Atlas of Healthcare Variation:
Methodology | Patient deterioration

November 2020

General points

- Data is not presented where there were fewer than 10 to preserve confidentiality.
- People were assigned to the district health board (DHB) that provided the service.
- Pregnant and recently pregnant women were excluded from analysis because a separate maternity early warning system is currently being developed. Pregnancy status is not always recorded so it is possible that some women were not excluded, especially those in the post-partum period (ie, 42 days after the date of delivery).

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Underlying data

If you would like the underlying data in MS Excel format, please email atlas@hqsc.govt.nz.

Note: When a DHB was missing part of a year of data, that whole year for that DHB was excluded from the analysis. This was done to allow years to be directly comparable across DHBs.

Confidence intervals
Data for each DHB are presented as rates, hours or scores. Upper and lower confidence intervals were calculated to a 95 percent level of confidence.
Data source – the Australian and New Zealand Intensive Care Society (ANZICS) Centre for Outcome and Resource Evaluation (CORE) adult patient database (APD)
The ANZICS CORE APD includes information on all patients admitted to participating intensive care units (ICUs). Participation in ANZICS CORE data collection is voluntary. Aotearoa New Zealand has adult public ICUs in 15 DHBs participating in ANZICS. Data collection by ANZICS CORE complies with relevant privacy legislation in Australia and Aotearoa New Zealand.
Ethnicity data
The ANZICS CORE APD collects information on whether the person is indigenous (for Aotearoa New Zealand, this is Māori) or non-indigenous. However, the population of this field was variable with three units not populating it at all. The Ministry of Health gave permission for 'fuzzy matching'[1] ANZICS data with the National Minimum Dataset (NMDS). This was done using age, gender, event start date, event end date and facility code. Eighty-six percent of the cases were able to be matched. Unmatched cases were excluded from the ethnicity analyses but presented in all other analyses. Ethnicity data presented is prioritised ethnic group (Māori, Pacific peoples and Other). For people

[1] This is a technique that matches individual records that cannot be directly linked via a unique identifier.

reporting multiple ethnic groups, the most recent value was selected.

Indicator #1:	**Emergency ICU admission from the ward (rate per 1,000)**
Numerator	Number of emergency ICU admissions from the ward
Denominator	Total number of hospital admissions with a length of stay > 0
Data source	ANZICS CORE APD (numerator) NMDS (denominator)
Analysis	By year, age group (18–44, 45–64, 65–74, 75–84 and 85+ years), ethnicity (Māori, Pacific peoples and Other)
Exclusions	Admissions with a length of stay of < 1 and non-casemix events were excluded. This is to exclude events such as rest-home hospital stays, which would differentially increase the denominator in different DHBs. Pregnant women and women in the post-partum period were excluded.
Rationale	This is a key measure used internationally; it may indicate what impact the recognition and response system is having on hospital resources. Depending on the response system in place, admissions may increase due to better identification of deterioration. The Australian Commission on Safety and Quality in Healthcare report *Evaluation of the NSQHS Standards*, Chapter 18: Standard 9 Recognising and responding to clinical deterioration in acute health care[2], found that: ‘Rates of admission to the ICU after an emergency team call increased between 2010 and 2013, but were decreasing between 2013 and 2014, which is consistent with better detection and management on the ward of deterioration on the ward. ICU length of stay was also decreasing significantly in this period.’
Commentary	**Description**: Rate of emergency ICU admissions from the ward per 1,000 emergency admissions with a length of stay of at least one day. This indicator is shown as a rate per 1,000 and a count in 2014–18, by ethnicity and age group. **Why is this important?** An important component of recognising clinical deterioration and escalating care is ensuring plans are in place to escalate care and call for emergency assistance. The rate of emergency admissions to ICU from the ward reflects detection and management of deterioration on the ward. An increase in rates may reflect improved identification of deterioration on the ward. **What questions might the data prompt?** • Are rates increasing or decreasing over time? • Why do rates vary between DHBs? How much can be explained by differences

[2] Australian Commission on Safety and Quality in Healthcare. nd. Recognising and responding to acute physiological deterioration. Sydney: Australian Commission on Safety and Quality in Healthcare. URL: www.safetyandquality.gov.au/our-work/recognising-and-responding-to-clinical-deterioration.

	in patient population? • What is the impact of ICU capacity on the rate of emergency admissions to ICU? • How do rates over time reflect changes in population health status?

Indicator #1a:	**Emergency ICU admission from the ward – Cardiovascular ICU**
Numerator	Number of emergency ICU admissions from the ward
Denominator	Total number of hospital admissions with a length of stay > 0 and health specialty code M10, S15 and S75
Data source	ANZICS CORE APD (numerator) NMDS (denominator)
Analysis	By year, age group (18–44, 45–64, 65–74, 75–84 and 85+ years), ethnicity (Māori, Pacific peoples and Other)
Exclusions	Admissions with a length of stay of < 1 and non-casemix events were excluded. This is to exclude events such as rest-home hospital stays, which would differentially increase the denominator in different DHBs.

Indicator #1b:	**Emergency ICU admission from the ward – Department of Critical Care Medicine**
Numerator	Number of emergency ICU admissions from the ward
Denominator	Total number of hospital admissions with a length of stay > 0, excluding admissions with a health specialty code M10, S15 and S75
Data source	ANZICS CORE APD (numerator) NMDS (denominator)
Analysis	By year, age group (18–44, 45–64, 65–74, 75–84 and 85+ years), ethnicity (Māori, Pacific peoples and Other)
Exclusions	Admissions with a length of stay of < 1 and non-casemix events were excluded. This is to exclude events such as rest-home hospital stays, which would differentially increase the denominator in different DHBs.

Indicator #2:	**Average length of stay for emergency ICU admissions from ward (hours)**
Numerator	Total ICU hours for emergency admissions from the ward
Denominator	Number of ICU emergency admissions from the ward (numerator indicator 1)
Data source	ANZICS CORE APD
Analysis	Average number of hours in ICU By year, age group (18–44, 45–64, 65–74, 75–84 and 85+ years), ethnicity (Māori, Pacific peoples and Other)
Exclusions	Pregnant women and women in the post-partum period were excluded.

Rationale	Indicates the impact the rapid response system is having on hospital resources. ICU length of stay could increase if survival among ICU admissions increases. Australia has seen a small but significant reduction in ICU length of stay, following the introduction of the Australian Commission on Safety and Quality in Healthcare's Standard 9 Recognising and responding to clinical deterioration in acute health care.
Commentary	**Description**: Average length of stay for emergency ICU admissions from the ward. This indicator shows the average length of stay in hours and the count of the ICU emergency admissions from the ward (2014–18), by ethnicity and age group. **Why is this important?** This indicator can be used to track the impact rapid response teams may be having. It is expected that earlier admission to ICU will improve patient outcomes, however this might not result in reduced length of stay, particularly if early identification leads to increased survival. **What questions might the data prompt?** • Is the average length of stay increasing or decreasing over time? Why might this be? • How does the average length of stay following an emergency admission to ICU from the ward compare with the average length of stay for all ICU admissions?

Indicator #3:	**Percentage of patients receiving invasive ventilation following emergency ICU admission from the ward**
Numerator	Number of patients admitted as an emergency to ICU from the ward and who received invasive ventilation. Invasive ventilation was defined as any form of positive pressure ventilation delivered through an artificial airway, such as oral/nasal endotracheal tube or tracheostomy. This includes all modes of mandatory ventilation, spontaneous pressure support ventilation and continuous positive airways pressure.
Denominator	Number of emergency ICU admissions from the ward where the invasive ventilation field is populated (yes or no)
Data source	ANZICS CORE APD
Analysis	By year, age group (18–44, 45–64, 65–74, 75–84 and 85+ years), ethnicity (Māori, Pacific peoples and Other)
Exclusions	Those with null from the denominator were excluded. Pregnant women and women in the post-partum period were excluded.
Rationale	While this is a subset of emergency ICU admissions, the proportion of patients requiring invasive ventilation following emergency admission to ICU from the ward is a measure of the severity of the patient's condition. A reduction in invasive ventilation hours over time may suggest that patients admitted to ICU are of a lower severity or are identified earlier.
Commentary	**Description**: Percentage of patients receiving invasive ventilation following an emergency ICU admission from the ward. This indicator is shown as a percentage and count in 2014–18, by ethnicity and age

	group. Note: Only admissions where the invasive ventilation field was populated were included. **Why is this important?** While this is a subset of emergency ICU admissions, the proportion of patients requiring invasive ventilation following emergency admission to ICU is a measure of severity of their condition. A reduction in the proportion of patients requiring invasive ventilation may suggest that patients admitted to ICU are of a lower severity or their deterioration is identified earlier. **What questions might the data prompt?** • Is the proportion of patients requiring invasive ventilation increasing or decreasing over time? Why might this be? • From local data, what was the time from admission to ICU to ventilation? • How do changes in this indicator correlate with changes to emergency ICU admission rates and average length of stay? • What is the impact of ICU bed capacity on rates?

Indicator #4:	**Severity of illness of emergency admissions to ICU from the ward (mean APACHE III score)**
Numerator	Sum of APACHE III score on admission to ICU from the ward
Denominator	Number of emergency ICU admissions from the ward (numerator indicator 1)
Data source	ANZICS CORE APD
Analysis	By year, age group (18–44, 45–64, 65–74, 75–84 and 85+ years), ethnicity (Māori, Pacific peoples and Other)
Exclusions	Pregnant women and women in the post-partum period were excluded.
Rationale	Indicates whether deteriorating patients are being identified earlier. Australia has seen a significant reduction in APACHE III on ICU admission, following the introduction of the Australian Commission on Safety and Quality in Healthcare's Standard 9 Recognising and responding to clinical deterioration in acute health care.[3]
Commentary	**Description**: Severity of illness of emergency ICU admissions from the ward This indicator shows the mean APACHE III score for the emergency ICU admissions from the ward (2014–18), by ethnicity and age group. **Why is this important?** The APACHE III score is a measure of a patient's risk of death on admission to ICU. Scores range from 0 (no risk) to 299 (very high risk). Tracking APACHE III scores over time may indicate whether deteriorating patients are being identified earlier. **What questions might the data prompt?**

[3] Australian Commission on Safety and Quality in Healthcare. nd. Recognising and responding to acute physiological deterioration. Sydney: Australian Commission on Safety and Quality in Healthcare. URL: www.safetyandquality.gov.au/our-work/recognising-and-responding-to-clinical-deterioration.

	• Are mean APACHE III scores changing over time? Why might this be?

Indicator #5:	**Percentage of emergency ICU admissions from the ward resulting in death in ICU (percent)**
Numerator	Number of emergency ICU admissions from the ward who died in ICU
Denominator	Number of emergency ICU admissions from the ward (numerator indicator 1)
Data source	ANZICS CORE APD
Analysis	By year, age group (18–44, 45–64, 65–74, 75–84 and 85+ years), ethnicity (Māori, Pacific peoples and Other)
Exclusions	Pregnant women and women in the post-partum period were excluded.
Rationale	While the goal of this indicator may not be zero, ie, death in ICU may represent good practice for some people, in general it is thought that patients should either be admitted from the ward early enough so the reversible components of their condition can be treated or they should not be admitted to ICU.
Note	In some cases numbers were too low to report by age group and ethnicity
Commentary	**Description**: Percentage of emergency ICU admissions from the ward resulting in death in the ICU. This indicator is shown as a percentage and count in 2014–18, by ethnicity and age group. **Why is this important?** While the goal of this indicator may not be zero, ie, death in ICU may represent good practice for some people, in general it is thought that patients should either be admitted from the ward early enough so the reversible components of their condition can be treated or they should not be admitted to ICU. **What questions might the data prompt?** • How are rates changing over time? Why might this be?

Indicator #6:	**Average ICU length of stay (hours)**
Numerator	Total ICU hours
Denominator	Number of ICU admissions (ANZICS field: type of care, ICU = 1)
Data source	ANZICS CORE APD
Analysis	Average number of hours in ICU By year, age group (18–44, 45–64, 65–74, 75–84 and 85+ years), ethnicity (Māori, Pacific peoples and Other)
Exclusions	Pregnant women and women in the post-partum period were excluded.
Rationale	To allow a comparison between average length of stay for emergency admissions from ward. To allow comparison between units in their average length of stay. Variation in average length of stay between units raises questions as to whether this reflects differences in their patient population or other factors such as bed

	capacity in both the ward and ICU or ability to provide higher-level care in the ward.
Commentary	**Description**: Average ICU length of stay in hours for all ICU admissions. This indicator shows the average ICU length of stay in hours and the number of ICU admissions (2014–18), by ethnicity and age group. **Why is this important?** Average ICU length of stay may reflect the health of the patient population served by a DHB. It is also a reflection of whether the hospital is a tertiary centre treating higher-complexity patients who might be expected to have a longer length of stay. Aotearoa New Zealand tertiary hospitals are Auckland, Waikato, Capital & Coast, Canterbury and Southern. Counties Manukau and Hutt Valley are considered tertiary in other categories. **What questions might the data prompt?** • Do the tertiary centres have higher ICU average length of stay? If not, why not? • How much of the difference in average length of stay in ICU might be due to patient complexity and how much is due to different factors?

Indicator #7:	**Readmission to ICU within the same hospital admission (percent)**
Numerator	Any second or subsequent admission to ICU/high dependency unit (HDU) within the same hospital admission, excluding direct transfers to or from ICU/HDU.
Denominator	Number of ICU discharges not coded as died
Data source	ANZICS CORE APD
Analysis	By year, age group (18–44, 45–64, 65–74, 75–84 and 85+ years), ethnicity (Māori, Pacific peoples and Other)
Exclusions	Pregnant women and women in the post-partum period were excluded.
Rationale	There is no ideal rate of readmission to ICU. An increase in rates might reflect earlier recognition of patient deterioration or it might reflect premature discharge from ICU. This indicator should be interpreted with other indicators, such as the proportion of after-hours discharges and the rate of invasive ventilation following emergency admission to ICU.
Commentary	**Description**: Percentage of patients readmitted to the ICU in the same hospital admission. This indicator shows the percentage and count of all ICU discharges not coded as died where a patient was readmitted to the ICU/HDU within the same hospital admission (2014–18), by ethnicity and age group. Note: Direct transfers to or from the ICU/HDU were excluded. **Why is this important?** There is no ideal rate of readmission to ICU. An increase in rates might reflect earlier recognition of patient deterioration or it might reflect premature discharge from ICU. This indicator should be interpreted with other indicators, such as the proportion of after-hours discharges and the rate of invasive ventilation following emergency admission. **What questions might the data prompt?** • What is the impact of bed capacity in ICU on rates?

Indicator #8:	**After-hours discharge from ICU (percent)**
Numerator	Number of ICU discharges between 1800 and 0600 hours
Denominator	Number of ICU discharges not coded as died
Data source	ANZICS CORE APD
Analysis	By year, age group (18–44, 45–64, 65–74, 75–84 and 85+ years), ethnicity (Māori, Pacific peoples and Other)
Exclusions	Patients who died (discharge code 2). Pregnant women and women in the post-partum period were excluded.
Rationale	The proportion of after-hours ICU discharges might be a proxy measure for ICU capacity/pressure for beds. It suggests bed capacity in ICU might be limiting the ability to admit patients. Previous analyses of ANZICS data has demonstrated that after-hours ICU discharge results in increased mortality (6.4 percent versus 3.6 percent) and higher ICU readmissions (5.1 percent versus 4.5 percent). This risk factor for mortality and readmission is modifiable. Gantner D, Farley K, Bailey M, et al. 2014. Mortality related to after-hours discharge from intensive care in Australia and New Zealand, 2005-2012. *Intensive Care Med* 40(10): 1528–35.
Commentary	**Description**: After-hours ICU discharges. This indicator shows the percentage and count of all ICU discharges not coded as died where the discharge occurred between 1800 and 0600 hours (2014–18), by ethnicity and age group. **Why is this important?** The proportion of after-hours ICU discharges might be a proxy measure for ICU capacity/pressure for beds. It suggests bed capacity in ICU might be limiting the ability to admit patients. **What questions might the data prompt?** • Why do rate vary widely between DHBs?