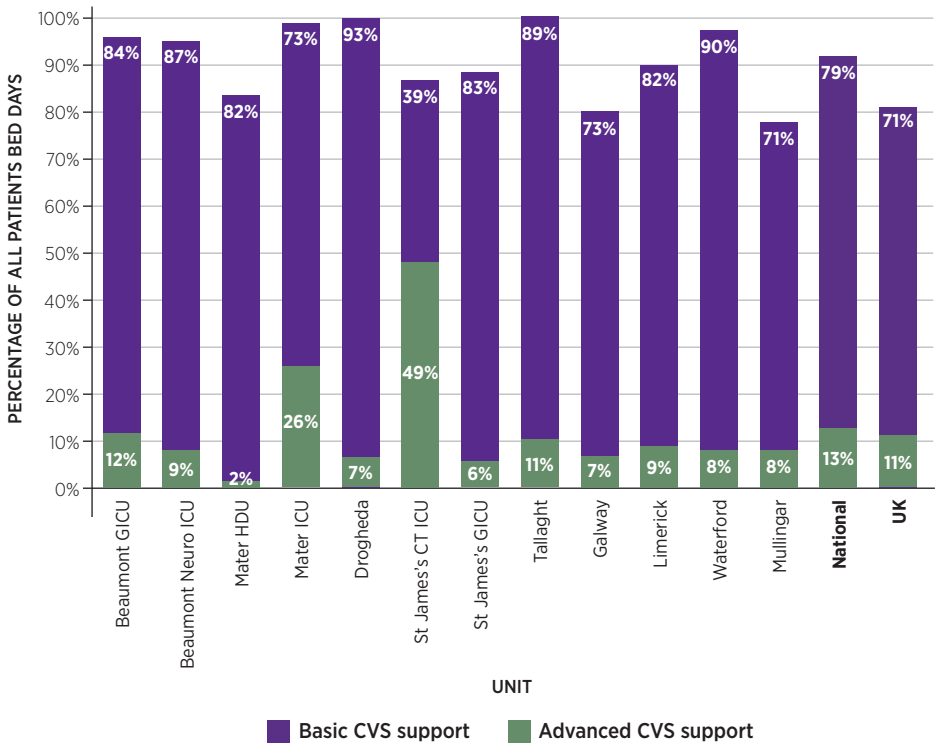


FIGURE 5.17: DAYS OF ADVANCED AND BASIC CVS SUPPORT (AS A PERCENTAGE OF ALL PATIENT DAYS)*

* Full hospital names are available within the frequency tables.

RENAL SUPPORT AFTER ADMISSION TO ICU

Renal support means dialysis either for acute renal failure or for patients on long-term dialysis if they are also receiving other acute organ support. The data below do not distinguish between intermittent haemodialysis (HD) or continuous renal replacement therapy (CRRT) (Figure 5.18). Normally HD is provided off-Unit in a Dialysis Unit but if patients are too sick to be managed off-Unit, this may be provided in the ICU. The majority of dialysis in ICU however is provided as CRRT.

Patients who require dialysis and who need to be in ICU tend to be very ill with multi-organ failure. CRRT is a complex treatment with a high requirement for skilled nurse staffing. In addition, these patients are commonly ventilated, on vasopressors, receiving enteral or parenteral feeding, and/or septic. Days on renal support made up a significant proportion of patient days in the Units that had high mean APACHE II scores, and indicate a requirement for high nurse–patient staffing ratios and for highly skilled nurses.

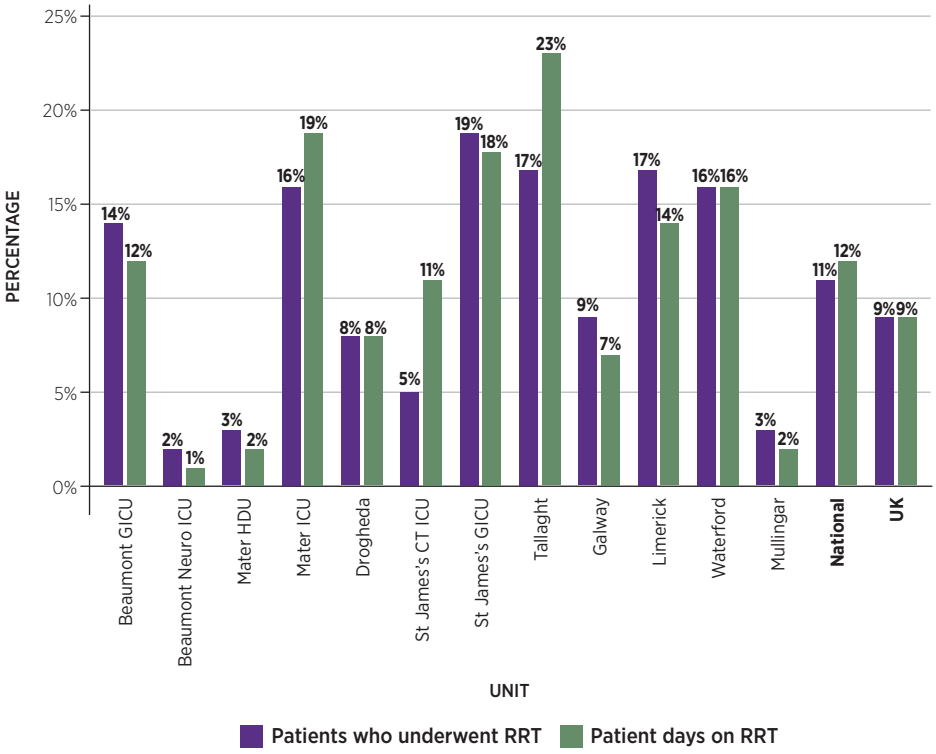


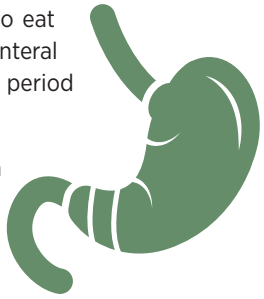
FIGURE 5.18: (I) ADMISSIONS WHO UNDERWENT RENAL REPLACEMENT THERAPY (RRT) (AS A PERCENTAGE OF ALL ADMISSIONS) AND (II) DAYS WHEN RRT WAS PROVIDED (AS A PERCENTAGE OF ALL PATIENT DAYS)*

* Full hospital names are available within the frequency tables.

GASTROINTESTINAL SUPPORT AFTER ADMISSION TO ICU

Enteral nutrition is provided via a tube into the stomach or small bowel – usually via the nose, but sometimes passing through the abdominal wall. Parenteral nutrition is provided via a drip into a large vein.

These methods of nutrition are required in patients who are unable to eat due to coma, impaired swallowing, or the gut not working properly. Enteral or parenteral nutrition is not needed if the patient is able to eat or if the period without nutrition is short, e.g. after surgery.



Some of the lower values for enteral or parenteral nutrition in the data in Figure 5.19 are explained by patients being able to eat either immediately or within a short period when they recovered sufficiently from surgery. However, if the duration without nutrition is likely to be prolonged, it is good practice to initiate artificial nutrition.

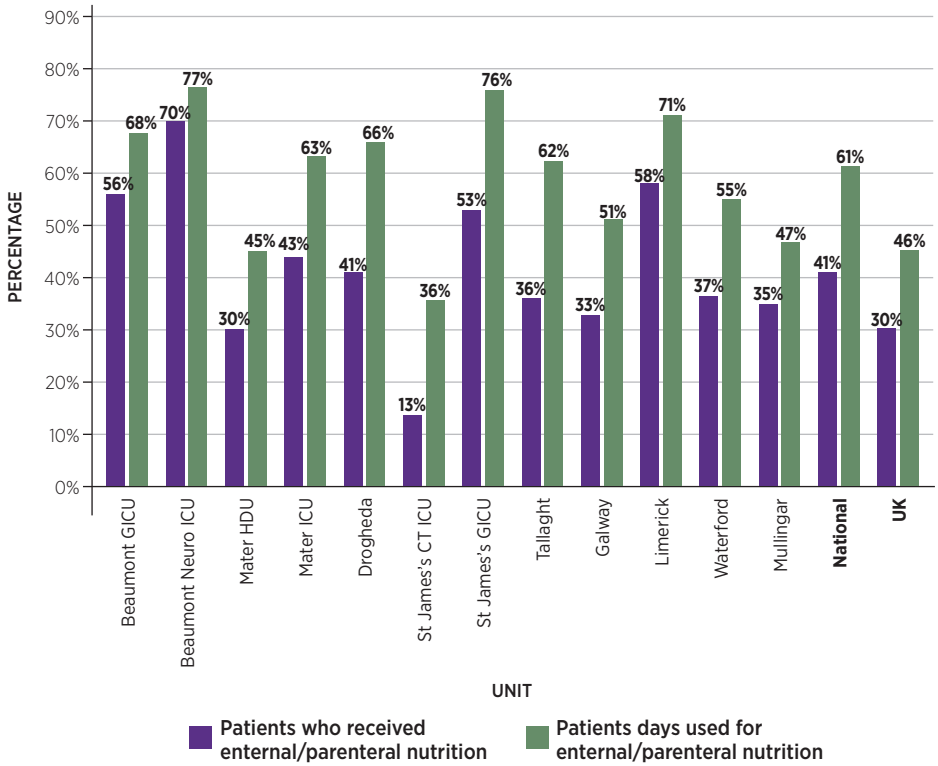


FIGURE 5.19: (I) ADMISSIONS WHO RECEIVED ENTERAL OR PARENTERAL NUTRITION (AS A PERCENTAGE OF ALL ADMISSIONS) AND (II) DAYS WHEN ENTERAL OR PARENTERAL NUTRITION WAS PROVIDED (AS A PERCENTAGE OF ALL PATIENT DAYS)*

* Full hospital names are available within the frequency tables.

NUMBER OF ORGAN SYSTEMS SUPPORTED IN ICU

Reports from ICNARC provide data on the number of organ systems supported and for how many days in the Unit. Figure 5.20 below shows the percentage of patients who had three or more organ systems supported as an indicator of the complexity of care provided in different Units. This parallels other indicators of illness severity, such as APACHE II score, the provision of ARS and advanced CVS support, renal support (dialysis), etc.

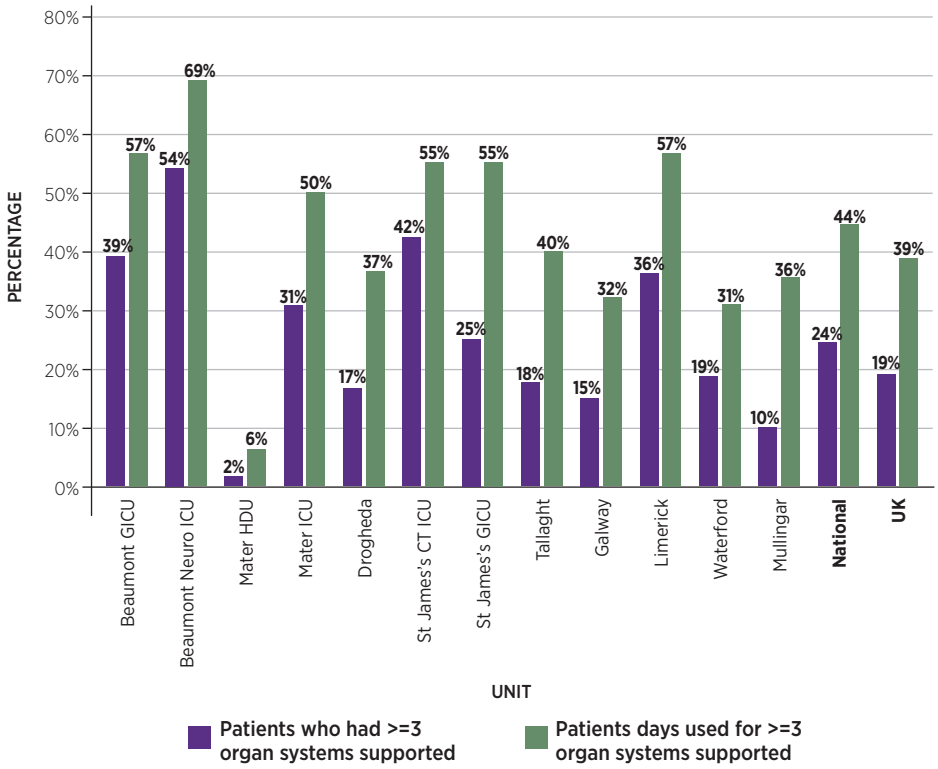


FIGURE 5.20: (I) ADMISSIONS WHO HAD 3 OR MORE ORGAN SYSTEMS SUPPORTED (AS A PERCENTAGE OF ALL ADMISSIONS) AND (II) UNIT DAYS WITH 3 OR MORE ORGAN SYSTEMS SUPPORTED (AS A PERCENTAGE OF ALL PATIENT DAYS)*

* Full hospital names are available within the frequency tables.

MORTALITY AFTER ADMISSION TO CRITICAL CARE

Mortality in critical care is high, especially when one considers that our data include patients admitted for HDU care rather than ICU care. Figure 5.21 presents the actual (crude) mortality for all patients included in the Audit, showing both deaths in the Unit and deaths in the ward before discharge from acute hospital.

A significant proportion of deaths in patients who have been admitted to critical care occur after they have left the Unit alive. This is the experience internationally and reflects a number of factors, such as (i) the severity of the underlying condition (e.g. brain injury), (ii) serious pre-existing conditions (e.g. cardiac disease, metastatic cancer), (iii) patient age, etc.

It is important that any consideration of mortality in critical care takes into account the severity of illness on admission as well as other risk factors such as age, pre-existing conditions, and underlying diagnosis. For this reason, we have published the risk-adjusted mortality for each Unit, not the crude mortality (Figure 5.22).

Eighty-eight per cent of patients survived to leave the original Unit they were admitted to in both Ireland and the UK.

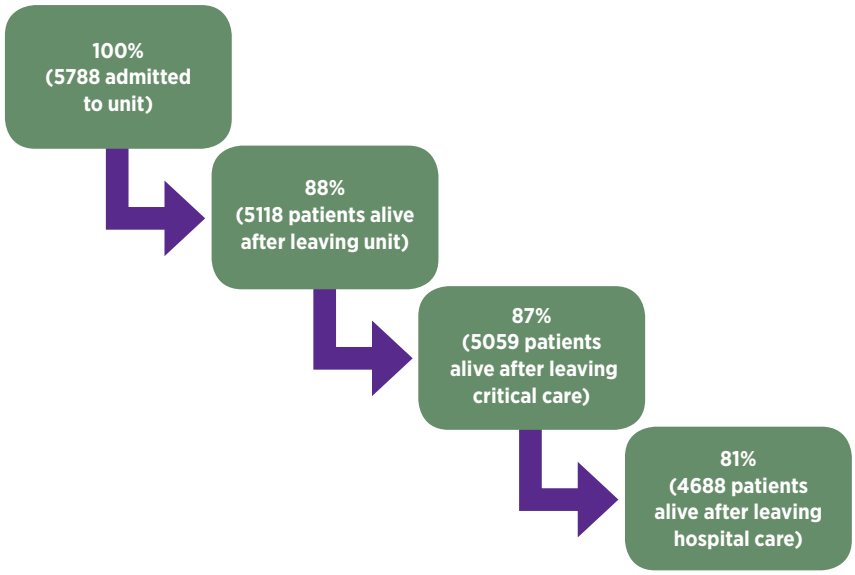


FIGURE 5.21: PERCENTAGE OF PATIENTS SURVIVING TO LEAVE ORIGINAL UNIT ADMITTED TO, TO LEAVE ALL CRITICAL CARE, AND TO LEAVE HOSPITAL IN THE REPUBLIC OF IRELAND (ROI) (N=5788)

STANDARDISED MORTALITY RATIOS

Crude mortality is not a good guide to outcomes in ICU because the biggest factor in determining mortality is the relative risk of death for individual patients. Units with a large proportion of high-risk patients will have a high mortality, independent of the quality of care. In order to overcome this, we compare risk-adjusted mortality rates between Units.

ICNARC uses a mathematical model to predict the risk of death of individual patients. This incorporates data on age, pre-existing conditions, source of referral, admission diagnosis and illness severity, as assessed by physiological and laboratory data. Patients who are readmissions to the Unit are excluded from analysis, otherwise they would be included in the mortality figures more than once. The analysis is based on outcomes from ICNARC's large database of ICU patients collected over the last 20 years. The model is updated and recalibrated regularly in order to account for changes in ICU practice and demographics, as well as for the generally improving outcomes in ICU observed over recent years with improved practice.

For each Unit, ICNARC will calculate an expected number of deaths based on this mathematical model. This is then used as the denominator to calculate the standardised mortality ratio (SMR), with the observed number of deaths being the numerator. If the SMR is 1.0, it means the Unit had the expected number of deaths.

There are flaws with using SMR as a measure of quality of care in ICU. ICU patients and ICUs are very heterogeneous and no single mathematical model is perfect for every patient and every Unit. Despite these reservations, SMR is generally accepted as an important signal of possible issues relating to quality of care, as it directly links to the most important outcome in ICU: survival.

With variability in case mix and unavoidable flaws in the mortality prediction model, a range of statistical variability in outcomes is expected. To allow for this, a variability of ±2 standard deviations (SDs) for Unit SMRs is expected around the value of 1, where the observed mortality matches the expected mortality. This range is referred to as the 'control limit' for SMRs; SMR values within this range are considered acceptable. Statistically, these limits should encompass 95% of all Units. Units that are in the 5% of Units outside these limits are considered to be outliers for this QI. Where the SMR is ≥ 2SD above the comparator value (of 1), the observed mortality is significantly higher than the expected and this is a signal that there may be concerns about quality of care and clinical outcomes.

SMR data for Irish Units are shown in Figure 5.22. The SMR for the 5,743 eligible Irish admissions in 2017 was 1.07, i.e. close to the expected value of 1.0.

There is a purple circle for each Irish Unit with letters to identify individual Units which are linked to the list of Units on Page 40. The SMR is plotted on the y axis, versus the number of Unit admissions on the x axis. The dotted line indicates + 2 Standard Deviations (SD), and the solid lines represent + 3 SD, above or below the comparator value of 1. The range between these lines becomes smaller as the number of patients admitted to a Unit increases and the SDs become less.

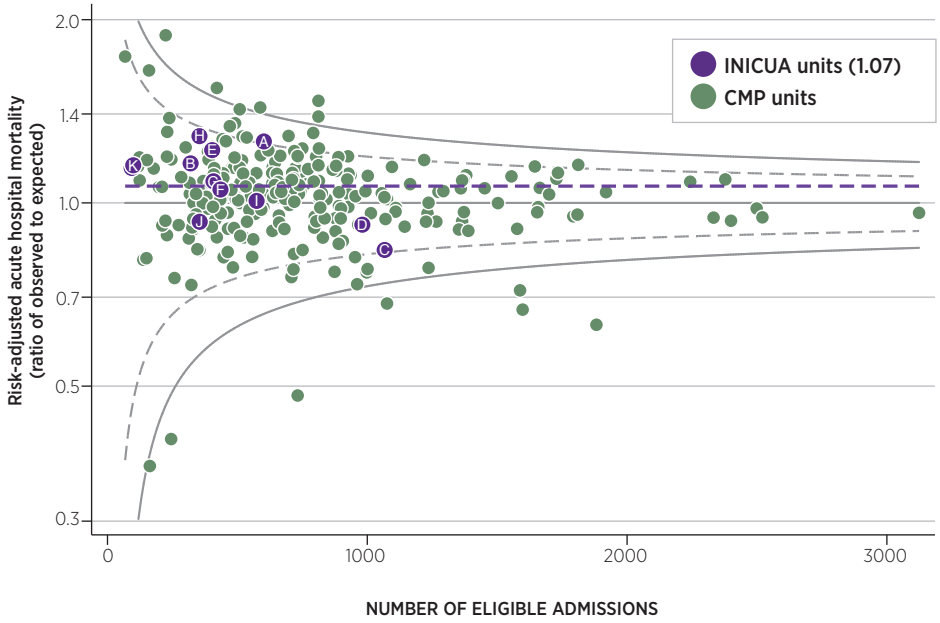


FIGURE 5.22: RISK-ADJUSTED ACUTE HOSPITAL MORTALITY (SMR) (ICNARC$_{H\text{-}2015}$ MODEL)[3]

One Unit, Beaumont Hospital General ICU exceeded these acceptable limits for SMR for 2017 by a small margin.

As these outlier data indicate a possible issue with patient safety and quality of care in the Unit, NOCA initiated a process of engagement with the hospital. Initially, the hospital was asked to check data quality in order to determine whether an issue with data collection, data interpretation, or data entry could account for these outlier findings.

The hospital replied that a check of the data had found no inaccuracies. The hospital chief executive officer (CEOs) was then asked to (i) initiate an investigation to explain the outlier finding, and (ii) outline the steps being taken to ensure correction of any causative factors. An edited version of the response from the hospital is provided here.

[3] Each purple circle marks an Irish Unit; the letter in the circle is linked to the relevant Unit in the list of Units on page 40.

Beaumont Hospital's response to outlier data for General ICU mortality

Outlier outcomes were noted for the following QIs for 2017:
1. Risk-adjusted hospital mortality for all ICU admissions (Figure 5.22).
2. Unplanned readmissions within 48 hours of discharge (Figure 5.35).

The ICU group investigated these outliers: (i) data entry was rechecked for accuracy, (ii) two intensivists reviewed the data and reviewed charts of all those who died and (iii) data were presented to the Department for discussion.

FINDINGS

- The annual number of admissions increased by 10% in 2017 compared with 2016.
- The annual number of admissions has increased by 52% since 2011.
- There were 182 admissions in three months in Q4 2017. This is equivalent to an annual rate of 728 admissions for a year. This annualised figure was 21% higher than the number of admissions in 2016 and 67% higher than the number of admissions in 2011 (Figure 5.23).
- Bed capacity has remained unchanged since 2011.
- Illness severity increased; the mean APACHE II score was 18 in 2017 compared with 17.5 in 2016.
- Bed occupancy was 112% in Q4 2017, compared with 107% throughout 2016.
- Mean length of stay decreased from 4.8 days in 2016 to 4.3 days in 2017.
- The percentage of patients undergoing cardiopulmonary resuscitation (CPR) before ICU admission increased from 4.0% in 2016 to 6.2% in 2017 (which increases the risk of mortality).
- Mortality in the ward after discharge from ICU increased from 10.7% in 2016 to 13.5% in 2017.
- Increasing admissions correlated with an increasing SMR, culminating in the SMR being identified as an outlier in Q4 2017.
- The outlier SMR for 2017 was predominantly accounted for by the increased SMR in Q4; the SMR was within acceptable limits for Q1 to Q3 2017.
- Unplanned readmissions are likely to have increased due to earlier discharges because of the need to admit sicker patients to ICU.

SUMMARY

Risk-adjusted mortality and readmissions to ICU were outside acceptable limits for 2017 due to a Q4 surge in admissions to a chronically over-occupied and overstretched Unit caring for increasingly severely ill patients.

RECOMMENDATIONS

Our Unit has an insufficient number of critical care beds for the number of patients that require critical care. This needs to be addressed by opening additional critical care beds with appropriate associated resources. Vacant, accessible bed space exists in the form of unfunded ICU beds and space for an eight-bed HDU.

ACTIONS

A new HDU will open on 3 December 2018 with four beds initially, with a plan to open a further four beds as soon as possible.

Since July 2018, two ICU registrars are on duty overnight Monday to Friday. From December 2018, this will be extended to two registrars throughout the weekend (currently there are two registrars during daytime only on Saturday and Sunday).

One additional consultant in ICU medicine and one non-consultant hospital doctor (NCHD) will be appointed to support the new HDU.

Two ICU consultants will be rostered per day from Monday to Friday starting on 1 January 2019 (two consultants are on duty three days per week at present). A clinical information system will be installed in order to allow inclusion of the HDU in the National ICU Audit.

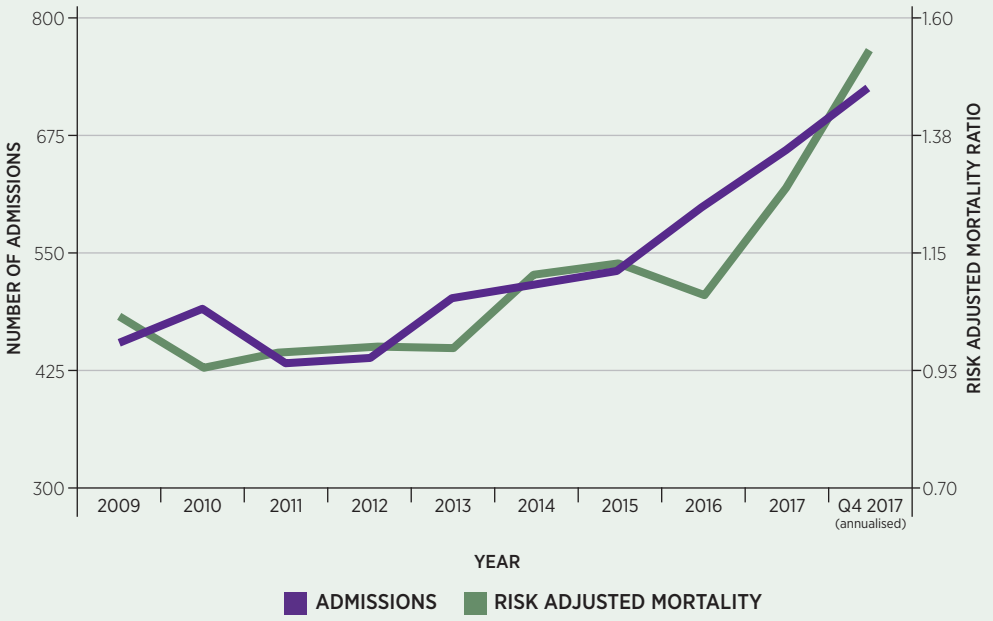


FIGURE 5.23: ANNUAL RISK-ADJUSTED MORTALITY (SMR) AND ANNUAL NUMBER OF UNIT ADMISSIONS, 2009–2017.

NOCA's comment on the outlier finding for the Beaumont Hospital General ICU

The data in Figure 5.23 show very starkly the effect on patient outcomes when there is inadequate ICU bed capacity to cope with increased demand. These data demonstrate a Unit being asked to cope with a greater workload without additional resources. If increased numbers of patients require ICU admission, the workload on ICU staff increases, there is less time to care for patients, and patients are discharged earlier from ICU. These factors are well established to lead to worsened patient outcomes.

Surprisingly, bed occupancy for 2017 was lower in the Beaumont Hospital General ICU (GICU) (86%) than the national average occupancy rate (91%), despite the indicators of pressure on bed capacity (Figure 5.27). This may reflect periods of low demand or some other factor. The hospital quoted a higher level of bed occupancy than the value calculated from ICNARC data. An alternative method of calculating bed occupancy is to count the day of admission and the day of discharge as full days for bed occupancy; if this approach was used, it would give a higher occupancy value than by calculating the exact number of hours a patient was in an ICU bed, as per ICNARC's methodology.

Other healthcare systems cope with increased demands on ICU beds by transferring patients from busy Units to other Units with spare capacity. Transferring critically ill patients to another hospital because of a lack of ICU bed capacity is uncommon in Ireland for a number of reasons: (i) other Units are also very busy and lack the capacity to accept a transfer, (ii) patients may need specialist care in the hospital with the bed shortage, and (iii) there are considerable logistical difficulties in arranging and undertaking the transfer of a critically ill patient, especially as the referring Unit is likely to be very busy if it is full.

NOTE: As an addendum to the hospital response above, 2018 reports to date show an SMR within the acceptable limits in Q1 and Q2 for the Beaumont Hospital GICU.

MORTALITY IN LOW-RISK PATIENTS

Figure 5.24 shows the SMR for patients who were judged to have a relatively low risk of death (<20%) when admitted to ICU. While some deaths are expected in this group, an excess number of deaths would suggest an issue with the quality of care.

This metric is useful as a QI in its own right and is also very useful in order to gain further insight into Units that have outlier data for overall mortality.

There were no outlier values for this QI from participating Units in 2017.

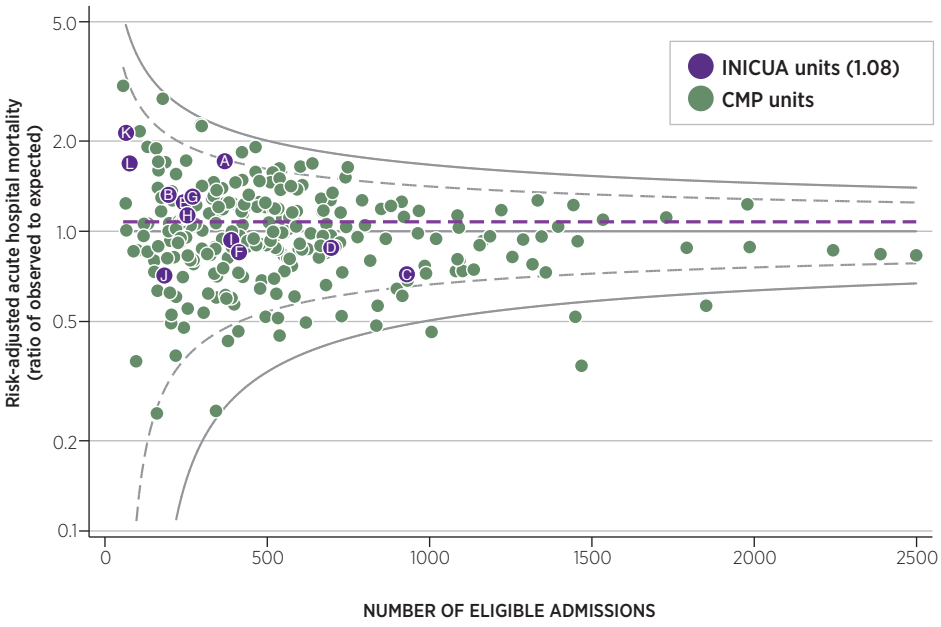


FIGURE 5.24: RISK-ADJUSTED ACUTE HOSPITAL MORTALITY RATIO OF OBSERVED TO EXPECTED; SMR FOR PATIENTS WHOSE PREDICTED RISK WAS <20% ($ICNARC_{H\text{-}2015}$ MODEL)[4]

[4] Each purple circle marks an Irish Unit; the letter in the circle is linked to the relevant Unit in the list of Units on page 40

BRAIN DEATH AND ORGAN DONATION

Death is normally confirmed by establishing the absence of circulation and respiration. However, patients in ICU may be maintained by mechanical ventilation in the absence of any clinical evidence of brain function. If absent brain function is demonstrated in conjunction with a clear diagnosis of the cause of the brain injury and the absence of any confounding factors, brain death is diagnosed. This allows discontinuation of ventilatory support (because it is futile), which quickly leads to cardiac standstill.

If the families of patients who are brain dead wish, these patients may become organ donors and contribute to saving the lives of up to six other patients. Saving life is the primary goal in ICU, but if therapy is unsuccessful it becomes a major priority to maximise the number of organ donors. The great majority of organ donors are patients who have been declared brain dead, and efforts to maximise organ donation are concentrated on this group.

Not surprisingly, brain death was most common in the Beaumont Hospital Richmond ICU (Neuro), but can occur in any ICU (Figure 5.25).

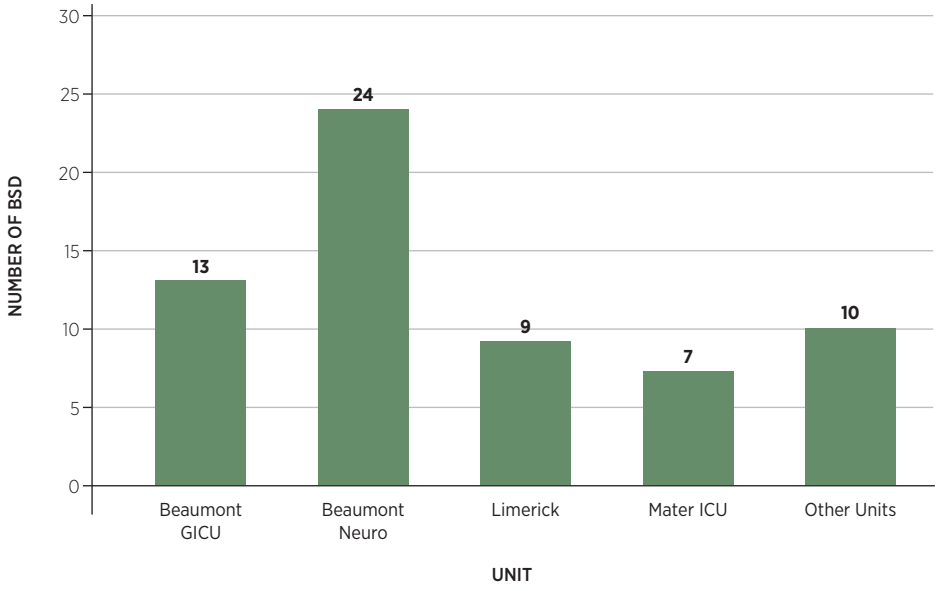


FIGURE 5.25: NUMBER OF PATIENTS DIAGNOSED WITH BRAIN DEATH (BD)*

* Full hospital names are available within the frequency tables.

A key metric for ICU audit is the percentage of patients who are brain dead who become organ donors. Inevitably, there will be patients who do not become organ donors – families may withhold consent, patients may be unsuitable to be donors, or there may be other reasons. However, it is well established that the education of clinical staff and the implementation of support structures for organ donation can maximise the number of brain dead patients who become organ donors.

In the Irish Units participating in the Audit, 63% of patients who are brain dead became organ donors, compared with 55% in the UK (Figure 5.26A).

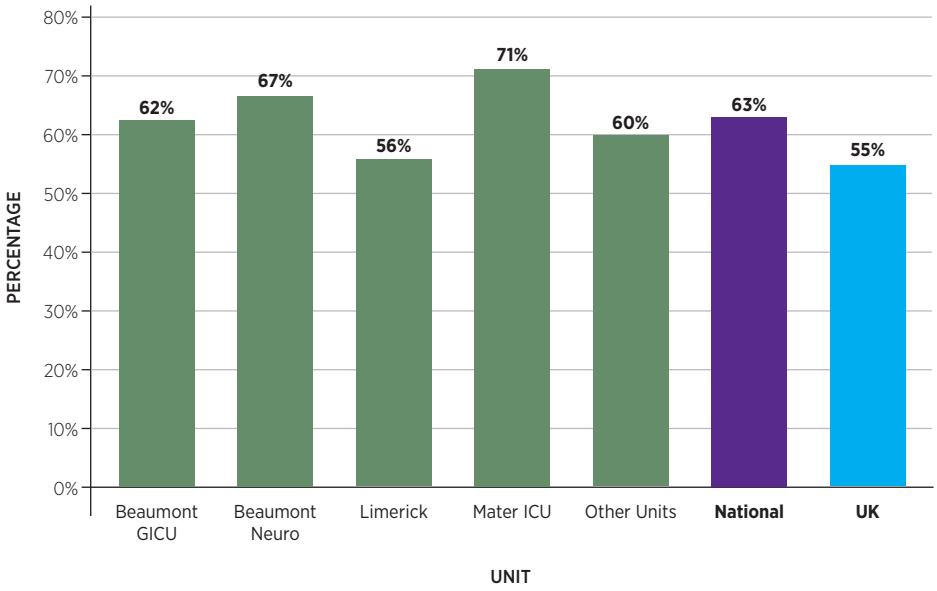


FIGURE 5.26A: PERCENTAGE OF PATIENTS WITH BD WHO BECAME ORGAN DONORS*

* Full hospital names are available within the frequency tables.

Patients with significant brain injury are usually transferred to a neurosurgical centre, which explains why the majority of organ donors in the Audit came from Beaumont Hospital (Figure 5.26B). However, significant numbers of organ donors also came from other hospitals.

Comparisons of donors between hospitals should take into account that not all hospitals had 12 months of data; Beaumont Hospital, Mater Misericordiae University Hospital, University Hospital Limerick, and Our Lady of Lourdes Hospital, Drogheda had 12 months of data, while the other Units had only three or six months of data.

While donation after brainstem death (DBD) is the predominant source of organ donors in most countries, donation after circulatory death (DCD) is a significant and increasing source of organ donation. As with DBD, the majority of DCD donors tend to come from neurosurgical centres, and this is the case with this Audit (Figure 5.26B). However, there is potential for expansion of DCD to other centres, which is being pursued actively by organ donation personnel.

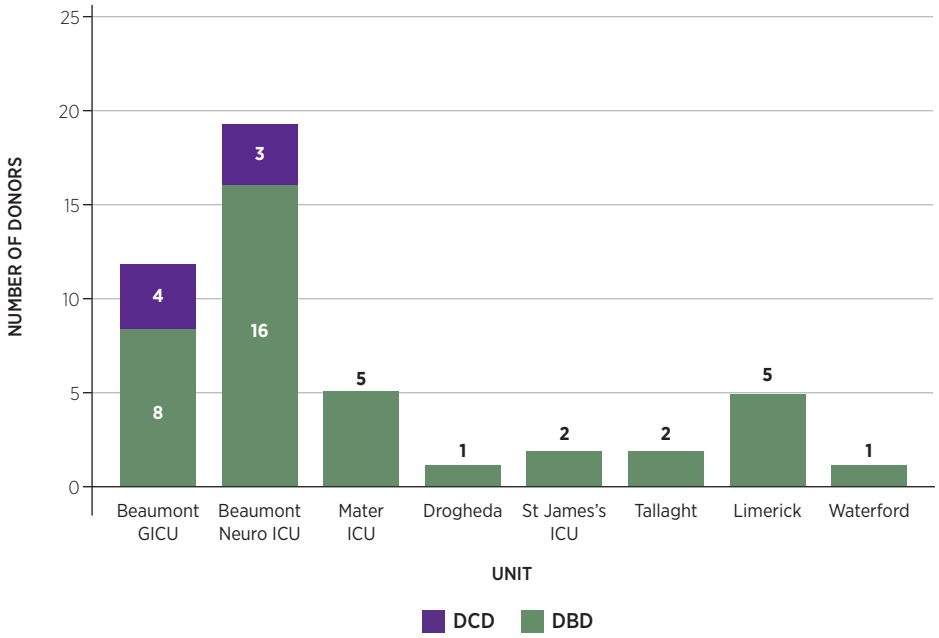


FIGURE 5.26B: NUMBER OF DBD AND DCD ORGAN DONORS IN EACH UNIT*

* Full hospital names are available within the frequency tables.

BED OCCUPANCY IN ICU

Bed occupancy is a key metric in the ICU Audit. High levels of bed occupancy mean that beds are full all the time and that beds are not available when needed urgently. As there are normally periods when beds are empty (for cleaning, while awaiting a new admission, during troughs in demand for beds, or during holiday periods in Units which cater for elective surgery), high levels of bed occupancy suggest that there are periods when the Unit is over capacity.

ICU activity typically fluctuates significantly between peaks and troughs of activity. This is commonly the case for general Units, where a large proportion of the workload is urgent or unplanned (less so in Units providing postoperative care for elective surgery patients). Units which have a high proportion of emergency admissions generally have fluctuations in demand. High levels of bed occupancy in this type of Unit suggest that there is not enough capacity to deal with surges or peaks in demand.

Conversely, low levels of bed occupancy suggest underutilisation of a very expensive resource. This was not a finding in Irish Units.

Bed occupancy was calculated by measuring the total duration in hours between the time of admission and time of discharge for each patient in order to provide length of stay. Figure 5.27 provides the bed occupancy for the Irish Units in the Audit, which was calculated in this manner. The number of admissions was multiplied by the mean length of ICU stay for the Unit (which ICNARC calculates using the exact duration of ICU stay in hours).

This gives a figure for the total patient time in days spent in each Unit. The number of bed days available is calculated by multiplying the number of open, staffed beds in each Unit by 365 (or by the number of days for which the Unit supplied data for the Audit). Percentage bed occupancy is then calculated as the number of patient days provided, divided by the number of available bed days, multiplied by 100.

This approach tends to underestimate bed occupancy, as it does not take account of the work involved in clearing and cleaning the bed space, the transfer of a patient to another location, waiting for a patient who is booked in for admission, or getting the bed space ready for a new patient.

Expert recommendations are usually for bed occupancy of 80 - 85% (Prospectus, 2009, Joint Faculty of Intensive Care Medicine of Ireland, 2011) although they do not specify how bed occupancy should be calculated. INICUA data for Irish Units (using a very stringent definition for bed occupancy) show a mean bed occupancy of 91%, with no Unit below 80% and peak occupancy of 99% in one Unit (Figure 5.27). These are very high levels of bed occupancy, well above recommended levels, and are likely to lead to delayed admissions, periods of being over capacity and pressure for early discharges. High bed occupancy also has implications for staff stress levels, retention, and recruitment, and limits opportunities for professional development. Retention of ICU nursing staff is a key challenge in every healthcare system, and high bed occupancy levels worsen this.

Bed occupancy data for the UK were not available for comparison.

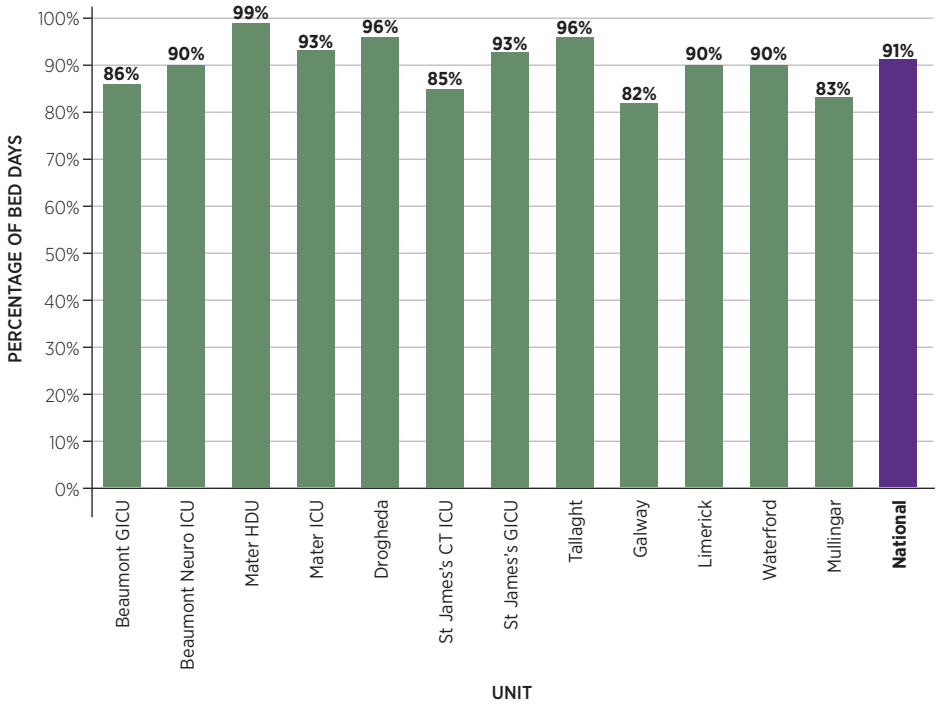


FIGURE 5.27: BED OCCUPANCY (BED DAYS OCCUPIED AS A PERCENTAGE OF BED DAYS AVAILABLE)*[5]

* Full hospital names are available within the frequency tables.

[5] Note: number of bed days was calculated based on the number of hours the bed was occupied.

LENGTH OF STAY IN ICU

Length of stay (LOS) for ICU survivors varied considerably between Units (Figure 5.28).

Interestingly, mean LOS was greater than median LOS for all Units, and by a large margin for some. This is because mean LOS is greatly influenced by a small number of patients who stay for a long time.

The variability in LOS between Units is quite striking, with a short mean LOS in some Units that had high scores for illness severity (Figure 5.11) and high requirements for organ support (Figures 5.13 to 5.19) and complex care (Figure 5.20). This suggests pressure on beds and early discharges from ICU.

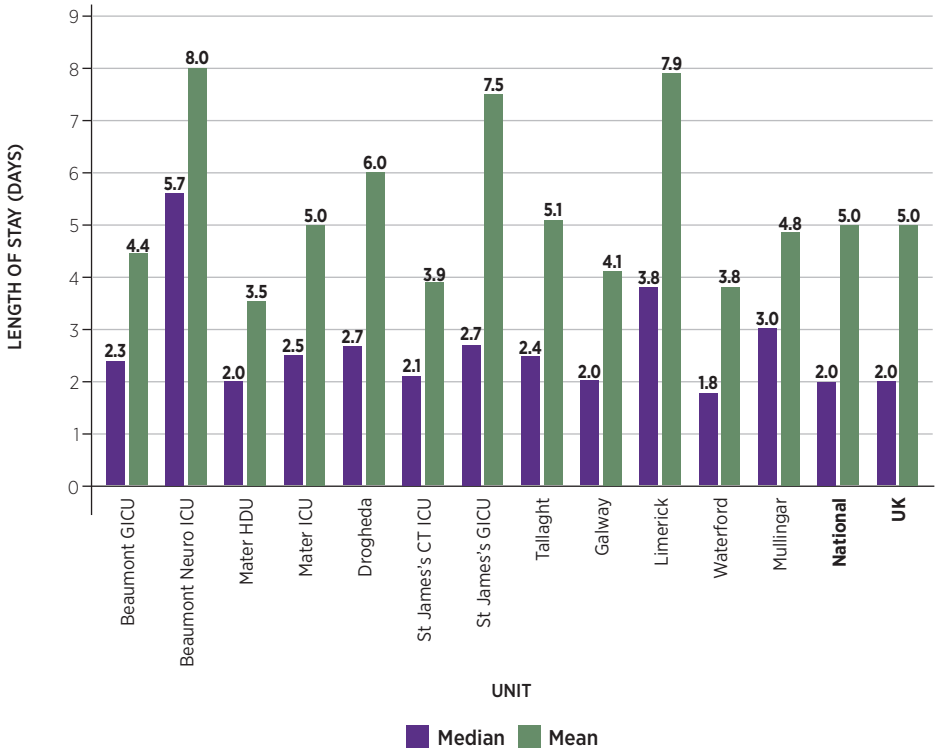


FIGURE 5.28: UNIT SURVIVORS' MEAN AND MEDIAN LOS IN THE UNIT (DAYS)*

* Full hospital names are available within the frequency tables.

LOS: UNIT SURVIVORS VERSUS NON-SURVIVORS

In some Units, survivors had a longer mean LOS than non-survivors, while in other Units the picture was the opposite (Figure 5.29). It is possible that this finding is random, that it reflects case mix in certain Units, or that it reflects earlier decisions regarding withdrawal of life-sustaining therapies by some Units. Comparisons with the findings in future reports will be interesting.

Nationally, mean LOS was five days for survivors versus six days for non-survivors. These data are comparable with the UK, which had a mean LOS of five days for both survivors and non-survivors.

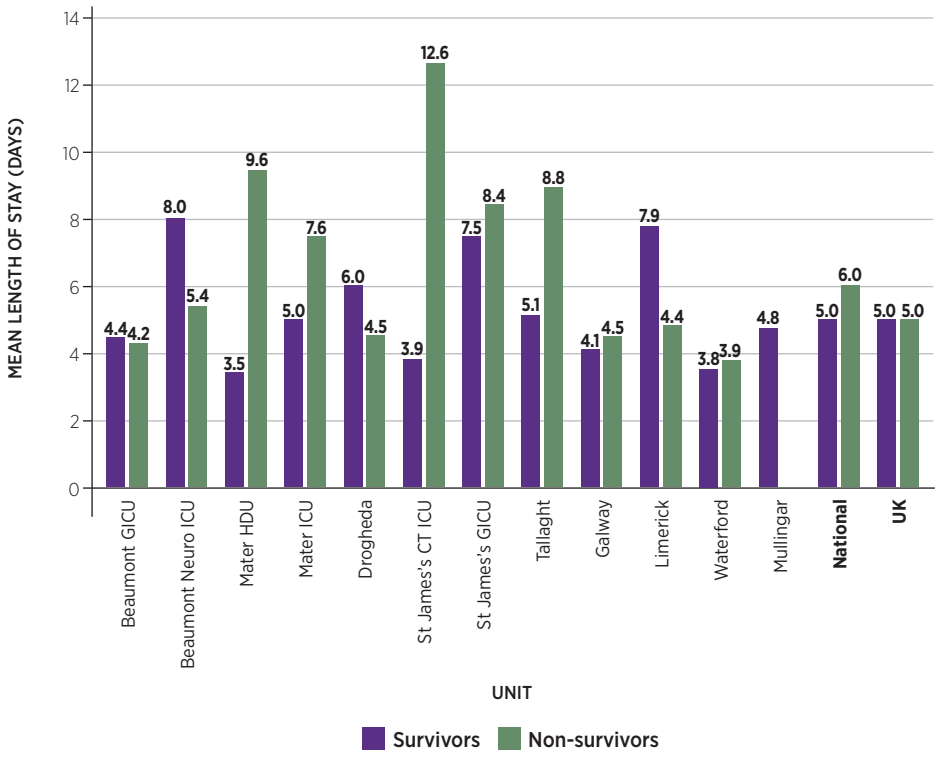


FIGURE 5.29: MEAN UNIT LOS FOR UNIT SURVIVORS VERSUS NON-SURVIVORS (DAYS)*[6]

* Full hospital names are available within the frequency tables.

[6] Note: Regional Hospital Mullingar non-survivors not reported due to small numbers.

UNPLANNED DISCHARGES FROM ICU AT NIGHT

Ideally, discharges to the ward from ICU should take place during normal working hours and only after patients have been declared fit for discharge. ICU patients discharged outside of normal working hours have worsened outcomes (Azevedo *et al.*, 2015). This may be related to factors in the wards such as reduced staffing levels, less experienced staff, or lack of knowledge of the patient's history. An additional factor may be that patients are discharged without being fully ready because of the need for an ICU bed for an urgent admission. The proportion of patients discharged out-of-hours is a well-established QI.

The proportion of unplanned discharges at night in 2017 was 6% in Ireland, compared with 2% in the UK (Figure 5.30). The usual reason for discharge at night is because the ICU bed is needed for a new admission. The provision of ICU beds is low in Ireland by European standards, leading to huge pressure on ICU bed availability. This makes it unsurprising that discharge at night is an issue.

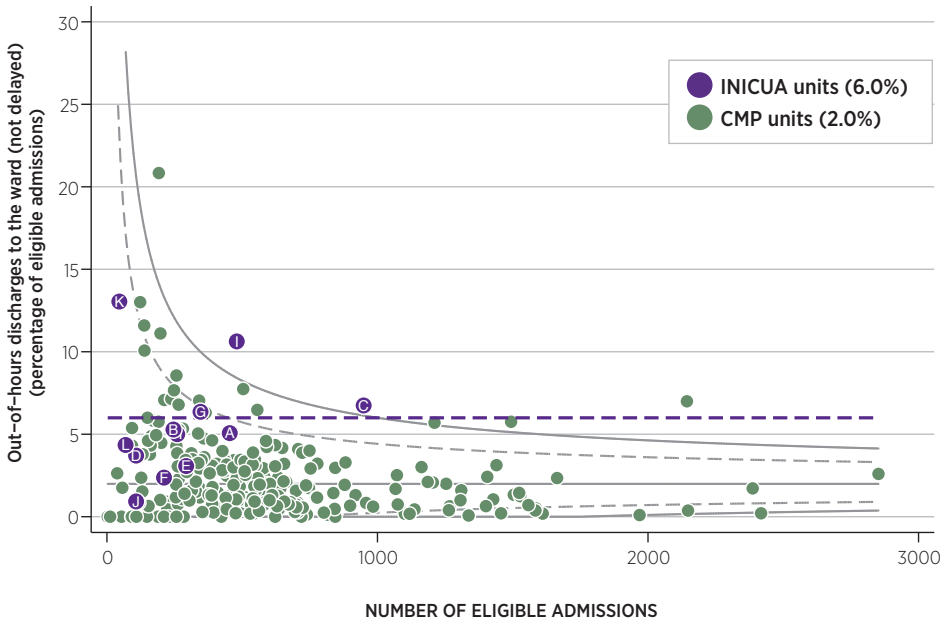


FIGURE 5.30: DISCHARGES TO THE WARD FROM 22.00–06.59 (NOT CLEARED FOR DISCHARGE BY 18.00 THAT EVENING) (AS A PERCENTAGE OF ALL UNIT SURVIVORS)[7]

Two Units (Figure 5.30) were outliers for the percentage of patients discharged at night without being cleared for admission by 18.00: the Mater Misericordiae University Hospital HDU and the University Hospital Galway ICU. An edited response from each hospital is included here.

[7] Each purple circle marks an Irish Unit; the letter in the circle is linked to the relevant Unit in the list of Units on page 40.

Mater Misericordiae University Hospital's response to outlier data for unplanned discharges out-of-hours from HDU

The Clinical Director and the relevant clinicians undertook a review of HDU patients who were subject to an 'out-of-hours discharge to a ward – not delayed'. The focus of the review was on identifying any significant patient impact and on improving internal audit data accuracy.

This review for the specific time frame in question indicated no patient readmissions to ICU or HDU and subsequently no adverse event for any patients.

However, a number of considerations have arisen:

- There is a requirement for additional critical care capacity. The HSE has allocated some resources for this, and recruitment is in progress.
- Demand for critical care arises 24/7, and discharge processes are evolving in order to ensure that discharge processes facilitate demand.
- The hospital should develop systems that accurately capture the decision of 'agree to discharge', (particularly in late evening) which defines the out-of-hours discharge potential.
- Mater Misericordiae University Hospital continues to evolve its practice relative to its national services and increasing trauma presentations. Against this demand, the hospital is satisfied that the governance processes and clinical oversight in place provide robust patient safety and quality assurance.
- NOCA should continue to provide robust independent review and assurance to the hospital in regard to this QI.

University Hospital Galway's response to outlier data for unplanned discharges out-of-hours

University Hospital Galway acknowledges that we were an outlier with regard to the QI 'out-of-hours discharges to the ward' for 2017.

The local ICU Audit Clinical Lead has reviewed the data regarding these results. Of note, the QI for the rate of readmission to the Unit within 48 hours of discharge was in the acceptable range.

Several ICU consultants felt that patients who were actually fit for ward discharge were not being identified during normal working hours (although no definite evidence of substantial misclassification was found). This concern has been addressed and we will continue to monitor this QI closely.

NOCA's comment on hospital responses

The key reason for measuring this QI is to identify patients who were not judged ready for discharge at the end of normal working hours but who were then discharged during the night, presumably because a bed was needed for an urgent admission.

Neither Unit with outlier data for this QI felt that patients had suffered. Both felt that there was an issue with a failure to define patients who were ready for discharge and both plan to improve practice in this regard. A formal process to identify and document patients who were ready for discharge is an improvement in practice, which seems to be a useful outcome of the Audit process.

DELAYED DISCHARGE FROM ICU > 24 HOURS

There is a shortage of hospital beds in Ireland, leading to well-publicised delays in the transfer of patients from the emergency department (ED). Delayed discharge from ICU is another result of ward bed shortages. Patients stay in ICU longer because of the pressure to take patients who are on a trolley in the ED when a ward bed becomes available, especially as LOS in ED is a key performance indicator (KPI) for hospitals.

There are some undesirable effects from this: patients stay longer than necessary in ICU, which may increase their risk of getting infections; there is a waste of expensive resources in keeping a patient in ICU unnecessarily; patients may end up being discharged at night (which is less safe); and patients requiring ICU admission are delayed until other patients can be discharged from ICU.

There were large differences between Units in the proportion of patients whose discharges were delayed > 24 hours (Figure 5.31). The reasons for this can probably only be explained locally, although some of the variation may be related to difficulty in capturing these data. The overall Irish figure was similar to that in the UK (18% compared with 19%).

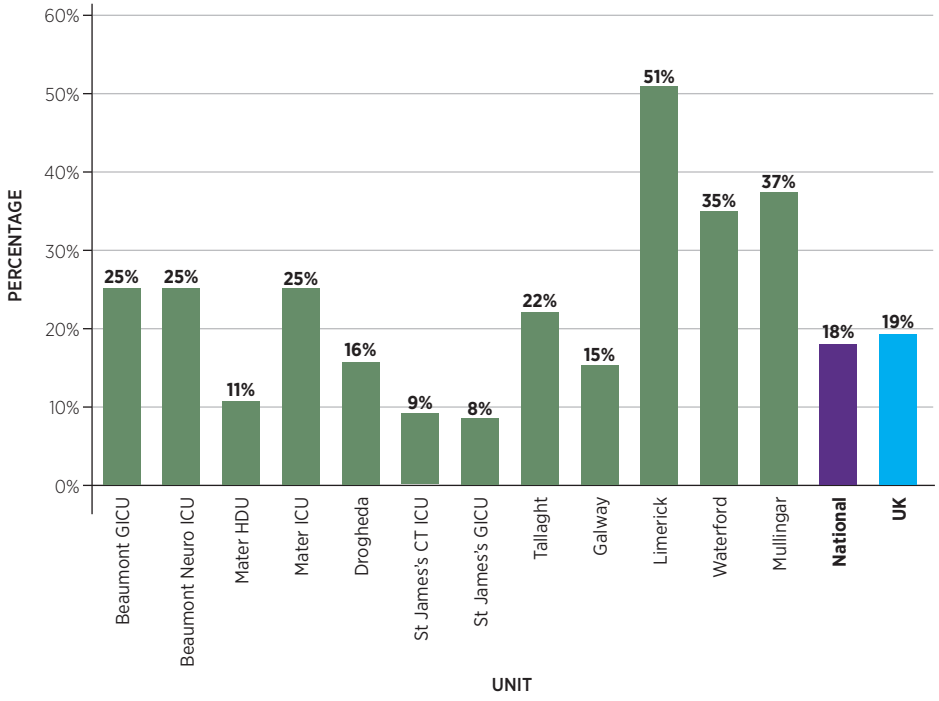


FIGURE 5.31: DISCHARGES TO THE WARD DELAYED >24 HOURS (AS A PERCENTAGE OF ALL DISCHARGES TO THE WARD)*

* Full hospital names are available within the frequency tables.

DELAYED DISCHARGE: NUMBER OF DAYS OF DELAY

ICU beds are commonly used for patients who are clinically ready for ward care (Figures 5.32 and 5.33). This is a potential waste of ICU resources, which in an ideal world would be utilised more efficiently.

However, it is difficult to achieve full efficiency with a resource such as ICU beds when demand is variable and unpredictable. ICUs must be resourced to deal with the peaks in demand rather than average demand – you cannot put an ICU patient on a waiting list for admission. It is not possible to temporarily close an ICU bed when it is unoccupied – the nurse cannot be sent home, as the bed may be needed unexpectedly in an hour's time.

Interestingly, Irish Units had lower values for days of delay than did UK Units (2.8% in Ireland compared with 4.9% in the UK for post eight-hour delay, and 1.4% compared with 2.9% in the UK for post 24-hour delay). However, these data are useful in indicating which Units are most in need of extra resources and which Units could consider a reallocation of resources to other areas. These data also highlight the potential for transfer of patients from a hospital whose ICU is full to a Unit which has beds occupied by patients who could be discharged to a ward.

A factor to be taken into account in interpreting this QI is that ICNARC calculates the bed days available (the denominator for this QI) based on the number of bed spaces in the Unit rather than on the number of staffed beds. In some Units, these are the same, but in others there may be bed spaces available but the beds are not staffed.

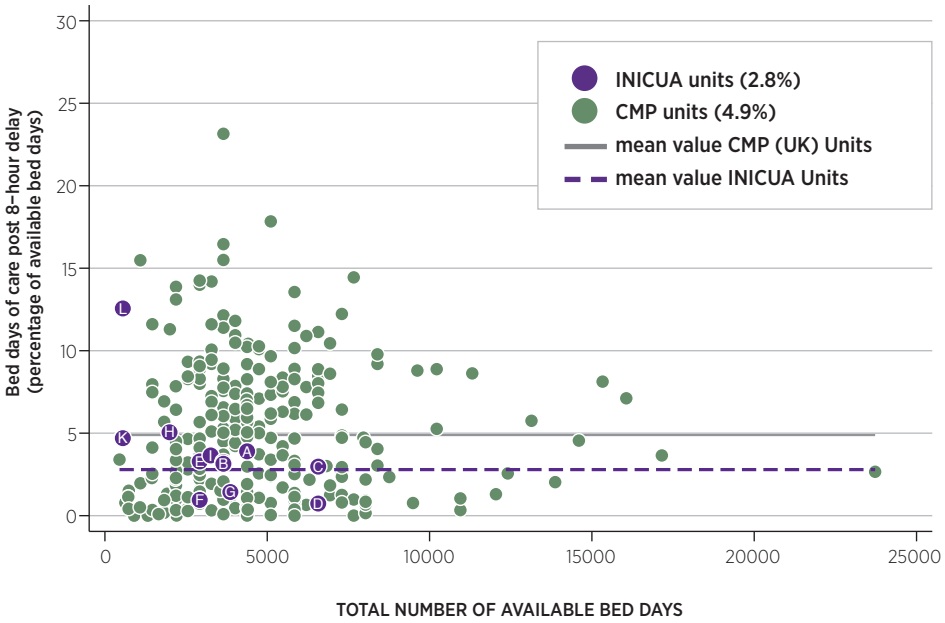


FIGURE 5.32: BED DAYS SPENT IN UNIT POST EIGHT HOURS AFTER BEING DECLARED READY FOR DISCHARGE (AS A PERCENTAGE OF AVAILABLE BED DAYS)[8]

[8] Each purple circle marks an Irish Unit; the letter in the circle is linked to the relevant Unit in the list of Units on page 40.

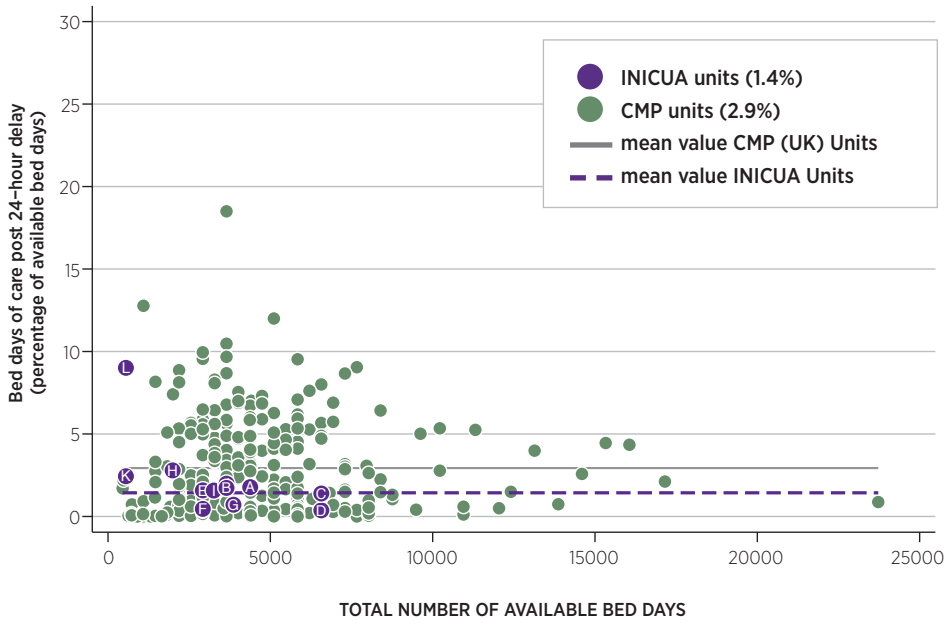


FIGURE 5.33: BED DAYS SPENT IN UNIT POST 24 HOURS AFTER BEING DECLARED READY FOR DISCHARGE (AS A PERCENTAGE OF AVAILABLE BED DAYS)[9]

[9] Each purple circle marks an Irish Unit; the letter in the circle is linked to the relevant Unit in the list of Units on page 40.

DISCHARGE DIRECTLY FROM ICU TO HOME

Discharge directly from ICU to home is unusual because if patients are sick enough to be in ICU, they normally need a period of step-down care and observation before discharge. Discharge directly from ICU to home normally means that discharge to a ward was delayed because of ward bed shortages.

Of all discharges from ICU/HDU in Ireland, 1.5% were direct to home (compared with 5.7% in the UK) (Figure 5.34). Unit J (University Hospital Limerick) had the highest percentage in Ireland (5.6%); this Unit also had a high percentage of delayed discharges (Figure 5.31).

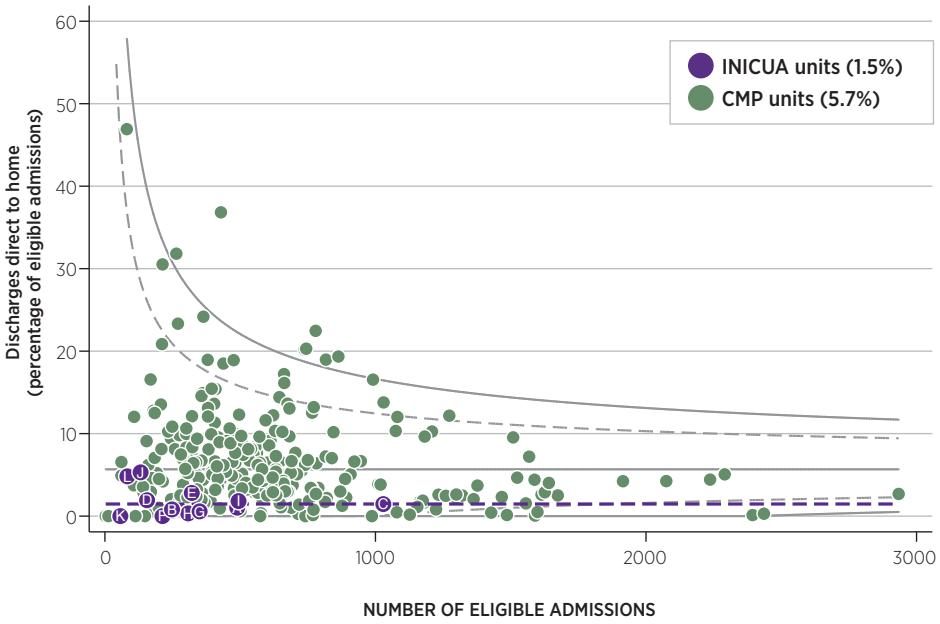


FIGURE 5.34: DISCHARGES DIRECTLY FROM THE UNIT TO HOME[10]

[10] Each purple circle marks an Irish Unit; the letter in the circle is linked to the relevant Unit in the list of Units on page 40.

UNPLANNED READMISSION TO ICU

Unplanned readmission to the Unit within 48 hours is a key QI in the ICU Audit. This can happen in individual cases due to an unpredictable event after Unit discharge, or due to an error in clinical judgement in assessing a patient as ready for ward care. However, an increased number of unanticipated readmissions suggests that patients are being discharged too early because of the need to make an ICU bed available for a new admission.

The mean rate of unplanned readmission to ICU for both Ireland and the UK was 1.1% in 2017 (Figure 5.35).

The Beaumont Hospital General ICU (GICU) was an outlier for this QI in 2017, with an overall unplanned readmission rate of 3.5%. This Unit was also an outlier for risk-adjusted mortality in 2017, and a response from the hospital in relation to these outlier findings is summarised on page 75.

The Beaumont Hospital GICU was within control limits for this QI in Q1 to Q3 2017, but the data for Q4 were so far outside the control limits that they brought the overall value for all of 2017 outside the control limits. This finding was in keeping with the other indicators of severe pressure on ICU beds for Q4 2017.

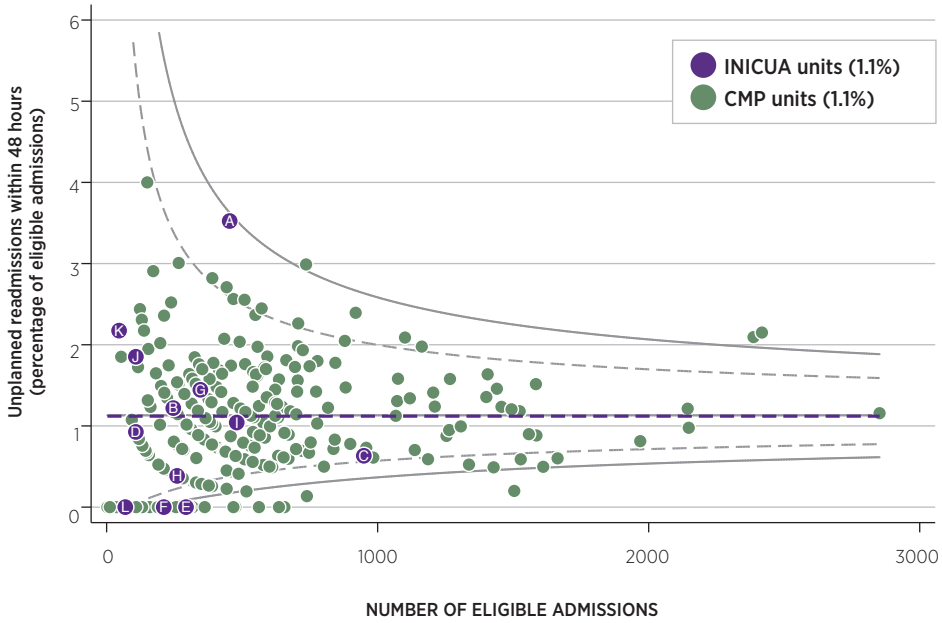


FIGURE 5.35: UNPLANNED READMISSIONS TO THE UNIT WITHIN 48 HOURS OF DISCHARGE FROM THE UNIT (AS A PERCENTAGE OF ALL ADMISSIONS)[11]

[11] Each purple circle marks an Irish Unit; the letter in the circle is linked to the relevant Unit in the list of Units on page 40.

LOS AFTER ICU DISCHARGE

Mean LOS in hospital after ICU discharge was greater than median for all hospitals, and by a large margin for some (Figure 5.36). This reflects the fact that LOS is greatly influenced by a small number of patients who stay for a long time.

There are variations between hospitals in hospital LOS after Unit discharge, which may reflect differences in case mix or differences in local community or convalescent facilities. Some differences are predictable; for example, a median LOS of 20 days after discharge from a neurosurgical ICU versus a median LOS of six days after discharge from a cardiothoracic ICU (neurosurgical patients tend to have intellectual impairment if they have suffered a brain injury severe enough to require care in ICU, leading to a longer LOS).

Mean LOS before hospital discharge for hospital survivors was 24 days in the Republic of Ireland (ROI) versus 15 days in the UK. This large difference may be due to differences in case mix (sicker patients in Ireland) or due to better community and convalescent facilities for care after discharge from hospital in the UK.

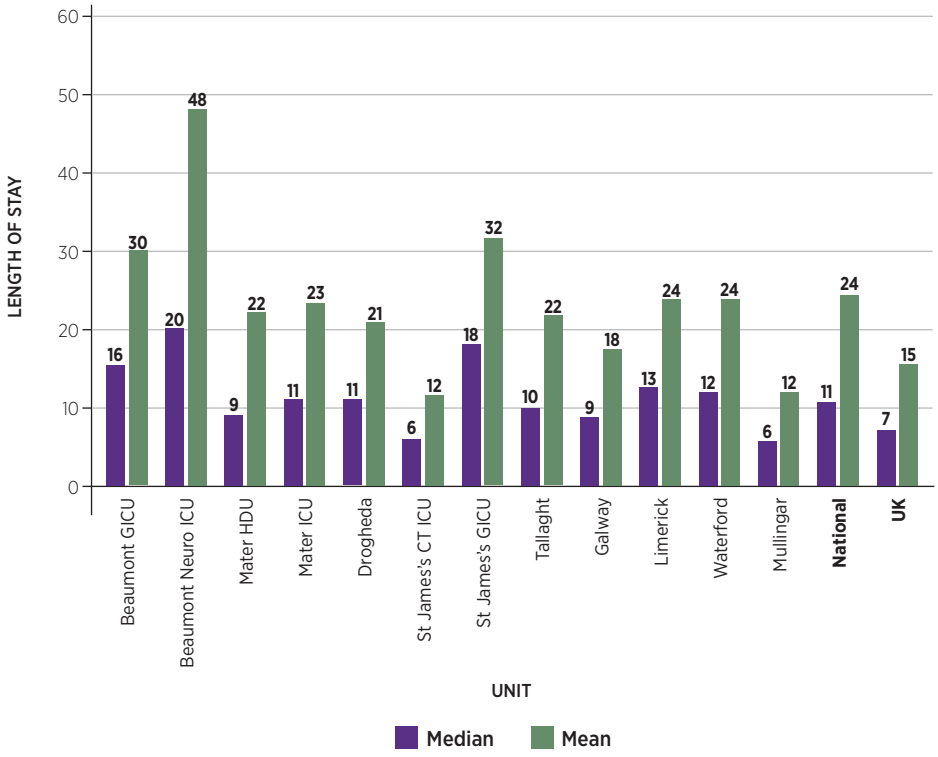


FIGURE 5.36: HOSPITAL SURVIVORS MEAN AND MEDIAN LOS IN ACUTE HOSPITAL AFTER UNIT DISCHARGE (DAYS)*

* Full hospital names are available within the frequency tables.

Mean LOS in hospital after Unit discharge in Ireland was 24 days for hospital survivors versus 35 days for non-survivors (the medians were 11 and 15 days, respectively) (Figure 5.37). Comparable UK figures were 15 days for survivors versus 19 days for non-survivors (with medians of seven and nine days, respectively).

The shorter LOS for hospital survivors in the UK may be explained by better community facilities to facilitate hospital discharge.

However, better community facilities would not explain the shorter LOS for hospital non-survivors in the UK compared with that in Ireland and the reason for this difference is unknown.

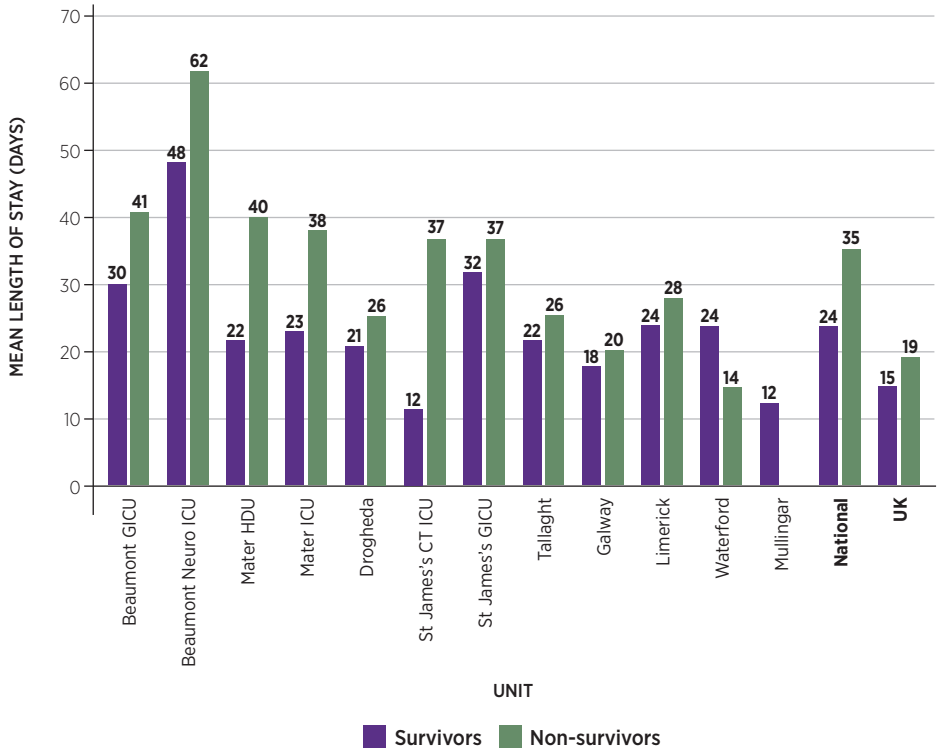


FIGURE 5.37: ACUTE HOSPITAL MEAN LOS AFTER UNIT DISCHARGE FOR HOSPITAL SURVIVORS VERSUS NON-SURVIVORS (DAYS)*[12]

* Full hospital names are available within the frequency tables.
[12] Note: Regional Hospital Mullingar non-survivors not reported due to small numbers.

CONCLUDING REMARKS: STRENGTHS AND LIMITATIONS

The data presented in Chapter 5 provide the first in-depth insight into the care provided for the most critically ill patients in Irish hospitals.

STRENGTHS

- The report provides a good cross-sectional view across critical care facilities nationally, with contributing Units including major tertiary referral centres, smaller regional hospitals, specialty Units, a HDU, and combined ICU/HDUs.
- The report covered an estimated 58% of national critical care activity in HSE-funded hospitals.
- The quality of data was good. ICU Audit Coordinators have been trained by ICNARC and NOCA, there is good ongoing support from the Audit Managers at NOCA in order to ensure national consistency in interpretation of ICNARC definitions for data entry, the numbers of ICU Audit Coordinators are generally adequate, and ICNARC provides invaluable support in validating the quality of data it receives and in liaising with individual Units about issues ICNARC identifies.
- Data analysis has been provided by ICNARC in the UK, allowing us to benefit from its experience, expertise and the credibility provided by its international reputation.
- The report provides benchmarking of Irish activity and outcomes against the UK.
- The report provides benchmarking between Irish Units, which is a powerful driver of quality improvement.
- There has been complete buy-in to the ICU Audit project by clinicians (both medical and nursing), hospital management, and national structures (the HSE, the Department of Health and Hospital Groups). This has facilitated implementation of the ICU Audit and should also support actions to improve patient care based on the findings of the report.

LIMITATIONS

- The report is somewhat preliminary in that a large number of hospitals with ICUs were not included. Thus, the case mix and outcomes may not be fully representative of the national situation.
- No private hospitals were included in the report.
- Some Units had only three or six months of data reported (see Page 40).
- While there is clear evidence of pressure on ICU bed capacity, there are no data on unmet need, i.e. patients who should have gone to ICU but were not admitted.
- There was insufficient coverage by the adult ICU Audit to calculate the number of admissions to ICU per 100,000 population (as the Paediatric Intensive Care Audit Network provided). This is a useful metric for comparison of ICU provision between countries.

This is the first annual report and it provides useful insights. The report for 2018 will expand coverage significantly to include more hospitals, which will result in the collection of data on 78% of ICU activity nationally. Despite the limitations identified, we can draw some conclusions from the data and make some recommendations based on the countrywide data we have.

FINDINGS: ADULT UNITS

- There was considerable variability between Units in the number of admissions, source of admissions, case mix, severity of illness, complexity of care required, and resources utilised in each Unit.

- Irish Units are very busy; mean bed occupancy (calculated from the exact number of hours the bed was physically occupied) was 91% (ranging from 82% to 99%). Standard recommendations are for occupancy rates of 70% to 80%.

- Illness severity on admission to the Unit was greater in Irish Units than in UK Units; the mean Acute Physiology and Chronic Health Evaluation (APACHE) II score for Ireland was 15.9 compared with 14.8 for the UK. The levels of cardiovascular, respiratory and renal support required were also greater for Irish patients.

- Despite higher markers of illness severity, mean length of stay was the same in Ireland and the UK (five days).

- The rate of unplanned out-of-hours discharges to the ward was greater in Irish Units (6% versus 2% in the UK).

- These data indicate that compared with UK patients, Irish patients need to be sicker to be admitted to ICU. For a given illness severity, they spend less time in ICU before discharge back to the ward, which is more likely to happen at night.

- Mortality is high in patients requiring admission to critical care (ICU or HDU); 13% of admitted patients died in ICU/HDU nationally, and a further 6% died after discharge from the Unit, before discharge from hospital.

- Outcome measures in Irish Units were comparable to UK Units, including a risk-adjusted hospital mortality rates (SMR) of 1.07 for Ireland versus the expected value of 1.0) and rates of unanticipated readmission to the Unit (1.1% versus 1.1%). This is reassuring and suggests that, despite the strains placed on them, Irish Units provide a high quality of care for patients and are a relatively safe environment for critically ill patients.

- It should be noted that the Audit has no way of identifying patients who should be in ICU or HDU based on clinical criteria but are not because of limited Unit bed capacity. The scale of this 'unmet need' and the effects on patient outcomes are not known.

- One Unit, Beaumont Hospital General ICU had outlier data for risk-adjusted hospital mortality. The SMR for the Unit for 2017 was 1.27 which was more than two standard deviations (SDs) above the expected value of 1.0.

- Data from the Beaumont Hospital General ICU provide compelling evidence of the effect on mortality of admitting increased numbers of patients; Unit admissions in the final quarter (Q4) of 2017 were 21% higher than the rate of admission for 2016 (and 67% higher than the rate of admissions in 2001). The number of open staffed beds in the Unit was unchanged during this time. Illness severity in this Unit on admission was increased and levels of cardiovascular, respiratory and renal support required were increased, but length of stay was decreased. The rate of risk-adjusted mortality (SMR) was increased for 2017 overall after a sharp increase in SMR in Q4 2017 (SMR from Q1 to Q3 had been within acceptable limits). The rates of unplanned readmissions to the Unit after discharge also increased in Q4 2017. These data convincingly demonstrate the outcome when demand increases beyond the available ICU bed capacity.

- It should be noted that mortality in the Beaumont Hospital General ICU was only marginally outside the acceptable limits in 2017. The Unit has had a mortality rate within the acceptable limits for Quarterly Quality Reports to date in 2018.

- The Mater Misericordiae University Hospital HDU and the University Hospital Galway ICU were outliers for unplanned discharges from the Unit to the ward at night (which is recognised to increase patient risk).

- Both of these hospitals noted that other indicators of patient outcomes had not been adversely affected. Both identified improved documentation of decisions to clear patients for discharge as a way to improve performance for this QI. In addition, Mater Misericordiae University Hospital noted a requirement for increased critical care capacity.

- Some Units have a problem with delayed discharges, presumably because of ward bed shortages. Facilitation of discharges from ICU would reduce ICU bed occupancy, reduce discharges out-of-hours, reduce delays in admission to ICU for critically ill patients, and could make beds available for patients from other Units which are over capacity.

- Length of hospital stay after ICU discharge was considerably longer in Ireland than in the UK (the mean was 24 days in Ireland versus 15 days in the UK). This could be related to a lack of step-down or rehabilitation facilities in Ireland, or it could be because the patients in Ireland were sicker on ICU admission than patients in the UK.

- The Audit covered only 58% of ICU activity, but a fuller picture will be available in the 2018 report, which will have 78% coverage.

- Preparation of this report identified anomalies due to issues with data quality and interpretation of ICNARC definitions. These have been addressed in audit coordinator workshops, which will lead to greater uniformity in data entry in future.

RECOMMENDATIONS: ADULT UNITS

FOR THE HSE

1. The HSE should prioritise measures to bring ICU/HDU bed capacity in Ireland up to levels which can deal comfortably with day-to-day requirements and to provide some reserve capacity in order to cope with surges in demand or with a major disaster. ICUs must be resourced to deal with peak demand rather than average demand, as patients cannot wait for admission.

   The *Health Service Capacity Review 2018* (Department of Health, 2018) recommended a 190-bed increase in critical care capacity by 2031; these data support this recommendation.

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2. The HSE should use the data in this report regarding occupancy, case complexity, requirements for organ support, out-of-hours discharges, and unanticipated ICU readmissions to identify the Units operating at or above capacity.

   Increased critical care bed capacity should be provided to these Units. As these are predominantly 'hub' hospitals, this would be consistent with the *"Model of Care for Adult Critical Care* (HSE Critical Care Programme, 2014).

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3. The HSE should take measures to facilitate transfers of critically ill patients between hospitals in order to make optimal use of scarce critical care beds and to facilitate transfers for specialist care. The INICUA database can support a live ICU Bed Information System (BIS) in order to provide data on bed capacity in participating Units, and this BIS could also be used to improve communication for referrals.

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4. The HSE should ensure that the specialist retrieval service for critically ill patients, the Mobile Intensive Care Ambulance Service (MICAS), is resourced to provide a comprehensive service 24 hours per day, 365 days per year.

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5. Identifying an unmet need for ICU care is difficult. The proposed BIS (see item 3 above) would have the capacity to document all referrals to ICU and to document whether these referrals were admitted or not. It would also document the reason for ICU referral. The HSE should fund implementation of the BIS nationally, and local clinicians should ensure that the relevant data on Unit referrals that are not accepted are inputted for all referrals.

FOR HOSPITAL MANAGERS, CLINICAL DIRECTORS, CLINICIANS AND ICU AUDIT COORDINATORS

6. Hospitals should prioritise discharges from ICU when patients are ready fo discharge. Doctors should clearly identify those patients ready for Unit discharge, and bed managers in hospitals should expedite these discharges.

7. Hospitals should minimise ICU discharges during night-time by performing timely discharges during normal working hours. A discharge summary with details of ICU care and a therapeutic plan should be provided in order to ensure seamless transition from Unit care to ward care.

8. Hospital management should ensure that there are always adequate audit resources in place to collect data, in order to ensure comprehensive data reporting.

9. Local clinicians and managers should benchmark their audit data against data from other Units in order to identify variance in their own activity metrics compared with other Units. This should be used to promote improvements in practice.

10. Local clinicians and audit coordinators should ensure that full documentation of the 'time of decision to admit to ICU' is kept in order to make the new HSE key performance indicator (KPI) for time to access ICU an effective measure of timeliness of ICU admission.

FOR NOCA

11. Consider ways to get more information on unmet need – patients who are not admitted to ICU because of a lack of beds.

12. Consider ways to get more information on the large number of patients who die after ICU discharge.

13. Consider ways to introduce patient-reported (or family-reported) outcome measures (PROMs) into the ICU Audit.

14. Put in place a national database for INICUA in order to expand the range of data analyses which can be provided.

15. Promote the development of national surveillance of catheter-related bloodstream infection in ICUs.

16. Target education on ICNARC definitions and output interpretation for ICU audit coordinators in training workshops.

PLANS FOR THE FUTURE

1. **Set up a national INICUA database**
   This will allow us to expand the range of reports beyond what ICNARC reports on. Areas of interest include:
   - Reports on children admitted to adult ICUs
   - Reports on obstetric patients admitted
   - Expanded information on organ donation
   - National Early Warning Scores before ICU admission and before discharge
   - Reports on CRBSI.

2. **Irish National ICU Audit Annual Report 2018**
   We plan to expand the number of data items which are reported by ICNARC but were not published in this report; possibilities include the following:
   - Percentage of patients admitted following CPR in the community or in hospital
   - Percentage of patients admitted directly from another ICU
   - Percentage of patients admitted directly from another hospital (not ICU)
   - Delayed admissions
   - Admissions with severe liver disease
   - Unplanned admissions after elective surgery
   - Number of bed days provided after trauma, and
   - ICU bed days at Level 3/Level 2 care (see Glossary for ICU Levels of Care).

   Other possibilities include further comparisons with UK data, development of data items for PROMs, data on the large number of patients who die after ICU discharge, etc.

3. Implement a standardised process for audit of CRBSI. This will need a national database to be in place to provide national reports.

4. NOCA is supporting a new KPI for hospitals regarding the time taken to access an ICU bed from the time a decision is made to admit the patient. Performance targets for this KPI are for 50% of patients to be admitted within one hour of a decision to admit and for 80% to be admitted within four hours of a decision to admit. National reports on this ICU access KPI will again require a national database to be in place.

5. An ICU BIS to improve the process of transferring patients from one hospital to ICU in another hospital has long been a requirement for the health service. The ICU Audit software, InfoFlex, interfaces in real time with hospital information technology (IT) systems that provide live information on ICU bed occupancy. NOCA and the InfoFlex developer, DMF Systems, are configuring a website linked to the INCIUA database. This would provide live data on ICU bed occupancy in hospitals participating in the Audit. This has the potential to provide a live BIS for use by all hospitals across the country.

6. This system has also been designed to allow transmission of relevant clinical information for referral of critically ill patients. We are currently exploring links between this system and the national service for transferring critically ill patients, MICAS.

7. The ICU BIS also has the potential to fill a gap in current IT systems in critical care by providing data on patients who are being cared for by the ICU team outside of an ICU. This BIS has been fully designed and built and has been piloted in two sites (St James's Hospital and Mater Misericordiae University Hospital in Dublin), but needs funding for additional staff in order to implement it nationally in 2019.

CHAPTER 6

FINDINGS FROM THE IRISH NATIONAL INTENSIVE CARE AUDIT (PAEDIATRIC) PICANeT ANNUAL REPORT 2018

CHAPTER 6: FINDINGS FROM THE IRISH NATIONAL INTENSIVE CARE AUDIT (PAEDIATRIC) PICANeT ANNUAL REPORT 2018

BACKGROUND TO THE PAEDIATRIC INTENSIVE CARE AUDIT NETWORK

The Paediatric Intensive Care Audit Network (PICANet) was established in 2001 in the UK with funding from the Department of Health (Paediatric Intensive Care Audit Network, 2018a). PICANet started collecting data from English and Welsh paediatric intensive care units (PICUs) in 2002. This was followed by data submissions from the PICUs in Edinburgh and Glasgow in 2004 and 2007, respectively. In 2008, the Royal Belfast Hospital for Sick Children joined PICANet. Our Lady's Children's Hospital, Crumlin (OLCHC) and the Temple Street Children's University Hospital (TSCUH), both based in Dublin, started submitting anonymised data to PICANet in 2010. There are now 32 participating organisations located in England, Wales, Scotland, Northern Ireland, and the ROI. This chapter is based on the *Paediatric Intensive Care Audit Network Annual Report 2018: Summary Report: Data collection period January 2015–December 2017* (Paediatric Intensive Care Audit Network, 2018a), with a focus on the two PICUs in the ROI.

GOVERNANCE FOR PICANET

PICANet receives support and advice from:

- A Clinical Advisory Group (CAG) drawing on the expertise of doctors and nurses
- A Steering Group (SG) whose membership includes health services researchers, representatives from the Royal Colleges of Paediatrics and Child Health, Royal College of Nursing and Royal College of Anaesthetists, a lay member, and commissioners, and
- A Paediatric Intensive Care (PIC) Families Group that considers the impact that admission to intensive care has on children and their families.

The PICANet Audit is commissioned by the Healthcare Quality Improvement Partnership and is funded by the National Health Service (NHS) England; the Welsh Government; NHS Lothian and the National Services Division of NHS Scotland; HCA Healthcare UK; the Royal Belfast Hospital for Sick Children; and NOCA (Paediatric Intensive Care Audit Network, 2018a). In the ROI, the HSE funds OLCHC and TSCUH, which are both voluntary hospitals. The National ICU Audit Governance Committee of NOCA provides governance for the PICANet Audit in Ireland.

METHODS

In the ROI, most critically ill children who need complex clinical care are treated in PICUs. These children may have had complex surgery, an accident or a severe infection. Children may be admitted to PICU from theatre, from an ED, or they may be transferred from another hospital. The PICANet dataset covers demographic and clinical data about the child and organisational data about the Unit. Data are stored on a secure database. Each organisation is able to view and download its own data, as well as reports on its data quality and activity. An annual report is produced each autumn. Comparisons between PICUs are made and assessed against established clinical standards and guidelines. PICANet provides technical and statistical support for the use of its data for local audit and research (Paediatric Intensive Care Audit Network, 2018a).

DATA COLLECTION AND SUBMISSION

Data are submitted by individual PICUs prospectively, using a secure web-based portal. Data submission can involve direct entry of patient data or an upload of a data file from an existing clinical information system. PICANet provides documentation on data definitions and standardised data collection forms.

PICANet collects information on the following:

Admission data: This consists of demographic details, e.g. date of birth, ethnicity and gender. It also records date of admission, clinical diagnoses, physiological parameters and ventilation status. Data on outcome and discharge details are also included.

Referral data: This includes details of the referring hospital, demographic details about the child, grade of the referring doctor or nurse, the transport team involved, and the destination PICU.

Transport data: This includes details about the transport team, journey times, any interventions carried out and critical incidents.

Staffing data: Staffing data are collected each year in November in order to monitor staffing levels within PICUs as well as against the Paediatric Intensive Care Society (PICS) standards relating to staffing requirements.

INFORMATION GOVERNANCE

PICANet processes data in alignment with the General Data Protection Regulation (GDPR) that came into effect in May 2018. Patient name and full address are not collected from the ROI. Following an agreement with the Data Protection Commissioner in Ireland in 2009, both OLCHC and TSCUH are permitted to send some personal details, such as the patient's full date of birth, to PICANet.

ANALYTICAL TECHNIQUES

Statistical analysis includes simple cross-tabulations, the calculation of crude and risk-adjusted SMRs, and 99% confidence intervals.

ASSESSING CASE ASCERTAINMENT, DATA QUALITY AND VALIDATION

PICU staff can access hospital data and reports in order to check monthly admissions totals using PICANet Web. Data are validated online via PICANet Web using logic and range checks, as well as by flagging missing data items. PICANet staff carry out on-site validation visits to cross-check against records held by PICUs and on PICANet Web. These checks allow assessment of case ascertainment and data quality assurance.

DATA INCLUDED

PICANet audits and reports on the clinical care of children admitted to PICUs in the UK and the ROI. The overall performance on preselected metrics (selected by PICANet) is presented (Table 6.1). This report presents data for the quality metrics described below for the ROI, and benchmarks performance against other participating PICUs in England, Wales, Scotland, and Northern Ireland. Specifically, it includes data from OLCHC, TSCUH, and the Irish Paediatric Acute Transport Service (IPATS). The data are presented for 2015–2017. This report should be read in conjunction with the *Paediatric Intensive Care Audit Network Annual Report 2018: Summary Report* (Paediatric Intensive Care Audit Network, 2018a). Figures and tables have been taken from the PICANet report, and some data from the report have been reproduced by NOCA.

Table 6.1 provides information on five key PICANet metrics: case ascertainment, retrieval mobilisation times, number of qualified nurses per bed, emergency readmissions within 48 hours, and mortality in PICUs (Paediatric Intensive Care Audit Network, 2018a).

TABLE 6.1: KEY PICANET PERFORMANCE METRICS

Metric	Title	Description
Metric 1	Case ascertainment and timeliness of data submission	This is a measure of the number of admissions to PICU reported to PICANet. 100% ascertainment means that information for all admissions was received. Timeliness of submission refers to whether data are submitted to PICANet within three months of discharge.
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 PIC following a clinical decision that PIC transport is required.
Metric 3	Number of qualified nurses per bed	In November each year, all PICUs record how many qualified nursing staff are employed on the PICU; total funded posts and any vacant posts are included.
Metric 4	Emergency readmissions within 48 hours	For each PICU, the frequency of emergency readmissions within 48 hours is recorded and compared with the averages for the UK and the ROI. This is calculated using the admission and discharge dates and times. This relative readmission rate allows PICUs to make comparisons with each other.
Metric 5	Mortality in PICU	Mortality (death) rates are assessed for every PICU 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 with the number who actually die in order to derive the risk-adjusted SMR.

KEY FINDINGS

Admissions to PICU

On average, there were approximately 20,000 annual admissions to PICUs in 2015, 2016 and 2017 across the UK and the ROI (OLCHC and TSCUH), although there was a slight decrease in admissions in 2017 in all countries except the ROI and the English non-NHS PICUs (Table 6.2). In the ROI, there were approximately 1,420 annual admissions over the three-year period being examined. These patient numbers do not include paediatric patients in adult ICUs outside Dublin; these data will only become available with complete implementation of the National ICU Audit in Ireland. According to the most recent report from PICANet (2018a), OLCHC is now the third busiest PICU of all participating PICANet Units (Figure 6.2).

TABLE 6.2: NUMBER OF ADMISSIONS BY COUNTRY AND YEAR, 2015-2017

Country	2015	2016	2017
England (NHS)	15 811	15 964	15 462
England (non-NHS)	270	336	502
Wales	466	530	493
Scotland	1321	1487	1393
Northern Ireland	630	557	522
Republic of Ireland	1397	1401	1463
Total	**19 895**	**20 275**	**19 835**

Table 6.3 presents a national view of bed days delivered. The number of bed days of care provided fluctuated throughout the three-year reporting period in all the admitting countries, with a consistent peak in 2016 in most countries with the exception of Northern Ireland. The number of bed days delivered in the ROI was approximately 10,000 annually within the reporting period.

TABLE 6.3: NUMBER OF BED DAYS DELIVERED BY COUNTRY AND YEAR, 2015–2017

Country	2015	2016	2017
England (NHS)	107 700	113 827	110 174
England (non-NHS)	3292	3473	2413
Wales	2353	2757	2451
Scotland	8747	11 020	10 768
Northern Ireland	3822	3480	3695
Republic of Ireland	10 174	10 319	9607
Total	**136 088**	**144 876**	**139 108**

BED OCCUPANCY IN PICU

Information about levels of bed occupancy is important in order to plan and deliver a PICU service in the ROI. Calculation of bed occupancy can be difficult because the number of beds open may vary depending on the number of staff available. OLCHC has 23 physical bed spaces and TSCUH has nine, but not all of these beds are open because funding is not available or because nursing posts are vacant.

NOCA has calculated bed occupancy from:

- PICANet data on bed days delivered, and
- The average number of open, staffed beds in both Irish PICUs in 2017.

In 2017, OLCHC had an average 21 open staffed ICU beds, and TSCUH had seven open staffed ICU beds (Healy 8 October 2018, at OLCHC personal communication; Doherty 8 October 2018 at TSCUH, personal communication).

Bed occupancy for PICUs in Ireland is presented in Table 6.4. For 2017, bed occupancy across both Units averaged 94% (97% in OLCHC and 86% in TSCUH). This is above recommended levels of occupancy and has implications for the quality of care that can be provided for patients. High occupancy levels also have implications for staff retention because of higher levels of stress, as well as implications for planned increases in service provision (e.g. surgery for congenital cardiac conditions or development of respiratory extracorporeal life support) and to cater for increases in population.

TABLE 6.4: BED OCCUPANCY IN ROI, 2017

	OLCHC	TSCUH	TOTAL
Bed days delivered	7402	2205	9607
Bed days available	7665	2555	10 220
Bed occupancy	97%	86%	94%

ADMISSION RATES

Rates of admission per 100,000 children are presented in Figure 6.1. The rate was highest in Northern Ireland, reaching 184 admissions for every 100,000 children, followed by Scotland (163), Wales (144), England (142) and the ROI (124). For the UK and the ROI combined, the admission rate was 143 per 100,000 population per year.

There was a clear geographical variation in admission rates to PICU by country. For example, Northern Ireland's admission rate was 50% higher than that in the ROI. The reasons for these differences are likely to be complex and multifactorial, but could include the proximity of patients to the PICUs, variation in admission policies between countries, and the extent of other services available to treat critically ill children.

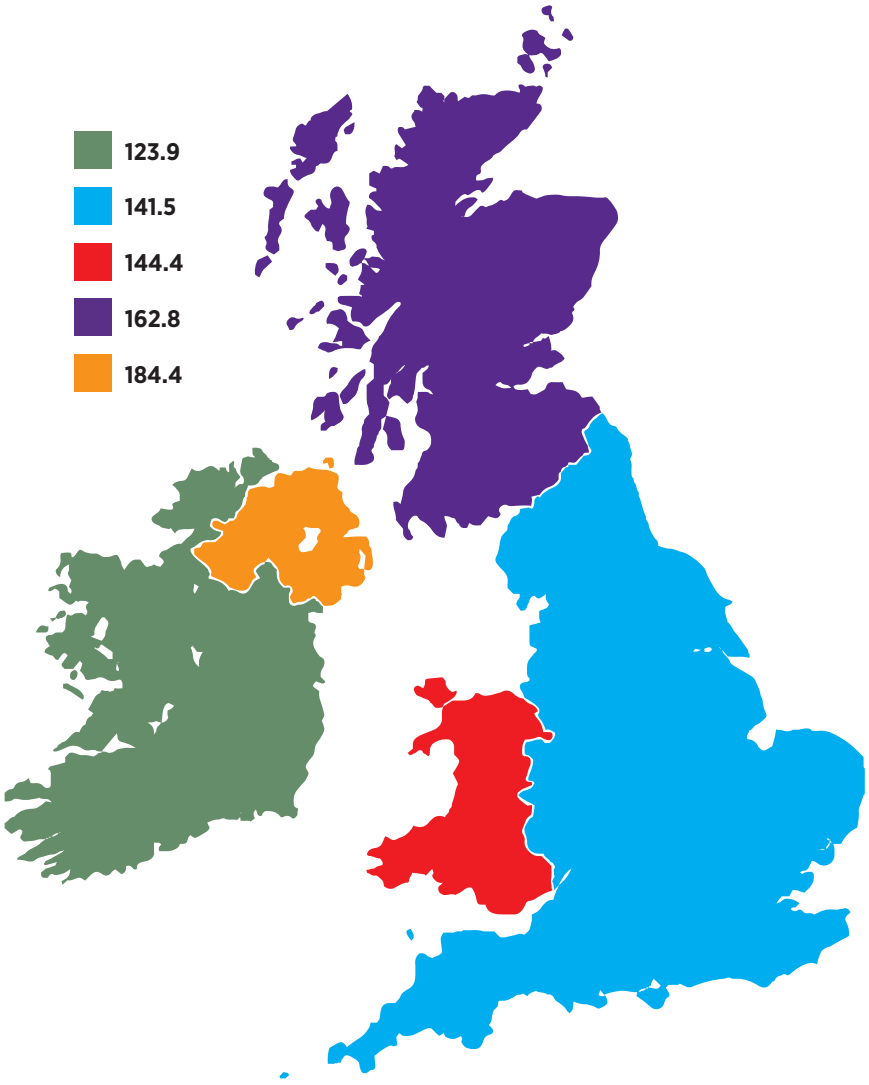


FIGURE 6.1: RATE OF ADMISSIONS PER 100,000 CHILDHOOD POPULATION, 2015–2017

ADMISSIONS TO PARTICIPATING PICUs

Admissions to all participating PICANet PICU in 2017 are presented in Figure 6.2.

OLCHC in Dublin was the third busiest PICU of all participating PICANet Units in terms of the number of children admitted in 2017 (Figure 6.2).

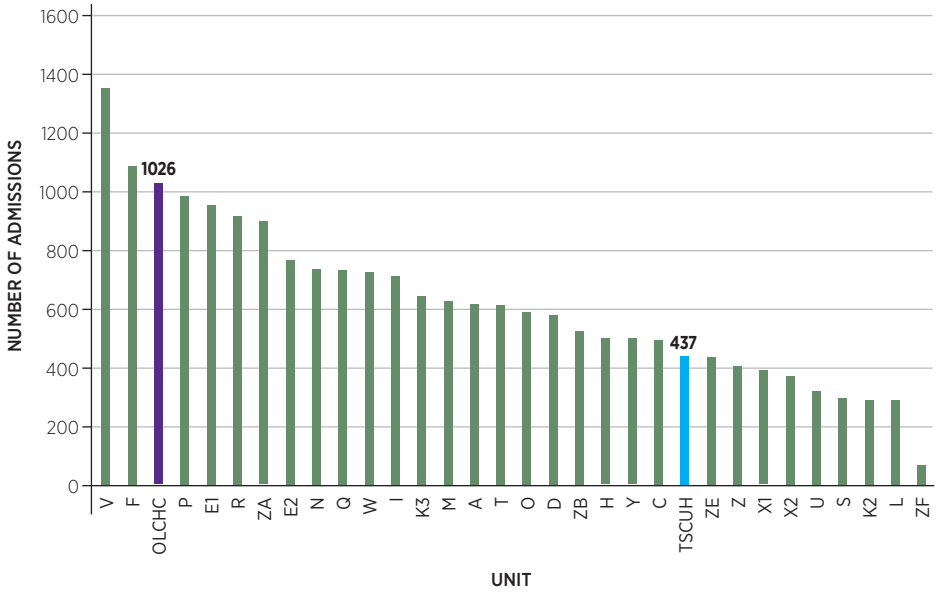


FIGURE 6.2: ADMISSIONS BY PARTICIPATING UNITS, 2017*

* Full hospital names are available within the frequency tables.

ADMISSIONS BY TYPE AND SOURCE

The majority of children who were admitted to the OLCHC and TSCUH PICUs between 2015 and 2017 were 'unplanned – other' (i.e. emergency) admissions (Figure 6.3). In TSCUH, the majority of emergency ('unplanned – other') admissions (64%) came from another hospital, whereas in OLCHC the majority of emergency admissions (59%) were in-patients in the same hospital (Figure 6.4). During this time period, four patients were admitted from both out-patient clinic or home.

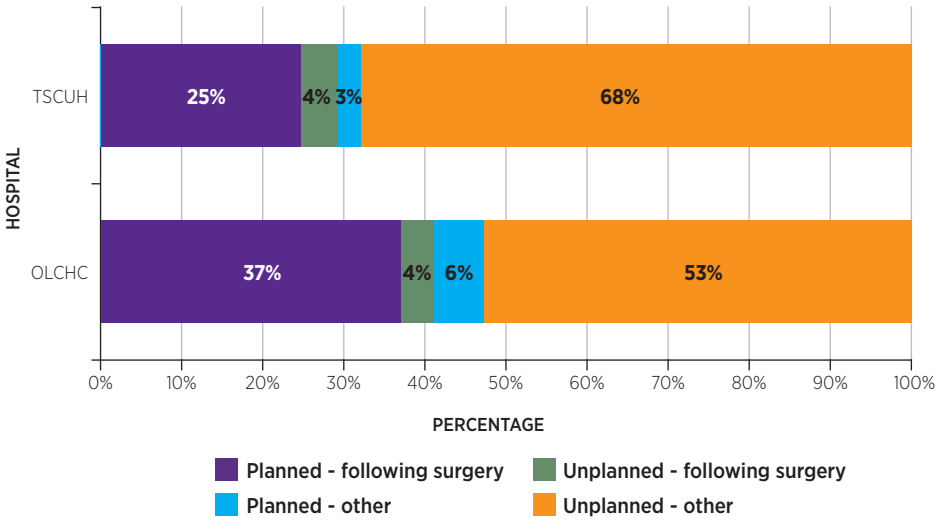


FIGURE 6.3: TYPES OF ADMISSIONS TO PARTICIPATING PICUs IN IRELAND, 2015–2017

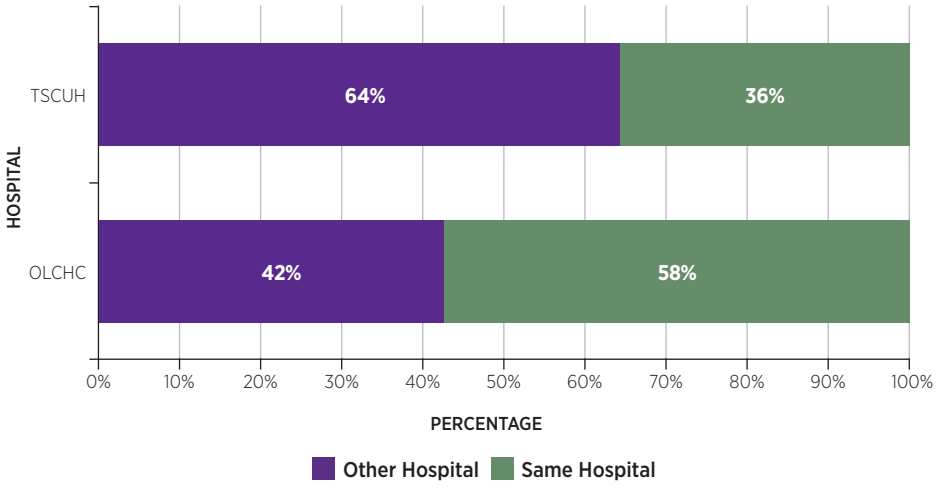


FIGURE 6.4: SOURCE OF 'UNPLANNED – OTHER' ADMISSIONS TO PARTICIPATING IRISH PICUs, 2015–2017

AGE PROFILE OF CHILDREN ADMITTED TO PICUs IN IRELAND

Figure 6.5 presents the age profile of children admitted to both Irish Units. Children under the age of one made up 57% of admissions in to OLCHC and 38% in of admissions to TSCUH. The age profile in the two Units varied considerably in 2017; overall, TSCUH patients were older than OLCHC patients.

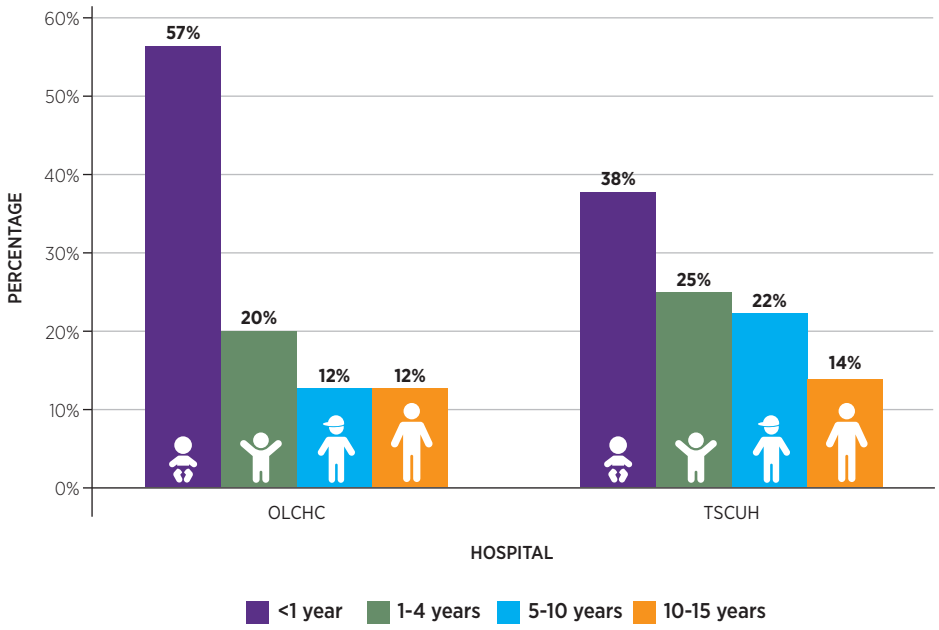


FIGURE 6.5: AGE PROFILE OF ROI PICU CHILDREN, 2017 (N=1463)*

* Please note: Percentages may not sum to 100% due to rounding.
Full hospital names are available within the frequency tables.

The total number of bed days delivered is calculated as the sum of children receiving intensive care in a PICU each day. Figure 6.6 presents total bed days delivered by age group in 2017. Children under the age of one occupied 71% of all PICU bed days in OLCHC and 39% of all PICU bed days in TSCUH.

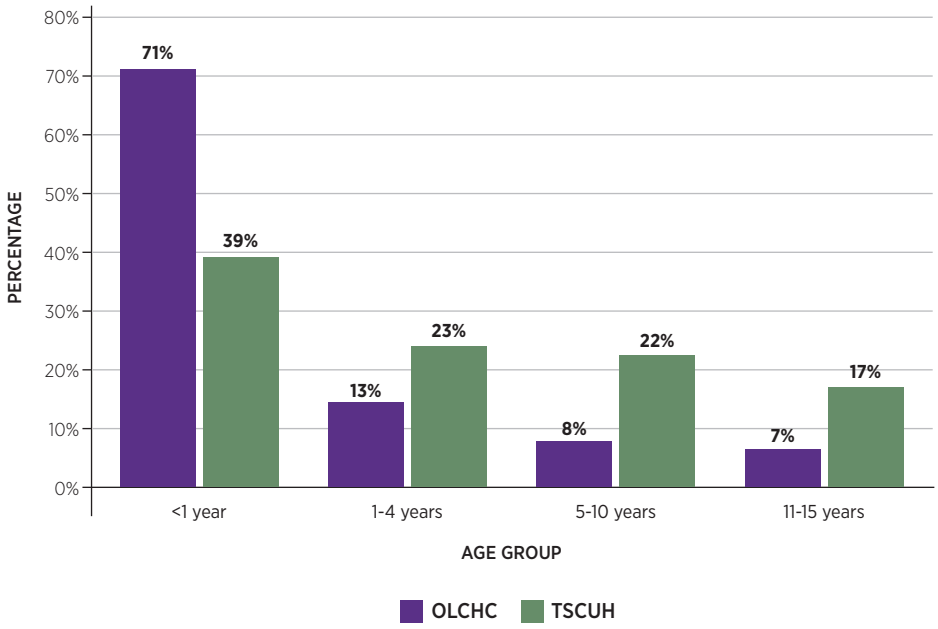


FIGURE 6.6: PERCENTAGE OF BED DAYS DELIVERED BY AGE GROUP, 2017*

* Please note: Percentages may not sum to 100% due to rounding.
Full hospital names are available within the frequency tables.

INTERVENTIONS IN PICUs IN IRELAND

Figure 6.7 illustrates the patient interventions carried out in the PICUs in OLCHC and TSCUH in 2015, 2016 and 2017. More than 60% of children admitted to each PICU underwent invasive ventilation, with a small additional percentage receiving non-invasive ventilation (Figure 6.8). Of the children ventilated, 90% received invasive ventilation across the reporting period (2015–2017).

There was a much greater use of vasoactive medication to support the patient's cardiovascular system in OLCHC. The percentage of patients requiring renal support was broadly similar in both Units.

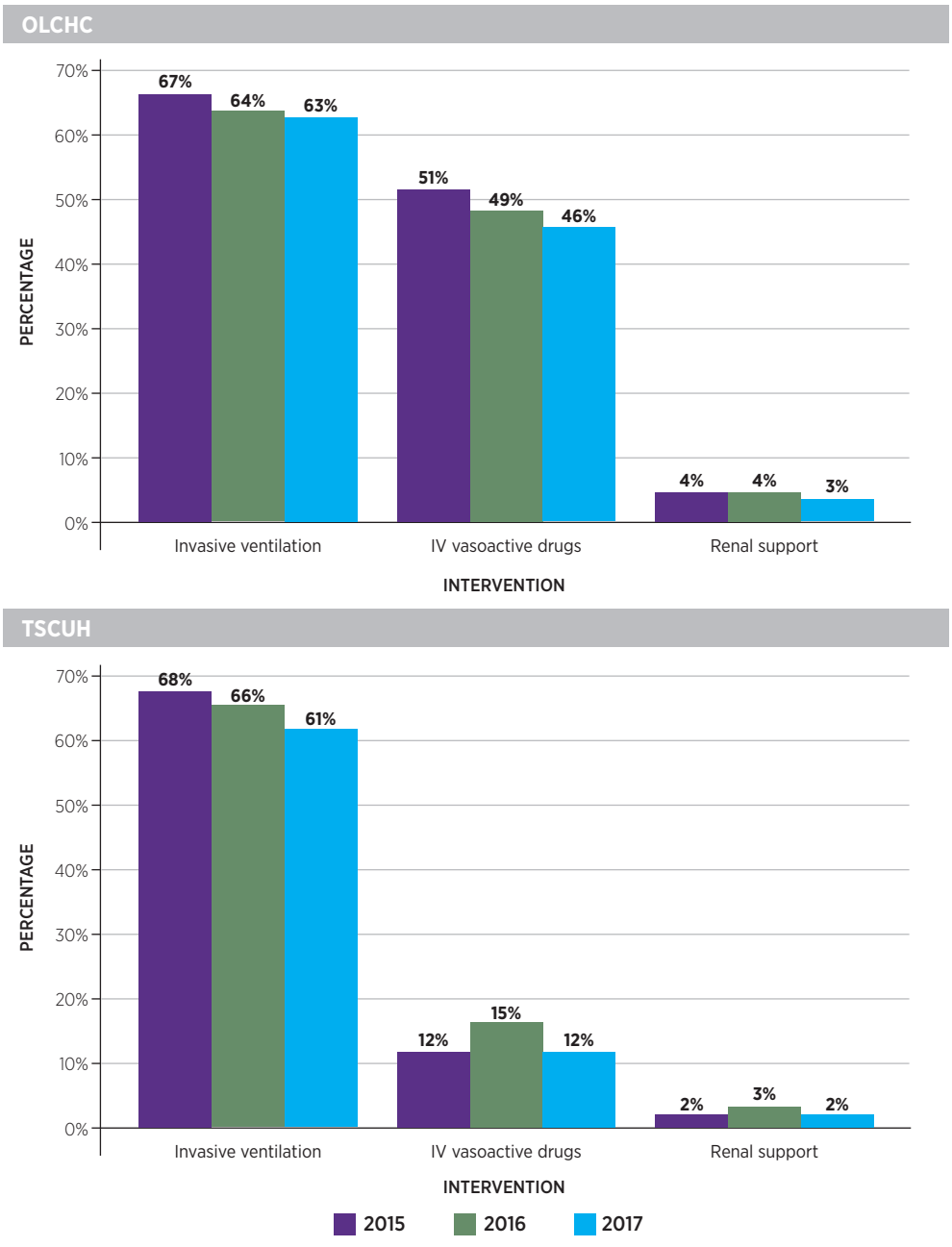
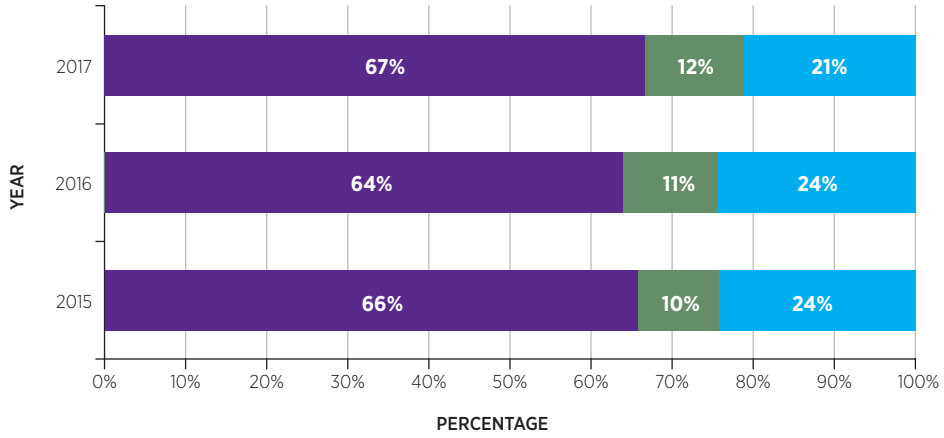


FIGURE 6.7: PERCENTAGE OF INVASIVE VENTILATION, VASOACTIVE DRUGS AND RENAL SUPPORT, 2015–2017*

* Full hospital names are available within the frequency tables.

OLCHC



TSCUH

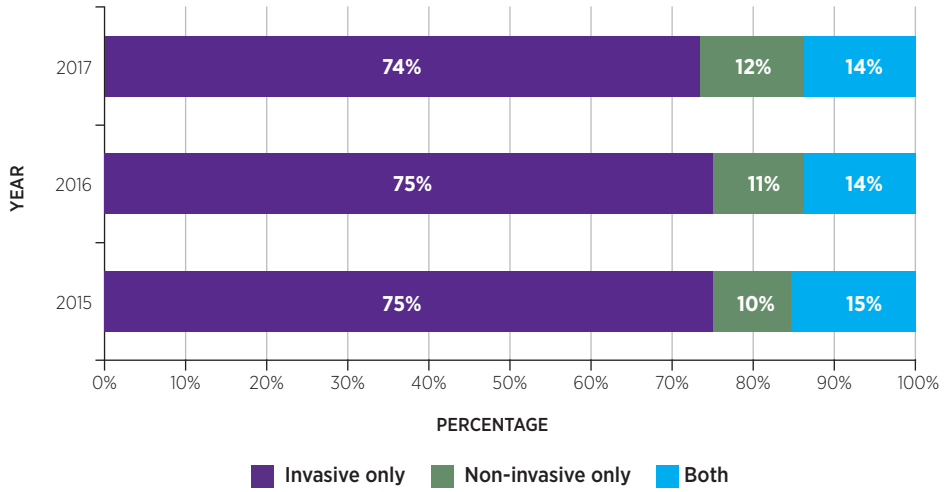


FIGURE 6.8: TYPE OF VENTILATION, 2015–2017*

* Please note: Percentages may not sum to 100% due to rounding.
Full hospital names are available within the frequency tables.

HIGH-FLOW NASAL CANNULA THERAPY

This intervention has been recorded since 2015. Usage is documented for both Irish PICUs in Table 6.5. In 2017, the number of children receiving high-flow oxygen therapy in OLCHC increased to more than 30%. In TSCUH, more than 30% of children received this intervention throughout the reporting period.

TABLE 6.5: ADMISSIONS RECEIVING HIGH-FLOW NASAL CANNULA THERAPY BY PICU, 2015-2017

		OLCHC				TSCUH		
		2015	2016	2017		2015	2016	2017
Number of admissions		214	209	329		149	123	147
Number of days		772	783	1229		386	272	411
Median number of days		9	10	11		7	10	14

LENGTH OF STAY

Length of stay (LOS) is presented in days (median, interquartile range (IQR)) for different age groups, hospitals and years in Table 6.6. Median LOS in 2017 was 2.9 days in OLCHC, compared with 1.9 days in TSCUH. The difference in LOS between the two hospitals was most noticeable for children aged under one year.

TABLE 6.6: LOS BY AGE GROUP, 2015–2017 (MEDIAN, IQR)

YEAR	HOSPITAL	<1 YEAR	1-4 YEARS	5-10 YEARS	11-15 YEARS	ALL AGES
2015	OLCHC	4.3 days (2.0–9.1)	1.9 days (1.0–4.3)	1.7 days (0.8–3.6)	1.9 days (0.9–3.8)	**3 days (1.2–6.9)**
	TSCUH	3.8 days (1.5–7.0)	1.4 days (0.8–3.80)	1.3 days (0.8–3.4)	1 day (0.8–1.8)	**2 days (0.9–5.5)**
2016	OLCHC	4.4 days (2.2–8.4)	1.9 days (0.9–4.8)	1.9 days (0.9–3.8)	1.7 days (0.9–3.1)	**3 days (1.5–6.6)**
	TSCUH	3.2 days (1.0–6.4)	1.6 days (0.7–3.7)	1.3 days (0.7–3.9)	1.4 days (0.8–3.3)	**2 days (0.8–5.8)**
2017	OLCHC	4 days (2.2–8.8)	2.4 days (1.3–4.0)	2 days (1.0–4.3)	1.7 days (0.9–3.9)	**2.9 days (1.7–6.2)**
	TSCUH	2.5 days (1.0–4.7)	1.8 days (0.8–3.9)	1.6 days (0.8–4.0)	1.6 days (0.9–3.9	**1.9 days (0.9–4.2)**

LOS is presented in days (median, IQR) for different diagnoses and hospitals in Table 6.7.

TABLE 6.7: MEDIAN LOS IN PICU BY DIAGNOSIS, 2015–2017

	OLCHC	TSCUH
Blood/lymphatic	5.1 days (1.7–9.9)	2.9 days (1.0–6.0)
Body wall and cavities	9.4 days (3.1–20.9)	4.1 days (1.1–7.0)
Cardiovascular	3.2 days (1.8–6.7)	1 day (0.3–3.0)
Endocrine/metabolic	2.6 days (1.0–5.3)	1.6 days (0.8–2.7)
Gastrointestinal	2.3 days (1.0–5.7)	2.5 days (1.0–6.0)
Infection	4.5 days (2.0–7.9)	3.7 days (1.5–6.0)
Multisystem	4.1 days (1.9–5.3)	14.1 days (5.8–26.8)
Musculoskeletal	0.9 days (0.8–1.8)	1 day (0.9–1.1)
Neurological	2 days (0.9–3.7)	1.7 days (0.8–3.8)
Oncology	2 days (1.0–4.1)	0.9 days (0.8–1.8)
Respiratory	3.7 days (1.7–7.2)	3.2 days (1.2–6.2)
Trauma	2.7 days (0.8–4.8)	0.8 days (0.5–1.8)
Other	1.8 days (0.8–4.1)	1 day (0.7–2.9)
Unknown	7.6 days (7.6–7.6)	0 days (0–0

LOS in PICU is presented for both Irish Units without accounting for case mix variables or predicted risk of mortality. Full LOS information for all participating PICUs is available in the *Paediatric Intensive Care Audit Network Annual Report 2018: Tables and Figures* (Paediatric Intensive Care Audit Network, 2018b). A more detailed look at predicted mortality risk for both OLCHC and TSCUH is presented on page 147 of that document.

UNPLANNED EXTUBATION

Unplanned extubation remains a relatively rare event in PICU. It is the most common adverse event related to airway management in intensive 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 PICU between 2010 and 2013 identified an acceptable threshold rate of unplanned extubations of less than 1 per 100 invasive ventilation days (Kanthimathinathan *et al*., 2015).

Rates of unplanned extubation across all participating PICUs are shown in Figure 6.9. Where the rate was zero, PICUs are excluded. In 2017, across all participating PICUs, there was a recorded annual average rate of 0.4 per 100 intubated days (4 per 1,000 days) of intubation (Paediatric Intensive Care Audit Network, 2018a). For all PICUs except one, the rate of occurrence of unplanned extubation was less than 1 per 100 intubated days, illustrating that this was a rare event in 2017. In 2017, data from OLCHC and TSCUH showed rates of 0.4 and 0.6 per 100 intubated days, respectively.

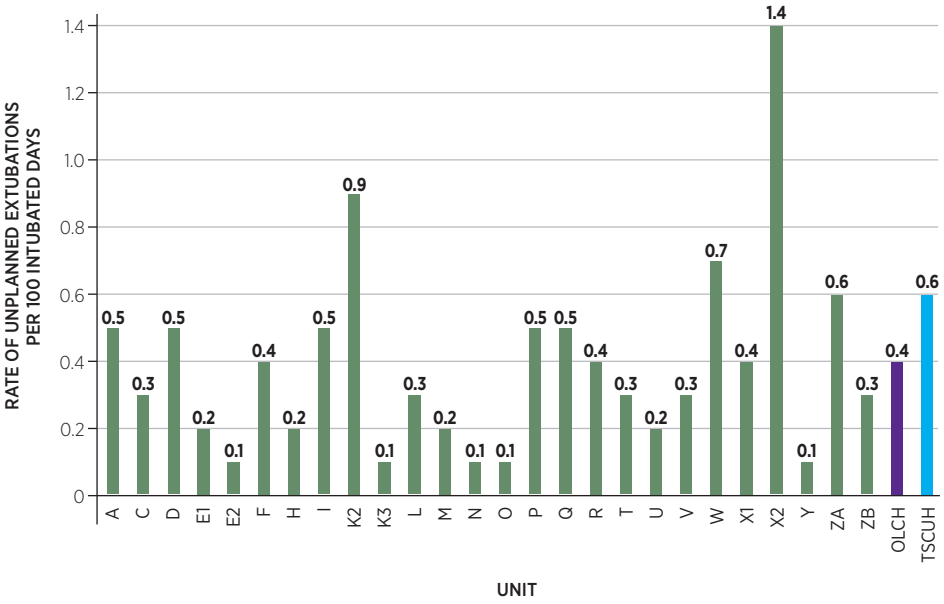


FIGURE 6.9: UNPLANNED EXTUBATIONS AT PARTICIPATING PICUs, 2017*

* Full hospital names are available within the frequency tables.

OLCHC LEARNING FROM PICANET: REDUCING THE RATE OF UNPLANNED EXTUBATION FROM 2015–2017

By continuously monitoring unplanned extubation rates, it was possible to show the effect of a change in practice. Of note, the unplanned extubation rate in OLCHC was higher than average in 2015 and 2016. This was highlighted to OLCHC by PICANet, which warned that the rate was above the acceptable range. As a result, a number of measures were instituted, i.e. bedside teaching, evaluation of endotracheal (ET) taping, and a change in practice when re-taping was complete. This resulted in a reduction in the number of unplanned extubations.

Dr Martina Healy, Clinical Lead for PICANet, OLCHC

TSCUH LEARNING FROM PICANET: UNPLANNED EXTUBATION IN 2017

During 2017, event surveillance identified an unexpected exponential increase in unplanned extubation in TSCUH. We quickly undertook a root cause analysis of each event. In this review, a new cohort of patients – those with spinal muscular atrophy (SMA type 1 and 2) who were undergoing nusinersen drug therapy – that was over-represented in the unplanned extubation numbers. This represented a previously unrecognised risk factor for unplanned extubation that was unique to this patient population. Following this review, targeted awareness and education were undertaken in order to address the problem. This showed the value of surveillance and audit.

Dr Dermot Doherty, Clinical Lead for PICANet, TSCUH

QUALITY METRICS

Information is presented for five key PICANet metrics: case ascertainment, retrieval mobilisation times, number of qualified nurses per bed, emergency readmissions within 48 hours, and mortality in PICUs.

Metric 1: Case ascertainment and timeliness of data submission

Two dimensions of data quality are reported for this metric: completeness and timeliness of submission.

- Completeness is a measure of the number of admissions captured on PICANet as a proportion of all PICU admissions. This dimension of data quality is referred to as coverage by the Health Information and Quality Authority (2018). This is presented for each participating PICU in Figure 6.10.
- Timeliness of submission refers to whether data are submitted to PICANet within three months of discharge. This is presented in Figure 6.11 for participating PICUs in the ROI.

Accurate, timely, comprehensive data support the appropriate and reliable interpretation of, and decision-making on, care provided in PICUs in Ireland. Overall data completeness in both ROI Units was high in the reporting period (Figure 6.10); both Units had a completion rate of almost 100%. However, timeliness of submissions could be improved, as illustrated in Figure 6.11.

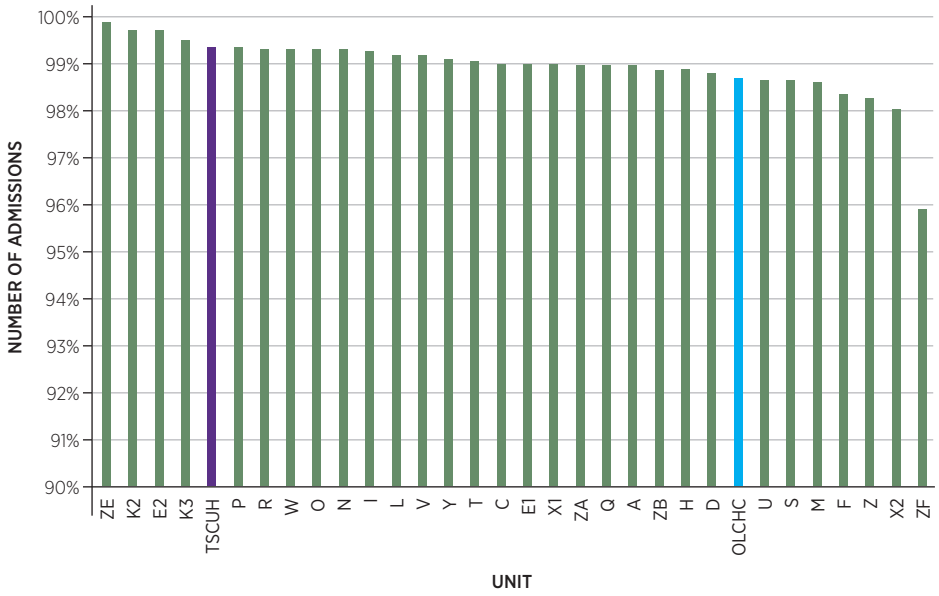


FIGURE 6.10: DATA COMPLETENESS BY PARTICIPATING PICUs, 2015–2017*

* Full hospital names are available within the frequency tables.

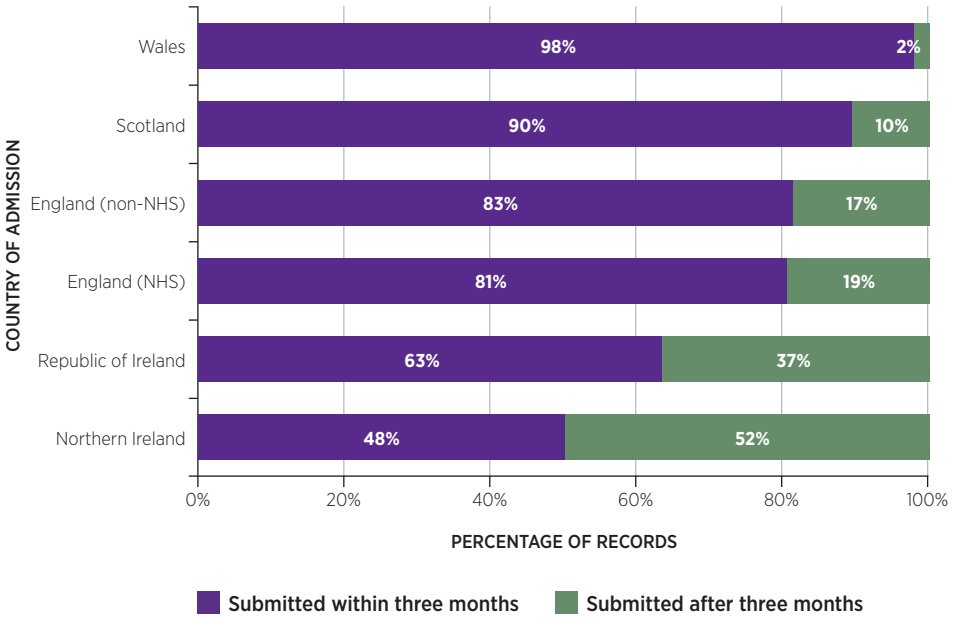


FIGURE 6.11: TIMELINESS OF DATA SUBMISSION, 2015–2017*

* Please note: Percentages may not sum to 100% due to rounding.
Full hospital names are available within the frequency tables.

Metric 2: Retrieval mobilisation times

Children commonly need to be transported to a PICU in a paediatric hospital for urgent care (non-elective transports). Retrieval of paediatric patients is carried out by the Irish Paediatric Acute Transport Service (IPATS). Table 6.8 presents the number of paediatric transfers planned and undertaken annually in the period 2015–2017. Transport of a child may be elective or non-elective (i.e. urgent). During the period 2015–2017, 284 transports of children (90%) were non-elective (urgent).

Each year, a number of planned transports were not carried out. This can occur either when a child's condition improves so that transport is not required, or when a child deteriorates so that transport is no longer appropriate or safe. On some occasions, the reason for transports not being carried out is not known.

TABLE 6.8: IRELAND: ELECTIVE AND NON-ELECTIVE TRANSPORT, 2015–2017

	Total	Non-elective	Elective	Transported	Not transported
2015	95	78	17	88	7
2016	115	106	9	108	7
2017	105	100	5	99	6

Once a CST team has agreed to transport a child, the UK Care Quality Commission recommends that the journey is commenced within one hour (Paediatric Intensive Care Audit Network, 2018a). This is not a formal target in Ireland, and the IPATS team and National Ambulance Service are not currently resourced to achieve this recommendation. Nonetheless, Figure 6.12 illustrates that while journey commencement in less than one hour was achieved in only about 40% of cases in 2015 and 2016, there was a clear improvement to about 70% in 2017.

The IPATS patient data document all patients transferred by a CTS team, irrespective of the patients' acuity needs. This metric includes both urgent and elective patient transports and does not differentiate patients in whom a rapid retrieval is indicated. A specific metric for this will be developed by the National Ambulance Service Critical Care Retrieval Services (NAS-CCRS) in 2019.

Current resourcing for IPATS precludes more rapid response times, and the service is limited to weekdays during daytime only. Yet it has been acknowledged that a delay in providing paediatric intensive care transfer services could put a sick child at risk, as the referring hospital may not have the resources to care for or safely transfer a critically ill child. It is the intention of IPATS to expand services in order to meet patient need in a more comprehensive manner. When the service has been adequately funded and fully staffed, these PICANet metrics will become more appropriate.

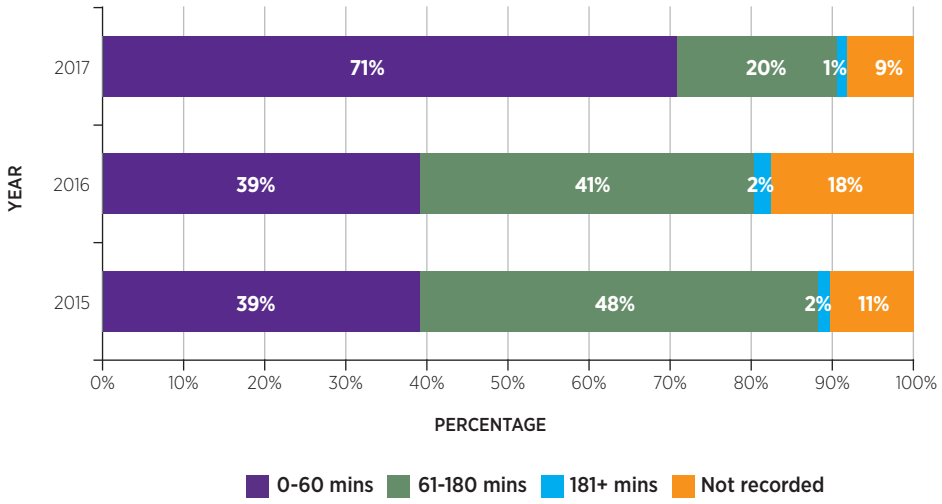


FIGURE 6.12: TIME TAKEN FOR MOBILISATION OF SPECIALIST PAEDIATRIC TRANSPORT TEAM, 2015–2017

Metric 3: Number of qualified nurses per bed

In November of each year, PICUs are asked to record how many qualified nursing staff are employed in their Unit: both their establishment (i.e. total funded posts) and any vacant posts. Currently, the UK Paediatric Intensive Care Society (PICS) *Quality Standards for the Care of Critically Ill Children, 5th Edition* (2015) recommends that 7.01 whole time equivalent (WTE) qualified nurses are required in order to staff one Level 3 critical care bed. This has increased from a previous recommendation of 6.4 WTE qualified nurses endorsed in earlier *PICS standards 2010.*

Figure 6.13 shows that for participating PICUs in the UK and the ROI, few Units met either of the PICS standards in 2017: three (9%) PICUs achieved 7.01 WTEs per bed and seven (21%) PICUs met the previous standard of 6.4 WTEs.

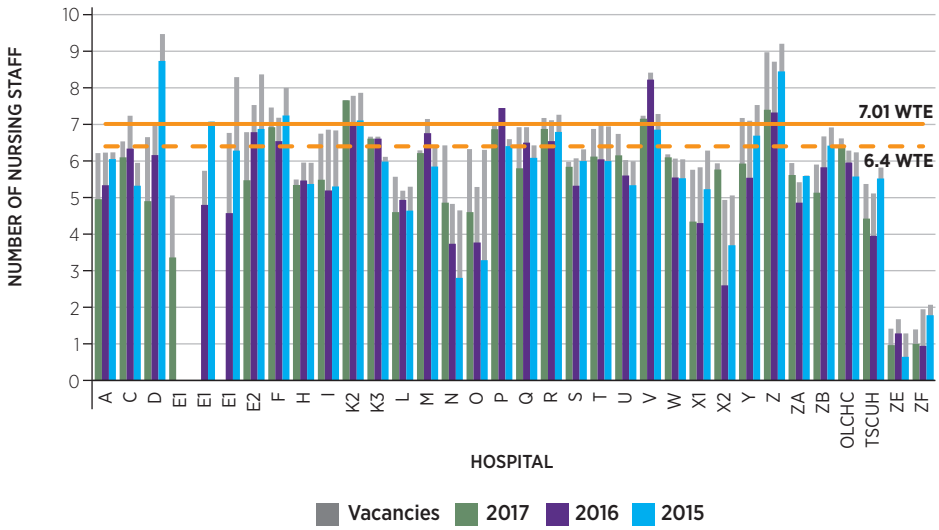


FIGURE 6.13: NUMBER OF CLINICALLY QUALIFIED NURSING STAFF IN POST (WTEs) PER BED BY HEALTH ORGANISATION, NOVEMBER 2015– NOVEMBER 2017*

There is a difference between the ROI and the UK in the way recommended levels of nurse staffing per ICU bed are calculated. The UK recommendation of 7.01 WTEs per ICU bed includes the aggregated number of nurses providing direct one-to-one patient care, as well as the number of clinical nurse managers in charge on each work shift, and the overall number of PICU nurse managers and clinical facilitators or nurse educators (Paediatric Intensive Care Society, 2015).

In 2012 in the ROI, the number of nursing staff required to open an additional Level 3 bed in ICU was defined as 5.8 WTEs (HSE Office of the Nursing and Midwifery Services Director recommendation to HSE Critical Care Programme, 8 August 2012, Dr Michael Shannon, personal communication). This recommended level of staffing was reduced to 5.6 WTEs to open a Level 3 ICU bed following the implementation of the Haddington Road Agreement which increased the working week for nurses to 39 hours (Labour Relations Commission, 2013).

The ROI standard of 5.6 WTE nurses includes the numbers required for 1:1 direct patient care only and does not include shift leaders or those involved in management or nurse education, which are integral aspects of a quality nursing service focused on delivering patient-centred care. If these are added into the numbers of nurses required for 1:1 care, the total numbers will approximate the recommendations for the UK.

There are currently no data relating to medical staffing in the ROI. In the ROI, trainee staff work 24-hour shifts and consultant cover is not in compliance with PICS standards (2015).

* Full hospital names are available within the frequency tables.

Metric 4: Emergency readmissions within 48 hours

Emergency readmissions within 48 hours of discharge from PICU are identified and compared with the average emergency readmission rate in all PICUs participating in PICANet. Emergency readmission within 48 hours may mean that a child was discharged too early or into the wrong care environment, or that the need for future intensive care was not foreseen. These issues should be explored and assessed at local hospital level.

There is no standard acceptable rate of emergency readmissions within 48 hours to PICU, so the average (mean) for all PICUs participating in PICANet was used. A funnel plot was then used to assess if any PICU had a higher rate than expected, based on the ratio of observed to expected numbers of readmissions. In the reporting period 2015–2017, no PICU had a higher rate than expected and both OLCHC and TSCUH were clearly within the control limits for this indicator (Figure 6.14). Low readmission rates are generally accepted as an indicator of good quality of care.

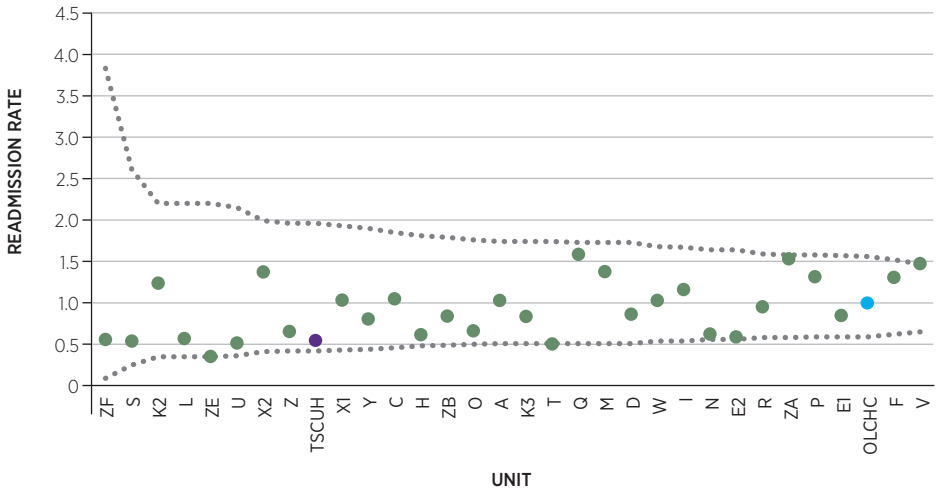


FIGURE 6.14: RELATIVE 48-HOUR EMERGENCY READMISSION RATE BY PARTICIPATING PICUs, 2015–2017*

* Full hospital names are available within the frequency tables.

Metric 5: Mortality in PICUs

PAEDIATRIC INDEX OF MORTALITY

The Paediatric Index of Mortality (PIM) model was developed to assess a child's risk of death in PICU based on data collected within the first hour following admission. This was updated (PIM3) in 2013 in order to improve the accuracy of the estimated risk of mortality in children admitted to intensive care in the UK, Ireland, Australia, and New Zealand. This risk adjustment is based on variables which include 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 risk of mortality is presented in a scoring system in categories of risk, ranging from <1% to 30%+.

The number of children admitted to PICU in both OLCHC and TSCUH in 2015, 2016 and 2017 is presented in PIM3 categories (Table 6.9). Complete PIM3 data for all participating PICUs are available in the *Paediatric Intensive Care Audit Network Annual Report 2018: Tables and Figures* (Paediatric Intensive Care Audit Network, 2018b).

TABLE 6.9: ADMISSIONS BY PREDICTED MORTALITY RISK GROUP BY HOSPITAL, 2015–2017

	<1%		**<1%-<5%**		**5%-<15%**		**15%-<30%**		**30%+**		**Total**
	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	N
2015											
OLCHC	373	(39.6)	366	(38.9)	139	(14.8)	42	(4.5)	22	(2.3)	942
TSCUH	176	(38.7)	185	(40.7)	65	(14.3)	19	(4.2)	10	(2.2)	455
2016											
OLCHC	352	(34.1)	458	(44.4)	157	(15.2)	43	(4.2)	21	(2.0)	1031
TSCUH	157	(42.4)	161	(43.5)	40	(10.8)	8	(2.2)	4	(1.1)	370
2017											
OLCHC	384	(37.4)	467	(45.5)	140	(13.6)	21	(2.0)	14	(1.4)	1026
TSCUH	204	(46.7)	166	(38.0)	47	(10.8)	11	(2.5)	9	(2.1)	437

STANDARDISED MORTALITY RATIO

Mortality rates are assessed for every PICU based on a statistical approach which 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 to the number who actually die in order to derive the risk-adjusted standardised mortality ratio (SMR) (Paediatric Intensive Care Audit Network, 2018a).

The risk-adjusted SMR for each PICU in the UK and the ROI is displayed in a funnel plot (plotted against the number of admissions) for the period 2015–2017 (Figure 6.15). In this reporting period, no PICU had a mortality rate higher than expected. Both OLCHC and TSCUH were clearly within the acceptable range for mortality.

Risk-adjusted mortality is an important high-level QI. 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.

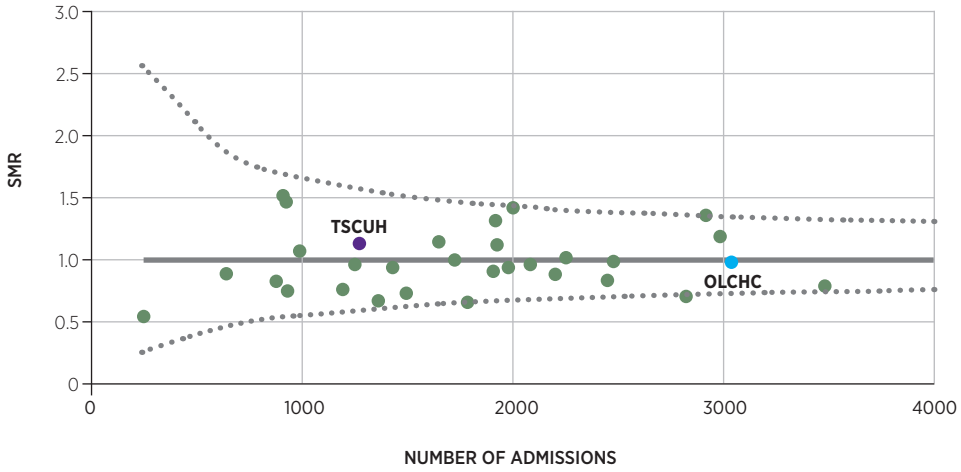


FIGURE 6.15: RISK-ADJUSTED SMR BY PARTICIPATING PICU, 2015–2017*

* Full hospital names are available within the frequency tables.

FINDINGS: PAEDIATRIC ICUs

- The number of bed days delivered in the ROI was approximately 10,000 annually from 2015–2017. Children under the age of one made up 57% of admissions to Our Lady's Children's Hospital, Crumlin (OLCHC) and 38% of admissions to Temple Street Children's University Hospital (TSCUH).

- Bed occupancy in both Irish paediatric ICUs (PICUs) was high in 2017 (97% in OLCHC and 86% in TSCUH). These are above the recommended levels for safe patient care and are likely to make staff retention more difficult.

- Quality metrics such as risk-adjusted mortality and emergency readmissions in both PICUs were within the expected range. These findings show that PICUs were safe places in the ROI in 2017.

- Clinical audit is a tool for improvement in patient care. In this report, both PICUs have shared their experiences of learning from previous PICANet Annual Reports to improve their prevention of unplanned extubation.

- There was an improvement in journey commencement times in 2017 for the Irish Paediatric Acute Transport Service (IPATS). Transfer commencement times of less than one hour increased from about 40% in 2015 and 2016 to around 70% in 2017. However, IPATS only operates on weekdays during the daytime, leaving a major gap in service provision outside of normal working hours.

- There was considerable variability in nursing staffing levels between participating Units in the PICANet Annual Report 2018. There were also considerable numbers of nursing vacancies in both OLCHC and TSCUH.

RECOMMENDATIONS: PAEDIATRIC ICUs

FOR THE HSE

1. The paediatric hospitals should increase bed capacity in PICUs as evidenced by the 94% bed occupancy across both Units in 2017. Increased bed capacity could be achieved by retention and recruitment of staff in order to open all available ICU capacity (31 beds), avoiding the need for an increase in structural bed capacity.

2. The HSE should prioritise the expansion of IPATS to a 24 hour / 7 day centralised transport service (CTS) in order to ensure safe transfer of all children to specialist PICU care in a timely manner; this requires investment in recruitment and retention of nurses and doctors.

FOR NOCA

3. Prioritise a national database for audit of adult ICUs, which will facilitate data collection and reporting on all children who are cared for in adult critical care. This information is critical to the health service for future planning of paediatric bed capacity and transport services.

4. Consider developing a dataset for rates of medical staffing per ICU bed for Ireland in consultation with PICANet. .

CONCLUSION

Both the OLCHC and TSCUH specialist PICUs in the ROI have contributed to PICANet since 2010, with governance from NOCA since 2015. PICANet has presented information on both PICUs since 2010, which has been available on the PICANet website (https://www.picanet.org.uk/annual-reporting-and-publications/). With the publication of a first report from the National ICU Audit, data and information from PICANet are included in order to present a fuller picture of critical care in Ireland. This chapter provided background information and methodology from PICANet as well as clinical audit findings.

The participation of OLCHC and TSCUH in PICANet enables comparison of data between PICUs across the island of Ireland as well as with PICUs in England, Scotland and Wales. With shared services across the island of Ireland, such as recent announcements that all emergency and urgent paediatric cardiac surgery will take place in OLCHC, comparison can only take place if the same standards and processes are in place. This report highlighted key differences in some healthcare standards supporting quality of access to care, such as levels of nurse staffing per PICU bed and availability of a CTS, as well as a recommendation to develop a short dataset on medical staffing for the ROI.

CHAPTER 7

LOCAL QUALITY INITIATIVES

CHAPTER 7: **LOCAL QUALITY INITIATIVES**

CATHETER-RELATED BLOODSTREAM INFECTION

Catheter-related bloodstream infection (CRBSI) is an important and commonly used measure of outcomes and of quality of care in critical care. Infection of a central venous catheter (CVC) is a serious complication that increases Unit and hospital LOS, mortality (by 15%) (Brady *et al.*, 2017), and hospital cost. CRBSI is preventable through simple and inexpensive improvements in clinical practice. Thus, CRBSI is an ideal metric for inclusion in clinical audit.

There is an extensive dataset within the INICUA dataset on bloodstream infection (BSI) in ICU. Infection must have been confirmed and the source of infection assigned at a multidisciplinary team (MDT) meeting in order to be included in the database.

Some participating Units are already submitting these data to the Intensive Care National Audit and Research Centre (ICNARC) and the remainder are working towards setting up this MDT structure for ICU infection surveillance. CRBSI rates are calculated as the number of MDT-confirmed infections per 1,000 CVC line days (Royal College of Physicians of Ireland, 2014). This metric can be reported by NOCA once the Irish National ICU Audit database is in place.

CRBSI is already commonly measured by Units in Ireland. Four of these Units have provided us with their data on CRBSI from 2017 (Figures 7.1–73 and Table 7.1).

CRBSI data in Figures 7.1–7.3 and Table 7.1 show good outcomes in terms of the rates of CVC infections, which are well within acceptable limits for all four Units. This is a very positive finding and shows good practice in terms of infection prevention measures in both the insertion and maintenance of CVCs.

Ideally, we would like to be able to benchmark data on CRBSI rates between different Units in Ireland. However, even in the small number of examples shown, there is considerable variability between Units in the methodology and terminology used. The figures show that different Units use different diagnostic criteria for CRBSI (Hospitals in Europe link for infection control through surveillance (HELICS) or Centers for disease control and prevention (CDC), different terminology, and different denominators to calculate the rates of infection.

NOCA hopes to roll out a standardised system for auditing CRBSI over 2019 which will allow implementation of a national audit of CRBSI.

BEAUMONT HOSPITAL GENERAL ICU CRBSI, 2017

There were two CVC-related BSIs in Beaumont Hospital General ICU (GICU) in 2017, four in 2016, one in 2015 and one in 2014. Figure 7.1 displays the Unit's annual rates of CVC-related BSI from 2011 to 2017. Both lines had been inserted in Beaumont Hospital GICU in 2017, with a completed insertion checklist available for one (50%), and both had up-to-date maintenance care bundle records. In 2017, Beaumont Hospital GICU observed a reduction in the annual CVC-related BSI rate to 1.0 per 1,000 CVC patient days (versus 2.5 in 2016).

Prior to the first recorded CVC-related BSI of 2017 (14 March 2017), there had been an interval of 230 days without a CVC-related BSI in Beaumont Hospital GICU (the last having been recorded on 27 July 2016). In 2017 alone, the longest interval without a CVC-related BSI in Beaumont Hospital GICU was 147 days, between March and August. There were no cases of peripheral venous catheter (PVC)-related BSI detected in Beaumont Hospital GICU during 2017, with 1,162 days since the last case in 2014.

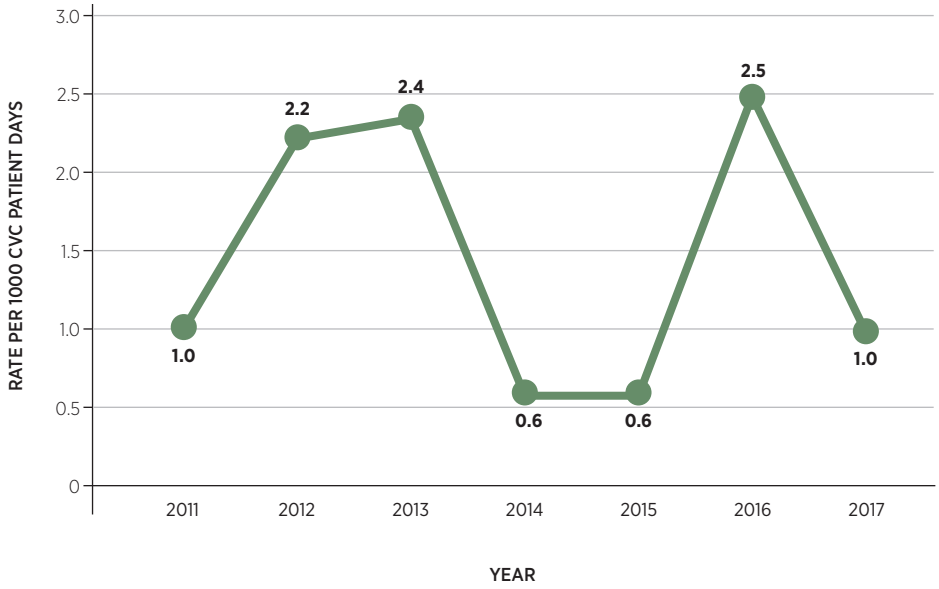


FIGURE 7.1: ANNUAL CVC-RELATED BSI RATE AT BEAUMONT HOSPITAL GICU, JULY 2011–2017[13]

[13] Data on the total daily number of CVCs in situ were not collected; the daily number of patients with a CVC in situ was used instead.

BEAUMONT HOSPITAL RICHMOND ICU (NEURO) CRBSI, 2017

Figure 7.2 displays annual rates of CVC-related BSI expressed per 1,000 CVC patient days. The longest interval during 2017 without a CVC-associated BSI in Beaumont Hospital Richmond ICU (Neuro) was 153 days between mid-March and mid-August. There were two vascular catheter-related BSIs in this Unit during 2017: one case of *Klebsiella* spp. BSI arising three days post insertion of a femoral CVC in theatre without documented insertion checklist, and one case of viridans streptococci BSI arising 24 days post insertion of a peripherally inserted central catheter (PICC) with a completed insertion checklist; for both lines, maintenance care bundles were up to date. A root cause analysis was conducted, with any issues identified and communicated.

There have been no cases of PVC-related BSI detected in Beaumont Hospital Richmond ICU (Neuro) since surveillance began in 2011.

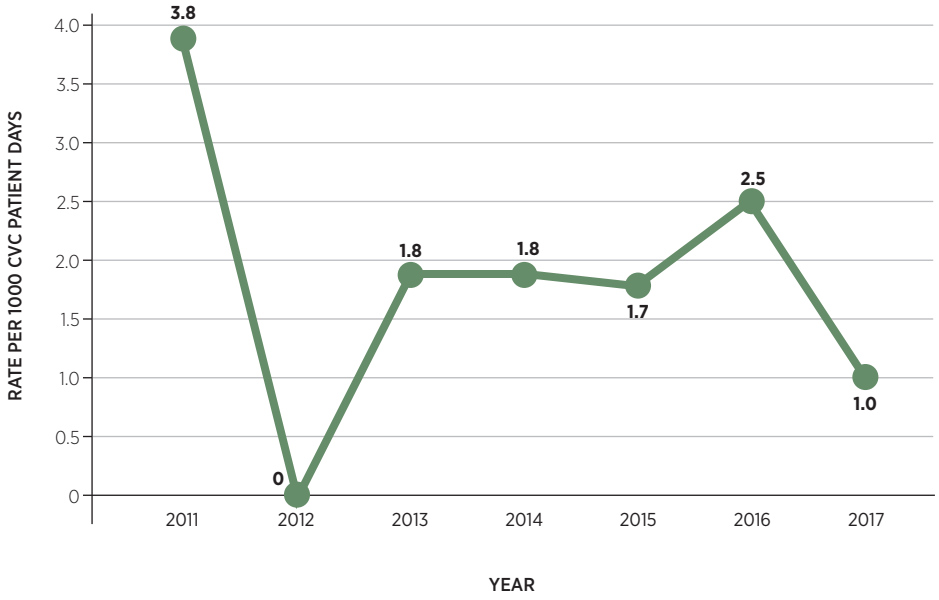


FIGURE 7.2: ANNUAL CVC-RELATED BSI RATE AT BEAUMONT HOSPITAL RICHMOND ICU (NEURO), JULY 2011–2017[14]

[14] Data on the total daily number of CVCs in situ were not collected; the daily number of patients with a CVC in situ was used instead.

UNIVERSITY HOSPITAL GALWAY ICU CRBSI, 2017

Table 7.1 shows documented cases of central line-associated BSI (CLABSI) at University Hospital Galway ICU in 2017, and includes information for 2015 and 2016. These data were obtained from the Clinical Lead for ICU at that Unit following local surveillance process.

TABLE 7.1: UNIVERSITY HOSPITAL GALWAY ICU CRBSI, 2017

	Number of unit-acquired CVC line Infections Critical Care Unit			CLABSI per 1,000 CVC line days Critical Care Unit		
	2015	**2016**	**2017**	**2015**	**2016**	**2017**
JAN	1	0	0	Q1	Q1	Q1
FEB	1	0	0	6.4	0	0
MAR	2	0	0			
APR	0	1	0	Q2	Q2	Q2
MAY	0	0	0	0	1.7	1.9
JUNE	0	0	1			
JULY	2	1	0	Q3	Q3	Q3
AUG	0	0	1	4.2	6.3	1.5
SEPT	0	3	0			
OCT	0	0	0	Q4	Q4	Q4
NOV	0	1	0	1.8	1.7	1.7
DEC	1	0	1			

ST JAMES'S HOSPITAL ICU CRBSI, 2017

Figure 7.3 shows documented cases of CRBSI at St James's Hospital ICU and HDU in 2017. The report includes information for the full year for 2017 and was obtained from the Clinical Lead for ICU at that Unit following local surveillance process.

CVAD Infection Surveillance in ICU & HDUSPD Q4 2017

	No. CVAD infections	Catheter Days	Infection Rate per 1000 catheter days	
Q1	2	1441	1.4	*S. epidermidis, S. hominis*
Q2	1	1368	0.7	*S. epidermidis*
Q3	2	1478	1.4	*S. hominis, C. parapsilosis*
Q4	2	1435	1.4	*S. hominis, S. epidermidis, E. aerogenes*
Year	7	5722	1.22	

Definitions:

Catheter day:
A day when a patient is exposed to one or more catheters.

Device Utilization Ratio:
Catheter days divided by Patient days. Indicates the overall usage risk of CVAD and so quantifies the of CVAD infection.

Guide to data interpretation

Quarterly rates are constructed from small numbers and so inherently contain a large amount of variation.

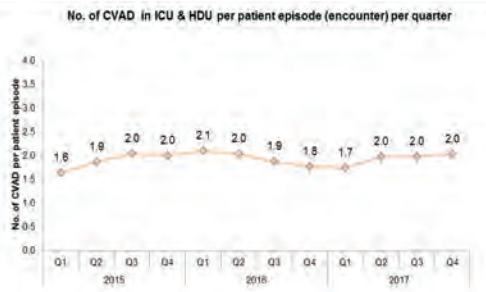
Variation is a normal phenomenon associated with all measurements.

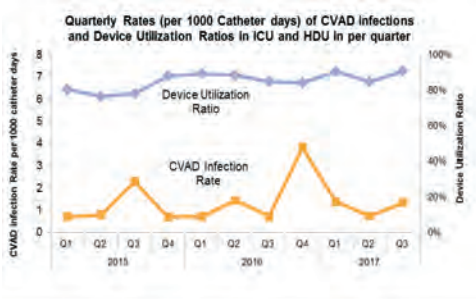
A clearer picture of trend can be seen when quarters are combined to give yearly rates. See graph bottom right.

Clinical Unit	Total CVAD	Total Patients with CVAD
ICU & HDU	383	209

Points to note:

- There were TWO CVAD infections in ICU/HDU for Q4 2017.
- The annual rate displays normal levels of variation over the seven years displayed . The annual Device utilization ratio has increased over the last three years.
- The number of CVAD per patient episode remains at 2.0 in Q4 (See graph showing No. of CVAD per patient episode per quarter)
- The Device utilization ratio (see bottom left graph) indicates the overall level of usage of CVAD and can be used to quantify the level of CVAD infection risk. It has been at more than 80% for eight consecutive quarters.





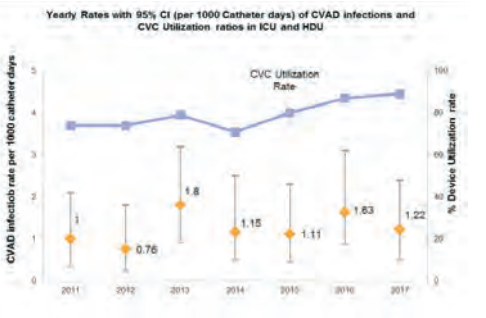


FIGURE 7.3: ST JAMES'S HOSPITAL ICU CRBSI, 2017

CHAPTER 8
CONCLUSION

CHAPTER 8: **CONCLUSION**

This report contains information from two significant audits of critical care in Ireland: adult and paediatric. These two audits provide an overview of critical care in Ireland, encompassing adult Units, specialised Units (e.g. cardiothoracic and neurosurgery), and paediatric Units.

Producing this report allows comparisons between Critical Care Units across Ireland as well as with those in the UK. This enables each Unit to benchmark its activity and outcomes and presents a fuller picture of critical care in Ireland, reported nationally for the first time. The report shows that the Audit data have already supported local improvements within Units. The overall picture is that critical care in Ireland is safe and comparable to international standards.

> ***"The anaesthetist said, 'You are very ill and your lungs need a break'. She held my hand and I just thought, 'You know what, take me wherever I have to go and do whatever you have to do; this is fine because I trust you'. She seemed to be really in control, 'We have you now'."***
>
> ***Barbara***

Contained in this report are key recommendations to inform changes to critical care in Ireland. Consideration of how these recommendations are implemented is vital in order to ensure that any changes to structures and procedures in critical care, both nationally and locally, do not negatively impact on existing practices, structures and networks. This is crucial, as the findings in this report indicate good outcomes despite existing pressures on Critical Care Units in Ireland. Under the governance structures provided by NOCA, these two audits from adult and paediatric will continue to report the processes and outcomes of critical care in Ireland.

The project is still some distance from achieving full national coverage. The inclusion of the remaining adult Irish Units in future reports will provide a more complete picture in order to inform better patient care. Additional analyses will improve the insights to be gained from the large dataset that is being collected. Future reports will benefit from input from those who read this report, both from their differing interpretations of the data presented and from their suggestions for different analyses.

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APPENDICES

APPENDIX 1: GOVERNANCE OF INICUA AND PICANet, 2017

NATIONAL ICU AUDIT GOVERNANCE COMMITTEE ATTENDANCE AT MEETINGS, 2017

Organisation	Name	25 Jan 2017	5 April 2017	4 Oct 2017	6 Dec 2017
NOCA Clinical Lead ICU Audit	Dr Rory Dwyer	✓	✓	✓	✓
National Lead for Paediatric Audit	Dr Martina Healy	✓	✓	✗	✗
Intensive Care Society of Ireland	Dr Catherine Motherway	✓	✗	✓	✓
Joint Faculty of Intensive Care Medicine of Ireland	Dr Jeanne Moriarty	✓	✓	✓	✓
College of Anaesthesiologists of Ireland	Dr Kevin Carson	✗	✓	✗	✗
Royal College of Surgeons in Ireland	Dr Chris Collins	✓	✓	✗	✓
ICU Audit Coordinator Representative	Ms Una Folan	✓	✓	Resigned	N/A
Office of the Nursing and Midwifery Services Director, HSE	Mr Derek Cribbin	✗	✓	✓	✓
Royal College of Physicians of Ireland	Dr Cora McNally	✗	✗	Resigned	N/A
Public/Patient Interest Representative	Ms Deirdre Donnellan	✓	✓	✗	Resigned
Irish Association of Directors of Nursing and Midwifery (Senior Accountable Healthcare Manager)	Ms Eileen Whelan	✓	✓	✓	✗
HSE Critical Care Programme	Dr Michael Power	✓	✓	✓	✗
National ICU Audit Manager	Ms Mary Baggot	✓	✓	✓	✓
NOCA Executive Director	Ms Collette Tully	✓	✓	✓	✓

APPENDIX 2: LOCAL HOSPITAL GOVERNANCE COMMITTEE

This guidance can be applied to any Hospital Clinical Audit Committee that is involved in overseeing the local operation of a national audit under the auspices of NOCA. In some hospitals, it may be appropriate that a single Clinical Audit Committee provides oversight to a number of clinical audits.

Role and remit of the Clinical Audit Committee

The Clinical Audit Committee should provide governance for the clinical audit. It should provide both clinical and professional expertise when required, and work closely with the hospital's Clinical Lead for each audit.

This committee is responsible for:

- Monitoring and supporting hospital participation in the clinical audit
- Identifying clinical expertise for case review
- Reviewing reports from the clinical audit and making recommendations regarding unexpected outcomes
- Reporting to the hospital's Quality and Safety Executive Committee on results from the clinical audit, and
- Providing assurance to the relevant NOCA Governance Committee regarding local governance of the clinical audit.

Membership of the Clinical Audit Committee

Membership should reflect the stakeholders in Patient Safety in each hospital and provide an appropriate mix of relevant expertise to support clinical audit governance.

Accountability and reporting relationships

The Clinical Audit Committee is accountable to the Hospital Quality and Safety Executive Committee Chair.

APPENDIX 3: ICU AUDIT DATA REQUEST FORM (NATIONAL OFFICE OF CLINICAL AUDIT, 2017)

ICU Audit Data Request Form

NCA National Office of Clinical Audit ICU Irish National ICU Audit

Please complete the following information for each Data Request you wish to make. This document has to be signed by the ICU Clinical Lead in order to progress your request.

Data Requestor Information			
Name of Data Requestor		Grade:	
Email Address		Contact Tel:	
Name of supervisor/ person giving authorisation for the Data request			

Information Required	Results
What is the purpose of the Data request	Activity analysis ☐ Quality Assurance ☐ Quality Improvement ☐ Medico-legal ☐ Teaching ☐ Professional Publication ☐ Research ☐ Ethical approval (if for research) ☐ Other (Please Specify)_____
In what format is the report required? All information provided as PDF	Paper copy ☐ In hospital Email only ☐ Other (Please Specify)_____
By what date is the report needed?	
If likely to be a repeat request how often is the data needed?	Once ☐ Monthly ☐ Quarterly ☐ Annually ☐ Other (Please Specify)_____
Please provide details of how you will ensure safety of this information	Shred Paper copy ☐ In hospital Email delete ☐ Other (Please Specify)_____

Please give details of the ICU Audit data you require	
Please give full description of your query	
What date parameters /time frame do you require for your query	
What group or clinical condition identifies your query	
What clinical measurement/features identify your group	
What specific outcome/content of the ICU Audit data set do you wish to observe/compare	
Other information	

I understand that any data I receive remains the property of OLOL hospital ICU Audit and may be used only for the purpose for which I have gained authorisation. I agree to acknowledge the ICU Audit staff in any publication using these data

Signed of applicant _____ Date_____

Authorisation Signature of National ICU Audit Clinical Lead _____ Date_____

Authorisation Signature of ICU Director _____ Date_____

Data supplied by _____ Date_____

Please complete this Data request form and return to ICU Audit Coordinator in your Hospital *V1.1 June 2016*

APPENDIX 4: FREQUENCY TABLES

Figure 5.5 Admissions direct to the Unit after emergency surgery and after elective surgery (as a percentage of all admissions)

	Emergency/urgent surgery		Elective/scheduled surgery		
	n	%	n	%	Total
Beaumont Hospital GICU	135	20%	97	15%	660
Beaumont Hospital Richmond ICU (Neuro)	143	41%	29	8%	349
Mater Misericordiae University Hospital HDU	86	7%	591	49%	1205
Mater Misericordiae University Hospital ICU	141	13%	485	45%	1083
Our Lady of Lourdes Hospital, Drogheda	27	6%	47	11%	428
St James's Hospital Keith Shaw Unit (CT ICU)	17	4%	400	88%	453
St James's Hospital GICU	27	6%	133	30%	445
Tallaght University Hospital	44	12%	126	34%	373
University Hospital Galway	90	15%	118	19%	615
University Hospital Limerick	87	23%	17	5%	371
University Hospital Waterford	12	11%	35	32%	109
Regional Hospital Mullingar	14	15%	17	18%	95
National	**823**	**13%**	**2095**	**34%**	**6186**

Figure 5.6 Admissions direct to the Unit after trauma (as a percentage of all admissions)

	Trauma admissions		Total admissions
	n	%	n
Beaumont Hospital GICU	74	11%	660
Beaumont Hospital Richmond ICU (Neuro)	82	23%	349
Mater Misericordiae University Hospital HDU	90	7%	1205
Mater Misericordiae University Hospital ICU	61	6%	1083
Our Lady of Lourdes Hospital, Drogheda	46	11%	428
St James's Hospital Keith Shaw Unit (CT ICU)	6	1%	453
St James's Hospital GICU	31	7%	445
Tallaght University Hospital	41	11%	373
University Hospital Galway	55	9%	615
University Hospital Limerick	22	6%	371
University Hospital Waterford	7	6%	109
Regional Hospital Mullingar	2	2%	95
National	**517**	**8%**	**6186**

APPENDIX 4: FREQUENCY TABLES

Figure 5.7 Patients admitted with AKI within 24 hours of admission (KDIGO Stage 1–3) (as a percentage of all admissions)

	AKI KDIGO Stage 3		AKI KDIGO Stage 1-2		Total KDIGO		Total admissions
	n	%	n	%	n	%	
Beaumont Hospital GICU	124	19%	251	38%	375	57%	660
Beaumont Hospital Richmond ICU (Neuro)	8	2%	65	19%	73	21%	349
Mater Misericordiae University Hospital HDU	98	8%	440	37%	538	45%	1205
Mater Misericordiae University Hospital ICU	138	13%	403	37%	541	50%	1083
Our Lady of Lourdes Hospital, Drogheda	61	14%	149	35%	210	49%	428
St James's Hospital Keith Shaw Unit (CT ICU)	8	2%	131	29%	139	31%	453
St James's Hospital GICU	60	13%	189	42%	249	56%	445
Tallaght University Hospital	64	17%	143	38%	207	56%	373
University Hospital Galway	74	12%	287	47%	361	59%	615
University Hospital Limerick	70	19%	148	40%	218	59%	371
University Hospital Waterford	26	24%	33	30%	59	54%	109
Regional Hospital Mullingar	3	3%	29	31%	32	34%	95
National	**734**	**12%**	**2268**	**37%**	**3002**	**49%**	**6186**

Figure 5.9 Admissions to the Unit with a diagnosis of sepsis (sepsis-2) with (i) 4 or more organ systems dysfunction within 24 hours of admission, and (ii) with 3 or fewer organ systems dysfunction (as a percentage of all admissions)

	Sepsis (4 or more organ systems dysfunction)		≤3 organ systems dysfunction		Total sepsis		Total admissions
	n	%	n	%	n	%	
Beaumont Hospital GICU	38	6%	203	31%	241	37%	660
Beaumont Hospital Richmond ICU (Neuro)	2	1%	33	9%	35	10%	349
Mater Misericordiae University Hospital HDU	10	1%	288	24%	298	25%	1205
Mater Misericordiae University Hospital ICU	38	4%	209	19%	247	23%	1083
Our Lady of Lourdes Hospital, Drogheda	18	4%	179	42%	197	46%	428
St James's Hospital Keith Shaw Unit (CT ICU)	0	0%	26	6%	26	6%	453
St James's Hospital GICU	21	5%	127	29%	148	33%	445
Tallaght University Hospital	9	2%	69	19%	78	21%	373
University Hospital Galway	20	3%	165	27%	185	30%	615
University Hospital Limerick	24	7%	127	34%	151	41%	371
University Hospital Waterford	3	3%	28	26%	31	28%	109
Regional Hospital Mullingar	0	0%	19	20%	19	20%	95
National	**183**	**3%**	**1473**	**24%**	**1656**	**27%**	**6186**

APPENDIX 4: FREQUENCY TABLES

Figure 5.13 Admissions who underwent mechanical ventilation within 24 hours of admission (as a percentage of all admissions to the Unit)

	Number mechanically ventilated	% mechanically ventilated	Total admissions
	n	%	N
Beaumont Hospital GICU	420	64%	660
Beaumont Hospital Richmond ICU (Neuro)	255	73%	349
Mater Misericordiae University Hospital HDU	44	4%	1205
Mater Misericordiae University Hospital ICU	903	83%	1083
Our Lady of Lourdes Hospital, Drogheda	240	56%	428
St James's Hospital Keith Shaw Unit (CT ICU)	438	97%	453
St James's Hospital GICU	251	56%	445
Tallaght University Hospital	134	36%	373
University Hospital Galway	221	36%	615
University Hospital Limerick	308	83%	371
University Hospital Waterford	48	44%	109
Regional Hospital Mullingar	17	18%	95
National	**3279**	**53%**	**6186**

Figure 5.14 Admissions who received ARS (as a percentage of all admissions)

	Number who received ARS	% who received ARS	Total admissions
Beaumont Hospital (General)	430	65%	660
Beaumont Hospital Richmond ICU (Neuro)	261	75%	349
Mater Misericordiae University Hospital HDU	60	5%	1205
Mater Misericordiae University Hospital ICU	935	86%	1083
Our Lady of Lourdes Hospital, Drogheda	208	49%	428
St James's Hospital Keith Shaw Unit (CT ICU)	437	97%	453
St James's Hospital (ICU)	241	54%	445
Tallaght University Hospital	154	41%	373
University Hospital Galway	218	35%	615
University Hospital Limerick	285	77%	371
University Hospital Waterford	49	45%	109
Regional Hospital Mullingar	20	21%	95
National	**3298**	**53%**	**6186**

APPENDIX 4: FREQUENCY TABLES

Figure 5.15 Days of ARS and BRS (as a percentage of all patient days)

	BRS (days used)		ARS (days used)	
	n	%	n	%
Beaumont Hospital GICU	454	13%	2061	59%
Beaumont Hospital Richmond ICU (Neuro)	357	12%	1970	67%
Mater Misericordiae University Hospital HDU	1306	24%	546	10%
Mater Misericordiae University Hospital ICU	948	14%	4534	67%
Our Lady of Lourdes Hospital, Drogheda	1377	49%	1459	51%
St James's Hospital Keith Shaw Unit (CT ICU)	430	18%	1263	53%
St James's Hospital GICU	887	23%	2461	64%
Tallaght University Hospital	1314	53%	1153	47%
University Hospital Galway	736	24%	951	31%
University Hospital Limerick	868	29%	1457	49%
University Hospital Waterford	91	18%	224	44%
Regional Hospital Mullingar	90	16%	153	28%
National	**8858**	**24%**	**18 232**	**49%**

Figure 5.16 Admissions who received advanced CVS support (as a percentage of all admissions)

	Number who received advanced cardiovascular system (CVS) support	**% who who received advanced CVS support**	**Total admissions**
	n	%	N
Beaumont Hospital GICU	166	25%	660
Beaumont Hospital Richmond ICU (Neuro)	72	21%	349
Mater Misericordiae University Hospital HDU	19	2%	1205
Mater Misericordiae University Hospital ICU	506	47%	1083
Our Lady of Lourdes Hospital, Drogheda	75	18%	428
St James's Hospital Keith Shaw Unit (CT ICU)	373	82%	453
St James's Hospital GICU	76	17%	445
Tallaght University Hospital	55	15%	373
University Hospital Galway	76	12%	615
University Hospital Limerick	82	22%	371
University Hospital Waterford	17	16%	109
Regional Hospital Mullingar	13	14%	95
National	**1530**	**25%**	**6186**

APPENDIX 4: FREQUENCY TABLES

Figure 5.17 Days of advanced and basic CVS support (as a percentage of all patient days)

	Advanced CVS support		Basic CVS support	
	n	%	n	%
Beaumont Hospital GICU	417	12%	2943	84%
Beaumont Hospital Richmond ICU (Neuro)	252	9%	2563	87%
Mater Misericordiae University Hospital HDU	98	2%	4519	82%
Mater Misericordiae University Hospital ICU	1792	26%	4949	73%
Our Lady of Lourdes Hospital, Drogheda	195	7%	2637	93%
St James's Hospital Keith Shaw Unit (CT ICU)	1159	49%	918	39%
St James's Hospital GICU	215	6%	3218	83%
Tallaght University Hospital	263	11%	2204	89%
University Hospital Galway	222	7%	2288	73%
University Hospital Limerick	254	9%	2437	82%
University Hospital Waterford	41	8%	462	90%
Regional Hospital Mullingar	41	8%	388	71%
National	**4949**	**13%**	**29 526**	**79%**

Figure 5.18 (i) Admissions who underwent renal replacement therapy (RRT) (as a percentage of all admissions) and (ii) days when RRT was provided (as a percentage of all patient days)

	Number who underwent RRT	% who underwent RRT	Number of days of RRT provided	% of patient days with RRT
Beaumont Hospital GICU	92	14%	419	12%
Beaumont Hospital Richmond ICU (Neuro)	6	2%	22	1%
Mater Misericordiae University Hospital HDU	35	3%	120	2%
Mater Misericordiae University Hospital ICU	171	16%	1264	19%
Our Lady of Lourdes Hospital, Drogheda	34	8%	226	8%
St James's Hospital Keith Shaw Unit (CT ICU)	23	5%	266	11%
St James's Hospital GICU	83	19%	711	18%
Tallaght University Hospital	64	17%	575	23%
University Hospital Galway	56	9%	208	7%
University Hospital Limerick	64	17%	404	14%
University Hospital Waterford	17	16%	81	16%
Regional Hospital Mullingar	3	3%	12	2%
National	**648**	**11%**	**4308**	**12%**

APPENDIX 4: FREQUENCY TABLES

Figure 5.19 (i) Admissions who received enteral or parenteral nutrition (as a percentage of all admissions) and (ii) days when enteral or parenteral nutrition was provided (as a percentage of all patient days)

	Number who received eternal/ parenteral nutrition	% who received eternal/ parenteral nutrition	Number of patient days with eternal/ parenteral nutrition	% of patient days with eternal/ parenteral nutrition
Beaumont Hospital GICU	372	56%	2385	68%
Beaumont Hospital Richmond ICU (Neuro)	243	70%	2281	77%
Mater Misericordiae University Hospital HDU	358	30%	2482	45%
Mater Misericordiae University Hospital ICU	469	43%	4296	63%
Our Lady of Lourdes Hospital, Drogheda	176	41%	1880	66%
St James's Hospital Keith Shaw Unit (CT ICU)	58	13%	853	36%
St James's Hospital GICU	236	53%	2953	76%
Tallaght University Hospital	134	36%	1529	62%
University Hospital Galway	201	33%	1593	51%
University Hospital Limerick	214	58%	2120	71%
University Hospital Waterford	40	37%	280	55%
Regional Hospital Mullingar	33	35%	257	47%
National	**2534**	**41%**	**22 909**	**61%**

Figure 5.20 (i) Admissions who had 3 or more organ systems supported (as a percentage of all admissions) and (ii) Unit days with 3 or more organ systems supported (as a percentage of all patient days)

	Number who received ≥3 organ systems support	% who received ≥3 organ systems support	Number of patient days with ≥3 organ systems support	% of patient days with ≥3 organ systems support
Beaumont Hospital GICU	260	39%	1938	57%
Beaumont Hospital Richmond ICU (Neuro)	187	54%	1986	69%
Mater Misericordiae University Hospital HDU	19	2%	278	6%
Mater Misericordiae University Hospital ICU	337	31%	3391	50%
Our Lady of Lourdes Hospital, Drogheda	73	17%	1038	37%
St James's Hospital Keith Shaw Unit (CT ICU)	189	42%	1194	55%
St James's Hospital GICU	110	25%	2046	55%
Tallaght University Hospital	67	18%	997	40%
University Hospital Galway	89	15%	848	32%
University Hospital Limerick	132	36%	1630	57%
University Hospital Waterford	21	19%	158	31%
Regional Hospital Mullingar	9	10%	158	36%
National	**1493**	**24%**	**15 662**	**44%**

APPENDIX 4: FREQUENCY TABLES

Figure 5.26A Percentage of patients with BD who became organ donors

	Number of BSDs	Number who became organ donors	% organ donors
Beaumont Hospital GICU	13	8	62%
Beaumont Hospital Richmond ICU (Neuro)	24	16	67%
University Hospital Limerick	9	5	56%
Mater Misericordiae University Hospital ICU	7	5	71%
Other Units	10	6	60%
National	**63**	**40**	**63%**

Figure 5.31 Discharges to the ward delayed >24 hours (as a percentage of all discharges to the ward)

	Survivors discharge delayed >24 hrs n	% of survivors discharge delayed >24 hrs %	Total discharges N
Beaumont Hospital GICU	116	25%	460
Beaumont Hospital Richmond ICU (Neuro)	63	25%	248
Mater Misericordiae University Hospital HDU	108	11%	967
Mater Misericordiae University Hospital ICU	28	25%	113
Our Lady of Lourdes Hospital, Drogheda	48	16%	302
St James's Hospital Keith Shaw Unit (CT ICU)	18	9%	211
St James's Hospital GICU	29	8%	348
Tallaght University Hospital	56	22%	261
University Hospital Galway	74	15%	490
University Hospital Limerick	60	51%	117
University Hospital Waterford	16	35%	46
Regional Hospital Mullingar	27	37%	74
National	**643**	**18%**	**3637**

Figure 6.3 Ireland: Type of admission to participating PICU 2015-2017.

	OLCHC		TSCUH	
	n	%	n	%
Planned - following surgery	1106	37%	314	25%
Unplanned - following surgery	124	4%	53	4%
Planned - other	182	6%	37	3%
Unplanned - other	1587	53%	858	68%
Total	**2999**		**1262**	

Figure 6.4: Source of 'unplanned-other' admissions to participating Irish PICUs,

	OLCHC		TSCUH	
	n	%	n	%
Other Hospital	545	42%	663	64%
Same Hospital	313	58%	920	36%
Total	**858**		**1583**	

APPENDIX 4: FREQUENCY TABLES

Figure 6.5 Age profile of ROI PICU children, 2017 (n=1463)

	OLCHC		TSCUH	
	n	%	n	%
<1 year old	580	57%	168	38%
1-4 years old	201	20%	111	25%
5-10 years old	121	12%	95	22%
11-15 years old	124	12%	63	14%
Total	**1026**		**437**	

Figure 6.6: Percentage bed days delivered by age group 2017

	OLCHC		TSCUH	
	n	%	n	%
<1 year old	5254	71%	860	39%
1-4 years old	984	13%	497	23%
5-10 years old	624	8%	478	22%
11-15 years old	540	7%	370	17%
Total	**7402**		**2205**	

Figure 6.7: Percentage invasive ventilation, vasoactive drugs and renal support 2015- 2017

	OLCHC		TSCUH	
	n	%	n	%
2015				
Invasive ventilation	627	67%	309	68%
IV Vasoactive drugs	478	51%	55	12%
Renal support	34	4%	9	2%
2016				
Invasive ventilation	662	64%	245	66%
IV Vasoactive drugs	504	49%	57	15%
Renal support	37	4%	10	3%
2017				
Invasive ventilation	644	63%	268	61%
IV Vasoactive drugs	476	46%	55	12%
Renal support	26	3%	8	2%

Figure 6.8 Type of ventilation, 2015–2017

	2015		2016		2017	
OLCHC	n	%	n	%	n	%
Invasive only	460	66%	481	64%	493	67%
Non- Invasive only	69	10%	86	11%	91	12%
Both	167	24%	181	24%	151	21%
Total	**696**		**748**		**735**	
TSCUH						
Invasive only	257	75%	207	75%	226	74%
Non- Invasive only	34	10%	30	11%	38	12%
Both	52	15%	38	14%	42	14%
Total	**343**		**275**		**306**	

Figure 6.12 Time taken for mobilisation of specialist paediatric transport team, 2015–2017

	0-60 mins	%	61-180 mins	%	181+ mins	%	Not recorded	%	Total
2015	26	39%	32	48%	1	2%	7	11%	66
2016	35	39%	37	41%	2	2%	16	18%	90
2017	58	71%	16	20%	1	1%	7	9%	82

APPENDIX 5: PARTICIPATING PICU ORGANISATION KEY

A	Addenbrooke's Hospital, Cambridge
C	Noah's Ark Children's Hospital for Wales, Cardiff
D	Royal Manchester Children's Hospital
E1	Great Ormond Street Hospital, London (PICU/NICU)
E2	Great Ormond Street Hospital, London (Cardiac ICU)
F	Evelina London Children's Hospital
H	King's College Hospital, London
I	Leeds General Infirmary
K2	Freeman Hospital, Newcastle upon Tyne
K3	Great North Children's Hospital, Newcastle upon Tyne
L	Royal Stoke University Hospital
M	Queen's Medical Centre, Nottingham
N	John Radcliffe Hospital, Oxford
O	Royal Brompton Hospital, London
P	Alder Hey Children's Hospital, Liverpool
Q	Sheffield Children's Hospital
R	Southampton Children's Hospital
S	James Cook University Hospital, Middlesbrough
T	St George's Hospital, London
U	St Mary's Hospital, London
V	Birmingham Children's Hospital
W	Bristol Royal Hospital for Children
X1	Glenfield Hospital, Leicester
X2	Leicester Royal Infirmary
Y	Royal Hospital for Sick Children, Edinburgh
Z	The Royal London Hospital
ZA	Royal Hospital for Children, Glasgow
ZB	Royal Belfast Hospital for Sick Children
ZC	Our Lady's Children's Hospital, Crumlin, Dublin
ZD	Temple Street Children's University Hospital, Dublin
ZE	Harley Street Clinic, London
ZF	The Portland Hospital, London
T001	Children's Acute Transport Service (CATS)
T002	Embrace: Yorkshire & Humber Infant & Children's Transport Service
T003	North West and North Wales Paediatric Transport Service (NWTS)
T004	South Thames Retrieval Service (STRS)
T005	KIDS Intensive Care and Decision Support
T008	Southampton Oxford Retrieval Team (SORT)
T010	Northern Ireland Specialist Transport and Retrieval (NISTAR) Paediatric
T016	ScotSTAR Paediatric Retrieval Service (Edinburgh)
T017	ScotSTAR Paediatric Retrieval Service (Glasgow)
T020	Scottish Specialist Transport and Retrieval (ScotSTAR)
T022	Irish Paediatric Acute Transport Service (IPATS)
T024	Wales and West Acute Transport for Children (WATCh)
T026	North East Children's Transport and Retrieval (NECTAR)
T027	Children's Medical Emergency Transport (CoMET)

APPENDIX 6: GLOSSARY OF TERMS: ADULT

A&E	Accident and Emergency also known as Emergency Department
ABF	activity-based funding
ACS	advanced cardiovascular support
AKI	acute kidney injury
APACHE II	Acute Physiology and Chronic Health Evaluation, is designed to measure the severity of disease for adult patients admitted to intensive care units
ARS	Advanced Respiratory support is a measure to support lungs that have failed to function correctly at an advanced level
BD	Brain death
BIS	Bed Information System
BRS	Basic Respiratory support is a measure to support lungs that have failed to function correctly at a basic level
BSD	brainstem death
BSI	Bloodstream infection
CAG	Clinical Advisory Group
Calender days	A calendar day is defined as any complete calendar day (00:00-23:59) or part thereof.
CRBSI	Catheter-related bloodstream infection (CRBSI)
CCP	Critical Care Programme
CCU	Coronary Care Unit
CEO	Chief Exexcutive Officer
CMP	Case Mix Programme, is the data collection undertaken by ICNARC within the UK
CLABSI	central line-associated BSI
CPR Cardio	Cardio Pulmonary Resuscitation. This is rescussitation of the heart and lungs in an emergency situation
CRBSI	Catheter related Blood stream infections, presence of bacteremia originating from an intravenous catheter
CRRT	Continuous Renal Replacment Therapy
CTS	centralised transport service
CVC	central venous catheter
CVS	Cardiovascular System
DBD	Donation after brain death
DCD	Donation after circulatory death
Dialysis	Removal of waste products from the body when the kidneys are not working
DVR	Data Validation Report
ECLS	extracorporeal life support
ED	Emergency Department also known as Accident and Emergency
ET	endotracheal

GDPR	General Data Protection Regulation
GP	General Practitioner
HCAI	Health Care Associated Infection; infection contracted in hospital
HD	Haemodialysis, used intermittantly to remove waste products from the body when the kidneys are not working using a machine.
HDU	High dependency unit
HIPE	Hospital In-Patient Enquiry system
HIQA	Health Information and Quality Authority
HSE	Health Service Executive
ICNARC	Intensive Care Unit Audit and Research Centre
ICT	Information Computer Technology
ICU	Intensive Care Unit
InfoFlex	ICU Audit software
INICUA	Irish National Intensive Care Unit Audit, is the name of this audit and is the term used for data collection supported by ICNARC within Ireland
INICUA web portal	This is a secure portal where INICUA anonymised data is loaded for transfer to ICNARC and Data validation and QQR's reports are retrieved by units
Invasive monitoring	Using direct measurement from within the body of a patient. This type of monitoring is common in the ICU and involves inserting a cannula in a suitable artery or vein.
IPATS	Irish Paediatric Acute Transport Service
IQR	interquartile range
IT	information technology
JFICMI	Joint Faculty of Intensive Care Medicine of Ireland
KDIGO	Kidney Disease: Improving Global Outcomes. This is a Definition and staging of acute kidney injury
KPI	key performance indicator
Levels of care	Specifies level of care received on each day of unit stay. Levels of care are from 0-3 and allocated based on the monitoring and support of organ failure. Level 3 -Monitoring and Support for 2 or more organs; Level 2 -Monitoring and Support for 1 or more organs; Level 1 - Admissions receiving a greater degree of observation than Level 0- Admission receiving normal ward care
Level of care days	Specifies the total number of calendar days during which the admission received a particular level of care
LOS	Length of Stay, the number of days that a patient spends in ICU and/ or hospital
MDT	multidisciplinary team
Mean	The mean is the average of the numbers
Mechanical Ventilation	Use of a machine as life support for breathing
Median	The "median" is the "middle" value in the list of numbers.
MICAS	Mobile Intensive Care Ambulance Service; transfers ICU patients between hospitals and units

NAS-CCRS	National Ambulance Service Critical Care Retrieval Services
NCHD	Non Consultant Hospital Doctor
NOCA	National Office of Clinical Audit
NQR	Network Quality Report, is a cumulative report of QQR's over a calendar year
OLCHC	Our Lady's Children's Hospital, Crumlin
Organ failure	When one or more organs of the body to fail to function correctly
PACU	Post anaesthetic Care Unit
PICC	Peripherally inserted central catheter
PICANet	Paediatric Intensive Care Audit Network
PICS	Paediatric Intensive Care Society
PICU	Paediatric intensive Care Unit
PIM	Paediatric Index of Mortality
PROMs	patient-reported outcome measures
PVC	Peripheral venous catheter
QI	Quality Indicator
QQR	Quarterly Quality Report
ROI	Republic of Ireland
RRT	Renal Replacment Therapy is a general term for treatment given for the removal of waste products from the body when the kidneys are not working
SD	Standard Deviation. This is a statistical measure
Sepsis	Sepsis is a potentially life-threatening complication of an infection. Sepsis occurs when chemicals released into the bloodstream to fight the infection trigger inflammatory responses throughout the body.
Severe sepsis	Sepsis is a potentially life-threatening complication of an infection. Sepsis occurs when chemicals released into the bloodstream to fight the infection trigger inflammatory responses causing organs of the body to fail to function correctly.
SG	Steering Group
SMR	Standardised Mortality Ratio, this is a statistical measure. The rate of patient deaths (mortality) in a hospital is shown as a mortality ratio that compares patients' actual mortality to their expected mortality. The "observed-to-expected mortality" is a risk-adjusted measure that compares the actual number of deaths in a hospital with the average.
SOFA	Sequential Organ Failure Assessment Score. This is a critical illness scoring system that assesses the performance of several organ systems in the body (neurologic, blood, liver, kidney, and blood pressure/hemodynamics) and assigns a score based on the data obtained in each category.
TSCUH	Temple Street Children's University Hospital
TUH	Tallaght University Hospital
UK Units	Intensive Care units in the United Kingdom. Intensive Care units in the UK that are reported on by ICNARC and used as comparitors within this report
WTE	whole time equivalent

APPENDIX 7: GLOSSARY OF TERMS: PAEDIATRIC

Admissions by type; Other	Patients admitted from the operating theatre where surgery is not the main reason for admission (e.g. a patient with a head injury who is admitted from theatre after insertion of an ICP monitor) are not included here. In such patients the main reason for admission is head Injury and thus the admission type would be unplanned - other.
A planned - other	Admission is any other planned admission that is not an emergency (E.g. liver biopsy).
Admissions by primary diagnostic group	The primary reason for admission has been categorised into 13 diagnostic groups to enable a simple comparison between organisations. The classification is based on the UK Read Codes (NHS, Digital, 2016). The groups are under headings of Infection, Neurological disorders, Oncology and Other.
Admissions by type as illustrated in Figure 6.3	Admissions by type can be after Surgery, planned,unplanned and other
Admissions by type; Surgery	admitted to the unit following undergoing all or part of a procedure or anaesthesia for a procedure in an operating theatre or anaesthetic room. PICANet use the following definitions for admission type
An admission that is planned	following surgery is one that the unit is aware of before the surgery begins or one that could have been delayed for 24 hours without risk (e.g. spinal surgery).
An admission that is unplanned	following surgery is one that the unit was not aware of before surgery began and one that could not have been delayed without risk (e.g. bleeding tonsillectomy).
An unplanned - other	Admission is one that the unit was not expecting and is therefore an emergency admission (e.g. status epilepticus).
High flow nasal cannula therapy	A new table showing the of high flow admissions by PICU with the number of days in which high flow nasal cannula therapy was administered is included.
New dataset	Two new measures were introduced in mid-2014: these were unplanned extubation, expressed as a rate per 100 intubated days and high flow nasal cannula therapy. By the 1 January 2015 all participating units commenced collection of these new data items, and these are included in this report.
Nusinersen (Spinraza)	is an ASO drug, is effective for treating spinal muscular atrophy (SMA).
PIM	Paediatric Index of Mortality
Primary reason for admission Infection	excludes any respiratory or gastrointestinal infection but includes meningitis.
Primary reason for admission Oncology	includes neuro-oncology (brain tumours).
Primary reason for admission Other	includes those diagnoses not covered by the other 12 groups.
Retrieval data	Data are collected on whether or not a child was retrieved / transferred into the PICU.
Spinal muscular atrophy (SMA)	SMA refers to several different motor neuron diseases. SMA is most commonly associated with mutations in the survival motor neuron 1 (SMN1) gene.

Standardised mortality ratios	Tables and figures showing the standardised mortality ratios for all units have been reproduced from the PICANet Annual Report (2018). These tables include all patients admitted to PICU regardless of age.
Unplanned extubation	Rates of unplanned extubation per 1000 intubated days is included in the PICANet report. Unplanned extubations were calculated for all children admitted to PICU regardless of age.
Ventilation status	Type of ventilation is presented. This includes both invasive and non-invasive ventilation. Non-invasive ventilatory support is defined as any method of ventilation not given via an endotracheal tube, laryngeal mask or tracheostomy. Non-invasive ventilation would include nasal prong or nasal / facial mask CPAP, nasal or facial BiPAP or negative pressure ventilation. It does NOT include high flow nasal cannula therapy.

NOTES

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