

Healthcare in Focus

New South Wales and the COVID-19 pandemic from 2020 to 2022

Technical Supplement

May 2023

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Please check the online version at bhi.nsw.gov.au for any amendments or errata.

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The conclusions in this report are those of BHI and no official endorsement by the NSW Minister for Health, the NSW Ministry of Health or any other NSW public health organisation is intended or should be inferred.

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Introduction

This document is a supplement to the Bureau of Health Information (BHI's) 13th annual performance report, *Healthcare in Focus – New South Wales and the COVID-19 pandemic from 2020 to 2022*. It contains a description of the data sources and methods used to analyse and visualise the data. This supplement is technical in nature and is intended for audiences interested in the creation and analysis of similar health performance measures.

To produce the report, BHI independently calculated measures from the following data sources:

- Ambulance activity and performance – NSW Ambulance Computer Aided Dispatch (CAD) system
- Patients' experiences with NSW ambulance services – Emergency Department Patient Survey (EDPS) (Ambulance module) 2022–23
- Emergency department activity and performance – NSW Health Emergency Department Data Collection (EDDC), accessed via the Health Information Exchange (HIE)
- Patients' experiences in emergency departments – EDPS 2019–20, 2020–21, 2021–22, 2022–23
- Admitted patient activity – NSW Health Admitted Patient Data Collection (APDC), accessed via HIE
- Admitted patients' experiences – Adult Admitted Patient Survey (AAPS) 2019, 2020, 2021, 2022
- Elective surgery – Waiting List Collection On-line System (WLCOS)
- Virtual outpatient care – Enterprise Data Warehouse for Analysis Reporting and Decision Support (EDWARD)
- Virtual care with general practitioners – Australian Government Services Australia
- Patients' experiences of virtual care – Virtual Care Survey 2020, 2021
- Hospital admissions and mortality outcomes – Hospital Performance Dataset (a data asset linking Admitted Patient Data Collection (APDC) and deaths from the Registry of Birth Deaths and Marriages (RBDM)).

BHI used SAS version 9.4 software for all the statistical analyses (Copyright © 2019 SAS Institute Inc. SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc., Cary, NC, USA. SAS 9.4 [English]).

Setting the scene

COVID-19 cases, hospitalisations and deaths in NSW

COVID-19 information on number of cases, hospitalisations and deaths in NSW was provided by the COVID-19 Public Health Response Branch, NSW Ministry of Health. The daily patterns of COVID-19 cases, hospitalisations and deaths were reported from 1 January 2020 to 31 December 2022.

Throughout 2020 and 2021, the number of patients with COVID-19 (COVID cases) is based on the date the person reported that they first started to feel unwell (i.e. the symptom onset date). This is collected by public health staff via an interview at the time of diagnosis. If symptom onset date is not available, the earliest test date/specimen collection date is used. This number includes residents diagnosed in NSW who were infected overseas and in Australia (in NSW and interstate).

From December 2021, in response to the Omicron variant, contact tracing interviews were only conducted for those in the highest risk categories and date of symptom onset may not be available. Moreover, as rapid-antigen testing (RAT) grew in frequency throughout 2022, official COVID-19 case numbers became increasingly dependent on self-reporting. Therefore, case numbers reported throughout 2022 are a combination of polymerase chain reaction (PCR) testing and RAT with symptom onset dates obtained via a combination of contact-tracing and self-reporting.

'Number of patients with COVID-19 admitted to hospital' refers to the total number of people with COVID-19 who were admitted to hospital each day. 'Number of patients with COVID-19 admitted to ICU' refers to the total number of people with COVID-19 who were admitted to ICU each day. From 3 February 2022, people with COVID-19 were included in this analysis if their COVID-19 diagnosis was up to 14 days prior to their admission, or any time after the admission. Comparisons of data either side of 3 February 2022 should be made with caution. The COVID-19 diagnosis can be confirmed before or any time after the admission. People with COVID-19 may be admitted to hospital or ICU for reasons unrelated to COVID-19.

'COVID-19-related deaths' refers to the number of people in NSW who died with, or from, COVID-19. These people may have died from COVID-19 or from other diseases or chronic conditions where COVID-19 was a contributing factor.

People's perspectives of healthcare services

Information on people's perspectives of healthcare services was provided by the Australian Institute of Health Innovation (AIHI) at Macquarie University, Sydney. It was based on results from the AIHI and Consumers Health Forum of Australia (CHF) Australian Health Consumer Sentiment Survey.

The Australian Health Consumer Sentiment Survey is a population-based study of health consumer sentiment and provides an important barometer of satisfaction and opinions about the Australian health system.¹ The survey was co-produced by the National Health and Medical Research Council (NHMRC) Partnership Centre for Health System Sustainability and CHF. To date, the survey has been conducted twice – once in December 2018 (1,024 respondents) and once in October 2021 (5,100 respondents), the latter being conducted amidst the Delta wave of the COVID-19 pandemic.

BHI requested a custom breakdown of the 5,100 responses to the second survey, such that the attitudes and opinions of people living in NSW (1,623 responses) could be compared with those in other states and territories (3,477 responses). Calculations were conducted by researchers at AIHI.

Ambulance

Activity and performance

Ambulance information is based on BHI analyses of data extracted from the NSW Ambulance Computer Aided Dispatch (CAD) system, which is used to manage and record ambulance activity and time points across the entire patient journey. The CAD system contains information from all ambulance local response areas in NSW. Information is recorded using incident, response, transport, emergency department network access, ambulance release teams and calls as the counting units.

The categories 'rural' and 'urban' were created by classifying local areas according to the Accessibility and Remoteness Index of Australia (ARIA+), which is the standard used by the Australian Bureau of Statistics (ABS).

For activity and performance measures used in ambulance analysis, please refer to the [technical supplement](#) to *Healthcare Quarterly, October to December 2022*.

Patients' experiences with NSW ambulance services

The Emergency Department Patient Survey (EDPS) results reflect the experiences of patients who attended one of 77 large emergency departments in NSW. Between July and September of 2022, an additional module was added to the survey for patients who arrived at the ED by ambulance, asking them to reflect on their experiences with NSW ambulance services (1,230 respondents, 29% response rate).

Results for three key questions from the module are presented in this section. The results are weighted to be representative of the broader population (of patients who attended EDs via ambulance). Further technical details about the EDPS, as well as the ambulance module incorporated into the 2022–23 survey, are available in [questionnaire development reports](#).

Emergency department

Activity and performance

The NSW Ministry of Health maintains a data warehouse, the Health Information Exchange (HIE), containing the most recent accumulation of NSW hospital and health facility activity data. Visits to public hospital ED data are uploaded twice each week. BHI also receives a data file for Northern Beaches Hospital separately from the NSW Ministry of Health.

The categories 'rural' and 'urban' were created by classifying each hospital according to the Accessibility and Remoteness Index of Australia (ARIA+), which is the standard used by ABS.

Activity and performance measures are calculated by BHI using methodology outlined in the [technical supplement](#) to *Healthcare Quarterly, October to December 2022*.

Patients' experiences in emergency departments

The EDPS results reflect the experiences of patients who attended one of 77 large EDs in NSW.

Patients' overall ratings of their ED experiences were presented for each month from July 2019 to June 2022 to provide insights into patients' experiences in EDs at different times throughout the pandemic. Survey responses were weighted to optimise the degree to which results were representative of the experiences and outcomes of the overall patient population. Changes in monthly percentages are not adjusted for changing patient characteristics over time.

The categories 'rural' and 'urban' were created by classifying each hospital according to the Accessibility and Remoteness Index of Australia (ARIA+), which is the standard used by the Australian Bureau of Statistics (ABS).

Further technical details about the EDPS are available in [previous technical supplements](#).

Admitted patients

Activity

The NSW Health Admitted Patient Data Collection (APDC) is accessed via the HIE and contains episodes of care for all patients admitted to NSW public hospitals. BHI also receives a data file for Northern Beaches Hospital separately from the NSW Ministry of Health.

The categories 'rural' and 'urban' were created by classifying each hospital according to the Accessibility and Remoteness Index of Australia (ARIA+), which is the standard used by ABS.

Activity and performance measures are calculated by BHI using methodology outlined in the [technical supplement](#) to *Healthcare Quarterly, October to December 2022*.

Reporting by clinical cohort

All hospitals report diagnosis information using ICD-10-AM for admitted patients in the APDC. All diagnosis information has been mapped in the HIE to ICD-10-AM, 11th edition.

Diagnosis information was analysed using the 'principal diagnosis' field in the APDC data, which refers to diagnoses assessed to be primarily responsible for occasioning hospital admissions.

The diagnosis information for completed admitted patient episodes of care is added to the APDC after the end of the episode. The diagnosis information was downloaded more than seven weeks after the end of the reporting quarter; the NSW completion rate for diagnosis information was above 95% for any week until the week ending 25 December 2022.

In this report, quarterly patterns of admitted patient activity were provided for three clinical cohorts (Table 1).

Admitted patients' experiences

The Adult Admitted Patient Survey (AAPS) asks for feedback from people who have recently been admitted to a NSW public hospital. Each year BHI sends questionnaires to people within three months of the end of their hospital stay.

Patients' overall ratings of their hospital care were presented for each month from July 2019 to June 2022 to provide insights into admitted patients' experiences at different times throughout the pandemic. Survey responses were weighted to optimise the degree to which results were representative of the experiences and outcomes of the overall patient population. From July 2019 to December 2021, monthly percentages were weighted with annual weights, while from January 2022 to June 2022, they were weighted by quarterly weights. Changes in monthly percentages are not adjusted for changing patient characteristics over time. Further technical details about the AAPS are available in [previous technical supplements](#).

Table 1 ICD-10-AM diagnostic groups and corresponding clinical cohorts included in admitted patients chapter analysis

Clinical cohort	ICD-10-AM codes
Respiratory system	J00-J99 Disease of respiratory system
Mental health	<p>F10-F19 excluding 'F1n.5' where n is an integer 0–9: Mental and behavioural disorders due to psychoactive substance use</p> <p>F20-F29: Unspecified mental disorder. F1n.5, where n is an integer 0-9: Drug and alcohol use where psychotic disorder is present</p> <p>F30-F39: Mood (affective) disorders</p> <p>F40-F48: Neurotic, stress-related and somatoform disorders</p> <p>F50-59: Behavioural syndromes associated with physiological disturbances and physical factors</p> <p>F60-69 Disorders of adult personality and behaviour</p> <p>F80-89: Disorders of psychological development</p> <p>F90-F98: Behavioural and emotional disorders with onset usually occurring in childhood and adolescence</p> <p>F99: Unspecified mental disorder</p> <p>R44-R45 Symptoms and signs involving cognition, perception, emotional state and behaviour</p> <p>Z60 Problems related to social environment</p> <p>Z63 Other problems related to primary support groups, including family circumstance</p>
Injury	S00-T98: Injury, poisoning and certain other consequences of external causes

Elective surgery

Elective surgery waiting list data was accessed via the Waiting List Collection On-line System (WLCOS) which includes information on the date a patient is listed for surgery, the type of surgery required, the specialty of the surgeon, the urgency category of their surgery and whether the patient is currently ready for surgery. Some of these factors may change during the time a patient is on the waiting list. Elective surgery waiting list data are uploaded monthly.

The categories 'rural' and 'urban' were created by classifying each hospital according to the Accessibility and Remoteness Index of Australia (ARIA+), which is the standard used by ABS.

Activity and performance measures are calculated by BHI using methodology outlined in the [technical supplement](#) to *Healthcare Quarterly, October to December 2022*.

Virtual care

Virtual outpatient care

Total outpatient service events were extracted from the centralised data warehouse, Enterprise Data Warehouse for Analysis Reporting and Decision Support (EDWARD), administered by the NSW Ministry of Health. The number of service events were then split by the contact modes 'in-person', 'telephone', 'video call' and 'other', where 'other' included services delivered by electronic messaging, email or other technology. Service events were also split by rurality of the patient's residence, where the categories 'rural' and 'urban' were created by classifying each patient's postcode according to the Accessibility and Remoteness Index of Australia (ARIA+), which is the standard used by ABS.

The number of service events reported may differ from that of previous *Healthcare in Focus* reports. In previous reports, service events were obtained via NSW Health's Virtual Care app which sourced non-admitted patient data from the HIE. Moreover, in previous reports, service events were split by rurality of local health district (LHD) rather than rurality of patient postcode.

Patients' experiences of virtual care with public hospital outpatient clinics

The Virtual Care Survey asks people who had a virtual care appointment with a hospital outpatient clinic to provide feedback about their virtual care experiences. BHI partnered with the NSW Ministry of Health to develop this state-wide survey to help inform the monitoring and evaluation of the NSW Health Virtual Care Strategy. To date, it has been conducted twice – in 2020 and 2021.

The results of the Virtual Care Survey 2020 reflect the experiences of 2,618 people who had at least one virtual care appointment with a NSW public hospital outpatient clinic in 2020. The results of the Virtual Care Survey 2021 reflect the experiences of 2,816 people who had at least one virtual care appointment with a NSW public hospital outpatient clinic in 2021.

The eligible population included patients aged 18+ years who had a virtual care appointment (telephone or video call) at an eligible NSW public hospital outpatient clinic. Further technical details about the Virtual Care Surveys are available in [previous technical supplements](#).

Patients' experiences of virtual care with general practitioners

The results of the Virtual Care Survey 2021 also reflect the experiences of 1,810 hospital outpatients who had a virtual care experience with a general practitioner (GP).

The number of Medicare-subsidised GP attendances by type of appointment (in-person or virtual) in each month between January 2019 and December 2022 were extracted from Medicare Benefit Scheme data made available from Services Australia.² Data were presented by month of processing rather than month of service. Attendances based on month of processing may differ slightly from those based on month of service (depending on the number of days in the month, public holidays and overtime workload). Items for GP attendances were identified using Broad Type of Service groups (0101, 0102 and 0103) and flags indicating whether attendances were in-person or via telephone or video.

The data in the report include only those services that are performed by a registered provider, for services that qualify for the Medicare Benefit and for which a claim has been processed by Services Australia. They do not include services provided by hospital doctors to public patients in public hospitals or services that qualify for a benefit under the Department of Veterans' Affairs National Treatment Account.

Hospital admissions and mortality outcomes

Admissions and mortality

Data were drawn from the Hospital Performance Dataset, NSW Ministry of Health Secure Analytics for Population Health Research and Intelligence. The dataset links admitted patient records with death records from the Registry of Births Deaths and Marriages (RBDM). Record linkage was carried out by the Centre for Health Record Linkage (CHeReL).

Admissions to public or private hospitals for each of six clinical conditions were identified according to the inclusion and exclusion criteria listed in Table 2. Post-admission deaths were identified by examining a 30-day window between admission and death for each patient and flagging whether they had been admitted for one of the six clinical conditions. Some patients may have been admitted for more than one of the conditions within 30 days of their death. In such cases, a patient may appear in more than one clinical cohort.

Prediction model for estimating expected range of deaths

To estimate the expected range in relation to all-cause mortality and 30-day mortality following admission for each of six clinical conditions, BHI used methods established by the Australian Bureau of Statistics (ABS). The ABS uses Serfling's method³ to estimate excess deaths during the pandemic. The method models the pattern of deaths 4–6 years before the pandemic (i.e. before 2020) to establish a normal pre-pandemic (i.e. baseline) pattern of mortality. It then forecasts the normal pattern forward into the 2020–2022 pandemic period to predict the number of deaths that would have occurred had the pandemic not taken place. While the method is frequently used to model weekly numbers of deaths, BHI adapted it to model monthly deaths, largely as a means of avoiding problems posed by small numbers of post-admission deaths on a weekly timescale. While this decreased the number of baseline data points on which a forecast could be built, BHI mitigated this by extending the baseline period to six years, from January 2014 to December 2019.

Serfling's model allows for the estimation of upper and lower thresholds that define an 'expected range of deaths'. When the actual number of deaths resides in the upper part of the expected range, the number of deaths is said to be above what would be expected had the pandemic not taken place. Conversely, when actual deaths reside in the lower part of the expected range, the number of deaths is said to be below what would be expected had the pandemic not taken place. The report names the months that the number of deaths for selected clinical conditions were higher or lower than expected, based on six-year monthly trends before the pandemic, in instances when deaths are outside expected monthly variation. Although upper and lower thresholds can be based on a range of criteria depending on the goals of analysis, BHI's thresholds were based on a the commonly used 1.96 standard errors (of prediction) either side of the expected number of deaths estimated by the model.

Serfling's model was fitted using a robust regression procedure which down-weights extreme events in the baseline (pre-pandemic) such that their influence on forecasts is minimised. Seasonality was modelled as a harmonic with a 12-month cycle. Trends were modelled with a linear and quadratic term to account for any curvature. If the quadratic term did not improve model fit, it was removed from the model. Counts were modelled as Gaussian – the probabilistic calculations underlying the upper and lower mortality thresholds were therefore based on approximations of a normal distribution. The model is:

$$Deaths_t = A + Bt + Ct^2 + Dsine(2\pi t/p) + Ecosine(2\pi t/p)$$

where A , B , C , D , and E are the coefficients calculated from the regression, t is time (monthly) and p is a seasonal term set to 12 for a monthly series.

Table 2 Inclusion and exclusion criteria used to identify six condition cohorts in admitted patient data

Cohort	Inclusion criteria	Exclusion criteria
Pneumonia	Principal diagnosis of pneumonia (ICD-10-AM codes J13, J14, J15, J16, J18) Aged 18+ years Acute emergency admissions	Admissions to NSW hospitals administered by agencies external to NSW (i.e. Albury Base Hospital) Admissions with a secondary diagnosis of palliative care (Z51.5) ED-only admissions
Chronic obstructive pulmonary disease (COPD)	Principal diagnosis of COPD (ICD-10-AM codes J20*, J40*, J41, J42, J43, J44, J47) (*only if accompanied by a secondary diagnosis of J41, J42, J43, J44 or J47) Aged 45+ years Acute emergency admissions	Admissions to NSW hospitals administered by agencies external to NSW (i.e. Albury Base Hospital) Admissions with a secondary diagnosis of palliative care (Z51.5) ED-only admissions
Ischaemic stroke	Principal diagnosis of ischaemic stroke (ICD-10-AM code I63) Aged 15+ years Acute emergency admissions	Admissions to NSW hospitals administered by agencies external to NSW (i.e. Albury Base Hospital) Admissions with a secondary diagnosis of palliative care (Z51.5) ED-only admissions
Haemorrhagic stroke	Principal diagnosis of haemorrhagic stroke (ICD-10-AM codes I61, I62) Aged 15+ years Acute emergency admissions	Admissions to NSW hospitals administered by agencies external to NSW (i.e. Albury Base Hospital) Admissions with a secondary diagnosis of palliative care (Z51.5) ED-only admissions
Acute myocardial infarction (AMI)	Principal diagnosis of AMI (ICD-10-AM code I21) Aged 15+ years Acute emergency admissions	Admissions to NSW hospitals administered by agencies external to NSW (i.e. Albury Base Hospital). Admissions with hospitalisations coded as 'STEMI, not specified' (ICD-10-AM code I21.9) Admissions with a secondary diagnosis of palliative care (Z51.5) ED-only admissions
Congestive heart failure (CHF)	Principal diagnosis of congestive heart failure (ICD10-AM codes I11.0, I13.0, I13.2, I50.0, I50.1, I50.9) Aged 45+ years Acute emergency admissions	Admissions to NSW hospitals administered by agencies external to NSW (i.e. Albury Base Hospital) Admissions with a secondary diagnosis of palliative care (Z51.5) ED-only admissions

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