Data outlier review protocol

1. Background

The Australian and New Zealand Hip Fracture Registry (ANZHFR) is a clinical registry that collects data on the care provided, and the outcomes of care, for older people admitted to hospital with a hip fracture in Australia and New Zealand. The aim of the ANZHFR is to use data to improve performance and maximise outcomes for older people who have sustained a hip fracture.

The ANZHFR data outlier review protocol details the identification and management of outlier values for binational indicators of hip fracture care at the level of the participating hospital.

2. Key indicators of hip fracture care

A Clinical Care Standard has been developed for hip fracture outlining the clinical care that a patient with a hip fracture should be offered [1]. The 16 quality indicators in the *Hip Fracture Care Clinical Care Standard* [1] focus on the priority areas for quality improvement in hip fracture care and, as such, were selected for the identification of outliers of hospital-level performance and subsequent investigation of the causes of variation by participating hospitals (Appendix 1).

3. Identification of outliers

Outliers constitute unusually low or high values for an indicator of clinical care quality. Relevant statistical methods will be used to determine what constitutes an outlier as described in Sections 3a and 3b. Note: any outlier outcomes are retained within the ANZHFR annual report, with no data modified after the data provision close-off date, however an explanation of the outlier would be included in the annual report, where possible.

3a. Review of care quality indicators

All clinical care quality indicators are reported as a percentage for each hospital in the ANZHFR annual report, bar 30-day mortality (see Section 3b). Where a hospital's percentage value for an indicator is:

- less than 2 standard deviations from the average performance of all hospitals for the indicator, the result is considered to be within 'normal variation';
- between 2 and 3 standard deviations from the average performance of all hospitals for the indicator, the result will be considered an 'alert' and the lead investigator notified of the outcome; and
- greater than 3 standard deviations from the average performance of all hospitals for the indicator, the result will be considered an 'outlier' and the lead investigator notified of the outcome (see Section 4. Review and management of outliers). If non-parametric analyses are required, then an 'outlier' will be observations in the 1st percentile, an 'alert' will be observations between the 1st and 2.5th percentile, with observations above the 2.5th percentile considered 'normal variation' (Appendix 2).

3b. Review of 30-day mortality indicator (i.e. Indicator 8b)

Thirty-day mortality will be assessed against a rolling average of the previous 3 years ANZHFR data. The examination of survival at 30 days post-admission for hip fracture surgery should take into account the case-mix of hip fracture patients at each hospital. The 30-day mortality indicator will be risk adjusted for: age group, gender, ASA grade, source of admission, pre-fracture mobility, and fracture type [2] (Appendix 3).

Funnel plots will be used to indicate variation for 30-day mortality by hospital. A binomial logistic regression model will be used to generate the predicted probabilities of 30-day mortality. The predicted probabilities produced in the model will be summed for each hospital to produce the expected values. A standardised ratio will be calculated for each hospital using the number of observed and expected events for 30-day mortality. Two sets of upper and lower control limits (i.e., 95% CL, 99.8% CL) will be calculated for the standardised ratio based on a Poisson distribution [3]. Hospitals with values outside the upper or lower control limits will be considered to represent outliers for review.

4. Review and management of outliers

Annual review of outliers will be overseen by the ANZHFR Data Management sub-committee that will report review results to the ANZHFR Steering Committee. Management of outliers will be overseen by the ANZHFR Steering Committee. The ANZHFR Australian and New Zealand Managers will notify the lead investigator at each hospital site that their hospital has had an outlier result for one (or more) indicators of hip fracture care.

The clinical care quality indicator review process includes:

- The lead investigator reviewing their hospital's ANZHFR dashboard with the local multidisciplinary team to assess data completeness and data accuracy for the indicators of hip fracture care. If data outliers are identified in specific indicators of hip fracture care, participation in a hospital-level data quality audit of ANZHFR data is recommended by the ANZHFR Steering Committee.
- If data outliers are identified in the indicators of hip fracture care, outliers may be the result of an anomaly in hip fracture care practices. A review of local hip fracture treatment protocols and procedures by the lead investigator with their local multidisciplinary team will assist with identifying possible reasons an outlying result(s) has occurred for the specific indicator of hip fracture care.
- If the hospital-level review confirms that a hip fracture care quality indicator is a true outlier relative to the average of all hospitals, then a plan to address the performance gap should be developed by the lead investigator in conjunction with colleagues at their organisation. Input from the ANZHFR Steering Committee can be requested by the lead investigator if required.
- If no improvement in the hip fracture indicator(s) is seen at the hospital-level in the following year's ANZHFR annual report, then a review of the actions undertaken to address the performance gap by the lead investigator and colleagues is recommended.

References

1. Australian Commission on Safety and Quality in Health Care. *Hip fracure care clinical care standard*. 2016.
2. Royal College of Physicians, *Detection and management of mortality outliers for the National Hip Fracture Database*, 2018, Royal College of Physicians: London.
3. Breslow, N and Day, N, *Statistical methods in cancer research*. 1987, London: Oxford University Press.

Appendix 1: The ANZHFR Outlier review protocol examines performance on 16 indicators from the ACSQHC Hip Fracture Care Clinical Care Standard

QS1: Care at presentation	
Indicator 1a:	Evidence of local arrangements for the management of patients with hip fracture in the emergency department
Indicator 1b:	Proportion of patients with a hip fracture who have had their preoperative cognitive status assessed
QS2: Pain management	
Indicator 2a:	Evidence of local arrangements for timely and effective pain management for hip fracture
Indicator 2b:	Proportion of patients with a hip fracture who have documented assessment of pain within 30 minutes of presentation to the emergency department AND either receive analgesia within this time or do not require it according to the assessment
QS3: Orthogeriatric model of care	
Indicator 3a:	Evidence of orthogeriatric (or alternative physician or medical practitioner) management during their admitted hip fracture episode of care
QS4: Timing of surgery	
Indicator 4a:	Proportion of patients with a hip fracture receiving surgery within 48 hours of presentation with the hip fracture
QS5: Mobilisation and weight bearing	
Indicator 5a:	Proportion of patients with a hip fracture who are mobilised on day one post hip fracture surgery
Indicator 5b:	Proportion of patients with a hip fracture with unrestricted weight-bearing immediately post hip fracture surgery
Indicator 5c:	Proportion of patients with a hip fracture experiencing a new Stage II or higher pressure injury during their hospital stay
Indicator 5d:	Proportion of patients with a hip fracture returning to pre-fracture mobility
QS6: Minimising risk of another fracture	
Indicator 6a:	Proportion of patients with a hip fracture receiving bone protection medicine at discharge from the operating hospital
Indicator 6b:	Proportion of patients with a hip fracture readmitted to hospital with another femoral fracture within 12 months of admission from initial hip fracture
QS7: Transition from hospital care	
Indicator 7a:	Evidence of local arrangements for the development of an individualised care plan at discharge for hip fracture patients
Indicator 7b:	Proportion of patients with a hip fracture living in a private residence prior to their hip fracture returning to private residence within 120 days post-discharge from hospital
Effectiveness indicators (Australia)	
Indicator 8a:	Re-operation of hip fracture patients within 30-day follow up
Indicator 8b:	Survival at 30 days post-admission for hip fracture surgery

Appendix 2: Hip fracture care quality indicators

Australian and New Zealand data from the ANZHFR patient-level data and also from the annual hospital survey is used to identify potential outliers of hospital-level performance.

Information on Indicators 1a, 2a, and 7a are obtained from the annual hospital survey and are reported as either 'evidence provided' or 'evidence not provided'. Indicator data is obtained using the following survey data variables: Indicator 1a (hipfrac_path), Indicator 2a (pain_path), and Indicator 7a (prevention_written).

Information on the remaining indicators (excluding Indicators 6b and 8a that are currently not collected) is obtained from the patient-level data. Not all indicators are available for every year of data and some indicators require a couple a number of data variables to be generated. Indicator data is obtained using the following patient-level data variables: Indicator 1b (cogassess), Indicator 2b (painassess and painmanage), Indicator 3a (passess and gerimed), Indicator 4a (arrdate, arrtime, sdate and stime), Indicator 5a (mobil), Indicator 5b (wbear), Indicator 5c (pulcers), Indicator 5d (walk and Fwalk2), Indicator 6a (dbonemed1), and Indicator 7b (uresidence and fresidence2).

The following should be noted:

- Indicator 1b 'Proportion of patients with a hip fracture who have had their preoperative cognitive status assessed' is recorded from 2017.
- Indicator 2b 'Proportion of patients with a hip fracture who have documented assessment of pain within 30 minutes of presentation to the emergency department AND either receive analgesia within this time or do not require it according to the assessment' is recorded from 2017.
- Indicator 3a 'Evidence of orthogeriatric (or alternative physician or medical practitioner) management during their admitted hip fracture episode of care' could be measured via two methods 'Preoperative medical assessment' equals 1 (Geriatrician/Geriatric team) or 2 (Physician/ Physician team) or via 'Assessed by geriatric medicine' equals 1 ('Yes') and both data variables are reported separately.
- Indicator 4a 'Proportion of patients with a hip fracture receiving surgery within 48 hours of presentation with the hip fracture' is generated by subtracting surgery date/time from arrival date/time.
- Indicator 5d 'Proportion of patients with a hip fracture returning to pre-fracture mobility' is generated by 'Walking ability at 120 days' is equal (i.e. same score) or better (i.e. lower score) than 'Preadmission walking ability'.
- Indicator 7b 'Proportion of patients with a hip fracture living in a private residence prior to their hip fracture returning to private residence within 120 days post-discharge from hospital' is generated by 'Usual residence' equals 1 ('Private residence') and 'Residence at 120 days' equals 1 ('Private residence').

Appendix 3: Review of 30-day mortality indicator

Australian data from the ANZHFR is linked with the National Death Index (NDI) by the Australian Institute of Health and Welfare (AIHW) on a routine basis to enable calculation of Indicator 8b - survival at 30 days post-admission for hip fracture surgery.

Review of data quality

A review of data quality is conducted prior to statistical analysis. The following data quality assessments are conducted:

- Duplicate hospitalisation records for the same person reviewed (i.e. review to examine the admission and discharge dates, age, sex, and side of hip fracture).
- Records with date of death earlier than the recorded dates of hospitalisation or surgery reviewed (i.e. records with hospital admission or surgery date after the date of death).
- Records with admission date after surgery date are excluded.
- Records with admission date after death date are excluded.
- Age <50 or >115 are excluded.
- Missing data for age and sex are excluded for the calculation of 30-day mortality.
- Missing data for admission date are excluded.

Crude and risk-adjusted 30-day mortality

Crude and risk-adjusted 30-day mortality rates within each hospital is estimated and presented using funnel plot methodology (Spiegelhalter 2005).

Adjusted estimates are derived using a logistic regression model, with adjustment made for:

- sex;
- age;
- premorbid level of function (mobility);
- fracture type;
- residence type; and
- ASA.

Data variables used for adjustment are categorised as:

- To satisfy the linearity in the logit assumption age was used as a continuous covariate in the 2016-2018 30-day mortality model.
- Pre-operative mobility was categorised as: (i) Usually walks without walking aids; (ii) Mobile with 1 or 2 aids or frame; and (iii) Wheelchair or bedbound.
- Fracture type was categorised as: (i) intracapsular and (ii) extracapsular, including other.
- Residence type categorised as: (i) private residence including retirement village; (ii) RACF; (iii) Other; and (iv) Not known and missing.
- ASA grade aggregated as (i) ASA grades 1 to 2; (ii) ASA grade 3 and unknown; and (iii) ASA grades 4 and 5 according to relevant literature (Tsang 2014).

References

1. Spiegelhalter DJ. Funnel plots for comparing institutional performance. Statistics in medicine 2005; 24(8): 1185-202.
2. Tsang C CD. Statistical methods developed for the National Hip Fracture Database annual report, 2014: a technical report. London: The Royal College of Surgeons of England, 2014.