Adherence to clinical care standards and mortality after hip fracture surgery in New South Wales, 2015–2018: a retrospective population-based study

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The known: Survival after hip fracture has improved in Australia in recent years. It is unknown whether the national hip fracture care clinical care standard has contributed to this improvement.

The new: Clinical care for two-thirds of hip fractures in people who underwent surgery in New South Wales during 2015–2018 adhered to at least five of six acute care quality indicators; significantly lower short and longer term mortality were associated with such care.

The implications: Quality hip fracture care is associated with improved survival. However, as care for one-third of fractures did not achieve high level adherence to quality care, the delivery of hip fracture care must be further improved.

Abstract

Objectives: To determine whether adherence to hip fracture clinical care quality indicators influences mortality among people who undergo surgery after hip fracture in New South Wales, both overall and by individual indicator.

Study design: Retrospective population-based study; analysis of linked Australian and New Zealand Hip Fracture Registry (ANZHFR), hospital admissions, residential aged care, and deaths data.

Setting, participants: People aged 50 years or older with hip fractures who underwent surgery in 21 New South Wales hospitals participating in the ANZHFR, 1 January 2015 – 31 December 2018.

Main outcome measures: Thirty-day (primary outcome), 120-day, and 365-day mortality (secondary outcomes) by clinical care indicator adherence level (low: none to three of six indicators achieved; moderate: four indicators achieved; high: five or six indicators achieved) and by individual indicator.

Results: Registry data were available for 9236 hip fractures in 9058 people aged 50 years or older during 2015–2018; the mean age of patients was 82.8 years (standard deviation, 9.3 years), 5510 patients were women (69.4%). Complete data regarding adherence to clinical care indicators were available for 7951 fractures (86.1%); adherence to these indicators was high for 5135 (64.6%), moderate for 2249 (28.3%), and low for 567 fractures (7.1%). After adjustment for age, sex, comorbidity, admission year, pre-admission walking ability, and residential status, 30-day mortality risk was lower for high (adjusted relative risk [aRR], 0.40; 95% confidence interval [CI], 0.30–0.52) and moderate indicator adherence hip fractures (aRR, 0.61; 95% CI, 0.46–0.82) than for low indicator adherence hip fractures, as was 365-day mortality (high adherence: aRR, 0.59 [95% CI, 0.51–0.68]; moderate adherence: aRR, 0.74 [95% CI, 0.63–0.86]). Orthogeriatric care (365 days: aRR, 0.78; 95% CI, 0.61–0.98) and offering mobilisation by the day after surgery (365 days: aRR, 0.74; 95% CI, 0.67–0.83) were associated with lower mortality risk at each time point.

Conclusions: Clinical care for two-thirds of hip fractures attained a high level of adherence to the six quality care indicators, and short and longer term mortality was lower among people who received such care than among those who received low adherence care.

Hip fractures, most of which are caused by falls, are devastating for older people. They are associated with substantial morbidity and mortality, reduced quality of life, and loss of independence; 25% of people die within twelve months of hip fractures, 50% do not regain their previous level of function, and for 11% the fracture leads to admission to residential care.[1,2] It was estimated that there would be one hip fracture in Australia every 16.2 minutes in 2022,[3] a substantial increase from one in every 33.5 minutes in 2002.[4] The increase largely comprises fractures in people aged 85 years or older and among those living with dementia,[5,6] adding to the complexity and cost of care.

Poor quality and coordination of care, including delayed surgery, delayed mobilisation, and not using an orthogeriatric model of care, have been associated with poor outcomes for people with hip fractures.[7-9] In Australia, the aim of the Australian and New Zealand Hip Fracture Registry (ANZHFR; https://anzhfr.org) guideline for hip fracture care[10] is to promote high quality care and reduce unnecessary variation in treatment. The guideline underpins the Australian Commission on Safety and Quality in Health Care (ACSQHC) hip fracture clinical care standard, introduced in 2016.[11] ANZHFR has collected and reported data on a set of quality indicators that have been used to measure adherence to the standard since 2016. The introduction of evidence-based clinical care standards has been associated with lower mortality in the United Kingdom[12-14] and Norway.[15] A recent study in New South Wales found that 30-day mortality among people who underwent surgery after hip fracture declined by 3.0% per year and 12-month mortality by 2.3% per year during 2011–2018.[16] However, the contributions of the introduction of guidelines, standards, and ANZHFR to these declines is unclear.

The aim of our study was to determine whether adherence to clinical care quality indicators influences mortality among people who undergo surgery after hip fracture in New South Wales, both overall and for individual indicators.

Methods

For our retrospective, population-based study, we analysed linked ANZHFR, hospital admissions, residential aged care facilities, and deaths data. We included data for all people aged 50 years or older who underwent hip fracture surgery in a participating NSW hospital during 1 January 2015 – 31 December 2018. The ANZHFR is a clinical quality registry that includes data from 21 New South Wales hospitals for the time period we examined. The registry includes patient-level data on demographic characteristics and care received, including comparison with the ACSQHC quality care indicators. ANZFHR

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data were linked to the NSW Admitted Patient Data Collection, which records data for all hospitalisations in NSW public and private hospitals, including demographic information for patients, diagnosis codes, and procedures; the Registry of Births, Death and Marriages mortality database, which includes records for all deaths of NSW residents; and the National Aged Care Data Clearing House, which records the dates of entry to and departure from residential aged care facilities, enabling determination of residential aged care status at time of fracture. Linkage of registry and hospital and mortality data was undertaken by the Centre for Health Record Linkage (CHeReL); linkage to residential aged care was undertaken by the Australian Institute of Health and Welfare Data Linkage Unit. We report the study in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.[17]

Clinical indicators

The ACSQHC hip fracture care clinical care standard comprises seven quality statements supported by 16 quality indicators.[11] Eight quality indicators are specifically related to the provision of acute care at the patient level; the six indicators for which the registry consistently collected data during the study period were included in our analysis (Box 1). Data for two acute care indicators — assessment of cognitive status prior to surgery; pain assessment within 30 minutes of emergency department presentation and provision of analgesia within this time if required — were only routinely collected from 2017, and were therefore not included in the analysis. Level of adherence to the indicators was classified as low (three or fewer indicators attained), moderate (four indicators attained), or high (five or six indicators attained), an approach that ensures reasonable proportions based on the frequency distribution of all patients.[12]

1 Attainment of clinical care standards, by ACSQHC hip fracture clinical care standard indicator, for 7951 hip fractures in people aged 50 years or older who underwent surgery in 21 New South Wales hospitals after hip fractures, 2015–2018 (complete case analysis)

Indicator[11]	Indicator attained	
	Yes	No
Standard 3. Orthogeriatric model of care		
3a. Orthogeriatric (or alternative physician or medical practitioner) management	7378 (92.8%)	573 (7.2%)
Standard 4. Timing of surgery		
4a. Surgery within 48 hours of presentation with hip fracture	6034 (75.9%)	1917 (24.1%)
Standard 5. Mobilisation and weight bearing		
5a. Offered mobilisation by day after hip fracture surgery	7039 (88.5%)	912 (11.5%)
5b. Unrestricted weight-bearing status immediately after hip fracture surgery	7615 (95.8%)	336 (4.2%)
5c. Did not experience a new pressure ulcer (stage II or higher) during hospital stay	7723 (97.1%)	228 (2.9%)
Standard 6. Minimising risk of another fracture		
6a. Received bone protection medication prior to discharge from hospital at which they underwent surgery	1476 (18.6%)	6475 (81.4%)

ACSQHC = Australian Commission on Safety and Quality in Health Care. ◆

Outcomes and covariates

The primary outcome was 30-day all-cause mortality; secondary outcomes were 120-day and 365-day all-cause mortality. Patient-level factors that influence mortality included as covariates were age, sex, comorbidity, pre-fracture mobility, residential aged care facility status, and year of admission. Comorbidity was determined from linked hospital records using the Charlson Comorbidity Index with a 12-month lookback period, a good predictor of 30-day mortality among people with hip fractures.[18] The weighted Charlson Comorbidity Index score was classified as indicating no comorbidity (0), mild comorbidity (1 or 2), or severe comorbidity (3 or more). Pre-fracture mobility was identified in ANZHFR data, and classified as walking without aids, walking with a stick or crutch, walking with two aids or a frame, or as being wheelchair- or bed-bound. Pre-admission residential aged care status was determined from residential aged care data.

Statistical analysis

We summarise demographic characteristics, both overall and by level of quality indicator attainment, as means with standard deviations (SDs) for normally distributed continuous variables and as numbers and proportions for categorical variables. Associations between indicator attainment and short and longer term mortality were assessed in modified multivariable Poisson regression analyses, adjusted for age, sex, comorbidity, mobility, residential aged care status, and admission year; we report adjusted relative risks (aRRs) with 95% confidence intervals (CIs). To ensure complete capture of mortality outcomes, data for people admitted to hospital after 30 November 2018 were excluded from the 30-day mortality analysis, after 31 August 2018 from the 120-day mortality analysis, and after 31 December 2017 from the 365-day mortality analysis. Only fractures for which complete indicator adherence data were available were included in the primary analysis. In a sensitivity analysis that included data for all hip fractures, indicator attainment was classified as "yes" if the indicator was attained or "no" if it was not attained or the outcome was not documented or was unknown. All analyses were performed in SAS Enterprise Guide 8.4.

Ethics approval

The study was approved by the NSW Population Health Service Research Ethics Committee (2019/ETH01622) and the Australian Institute of Health and Welfare Ethics Committee (EO2018/1/401).

Results

Registry data were available for 9058 people aged 50 years or older who underwent hip fracture surgery in a participating NSW hospital during 2015–2018; as 89 people had more than one hip fracture, data for 9236 fractures were available. Mean age at hip fracture was 82.8 years (SD, 9.3 years); 5510 of 9058 patients were women (69.4%).

Complete data regarding adherence to clinical care standard indicators were available for 7951 fractures (86.1%) and were included in our analysis. Indicator attainment varied widely: 1476 people (18.6%) received bone protection medication at the time of discharge from hospital, 7615 attained unrestricted

2 Characteristics of people aged 50 years or older who underwent surgery in 21 New South Wales hospitals after hip fractures, 2015–2018 (7951 hip fractures: complete case analysis), by clinical care indicator adherence level

Characteristic	Clinical care indicator adherence level		
	Low	Moderate	High
Number of hip fractures	567 [7.1%]	2249 [28.3%]	5135 [64.6%]
Age group (years)			
50–74	185 (33.5%)	546 (24.9%)	822 (16.4%)
75–84	154 (27.9%)	641 (29.2%)	1724 (34.4%)
85 or older	214 (38.7%)	1005 (45.9%)	2469 (49.2%)
Unknown/missing data	14	57	20
Sex			
Men	208 (36.8%)	755 (33.6%)	1472 (28.7%)
Women	358 (63.2%)	1492 (66.4%)	3660 (71.3%)
Unknown/missing data	1	2	3
Pre-admission cognitive status			
Normal cognition	353 (63.9%)	1356 (61.6%)	3096 (62.0%)
Impaired cognition	199 (36.1%)	845 (38.4%)	1894 (38.0%)
Unknown/missing data	15	48	145
American Society of Anaesthesiologists Classification			
I	7 (1.5%)	49 (2.6%)	121 (2.8%)
II	63 (13.8%)	289 (15.2%)	795 (18.2%)
III	251 (55.0%)	1122 (58.8%)	2718 (62.3%)
IV/V	135 (29.6%)	448 (23.5%)	732 (16.8%)
Unknown/missing data	111	341	769
Charlson Comorbidity Index Score (weighted)			
0	160 (28.7%)	729 (33.1%)	1991 (39.5%)
1 or 2	211 (37.8%)	852 (38.7%)	1883 (37.3%)
3 or more	187 (33.5%)	621 (28.2%)	1171 (23.2%)
Unknown/missing data	9	47	90
Pre-fracture mobility			
Walks without walking aids	246 (44.3%)	1062 (47.6%)	2371 (46.6%)
Walks with stick or crutch	78 (14.1%)	308 (13.8%)	808 (15.9%)
Walks with two aids or frame	187 (33.7%)	788 (35.4%)	1801 (35.4%)
Wheelchair/bedbound	44 (7.9%)	71 (3.2%)	104 (2.1%)
Unknown/missing data	12	20	51
Pre-fracture residence			
Community-dwelling	414 (73.0%)	1608 (71.5%)	3778 (73.6%)
Residential aged care facility	153 (27.0%)	641 (28.5%)	1357 (26.4%)
Deaths			
In-hospital (acute care)	45 (7.9%)	67 (3.0%)	79 (1.5%)
30-day*	60 (10.8%)	150 (6.8%)	208 (4.1%)
120-day†	128 (25.2%)	330 (16.3%)	552 (11.7%)
365-day‡	137 (36.3%)	394 (27.5%)	706 (20.2%)

* Excludes 153 patients admitted after 30 November 2018. † Excludes 676 patients admitted after 31 August 2018. ‡ Excludes 2632 patients admitted after 31 December 2018. ◆

weight-bearing status immediately after surgery (95.8%), and 7723 did not develop new pressure injuries in hospital (97.1%) (Box 1).

For 5135 hip fractures (64.6%), the indicator adherence level was high, for 2249 fractures (28.3%) moderate, and for 567 fractures (7.1%) low. There was no clear pattern of change over the study period in the number of indicators attained or level of attainment (Supporting Information, figure 1). The proportions of fractures in women, people without other medical conditions, and people who were living in the community at the time of the fracture were larger for fractures with high indicator adherence than for fractures with low or moderate adherence (Box 2).

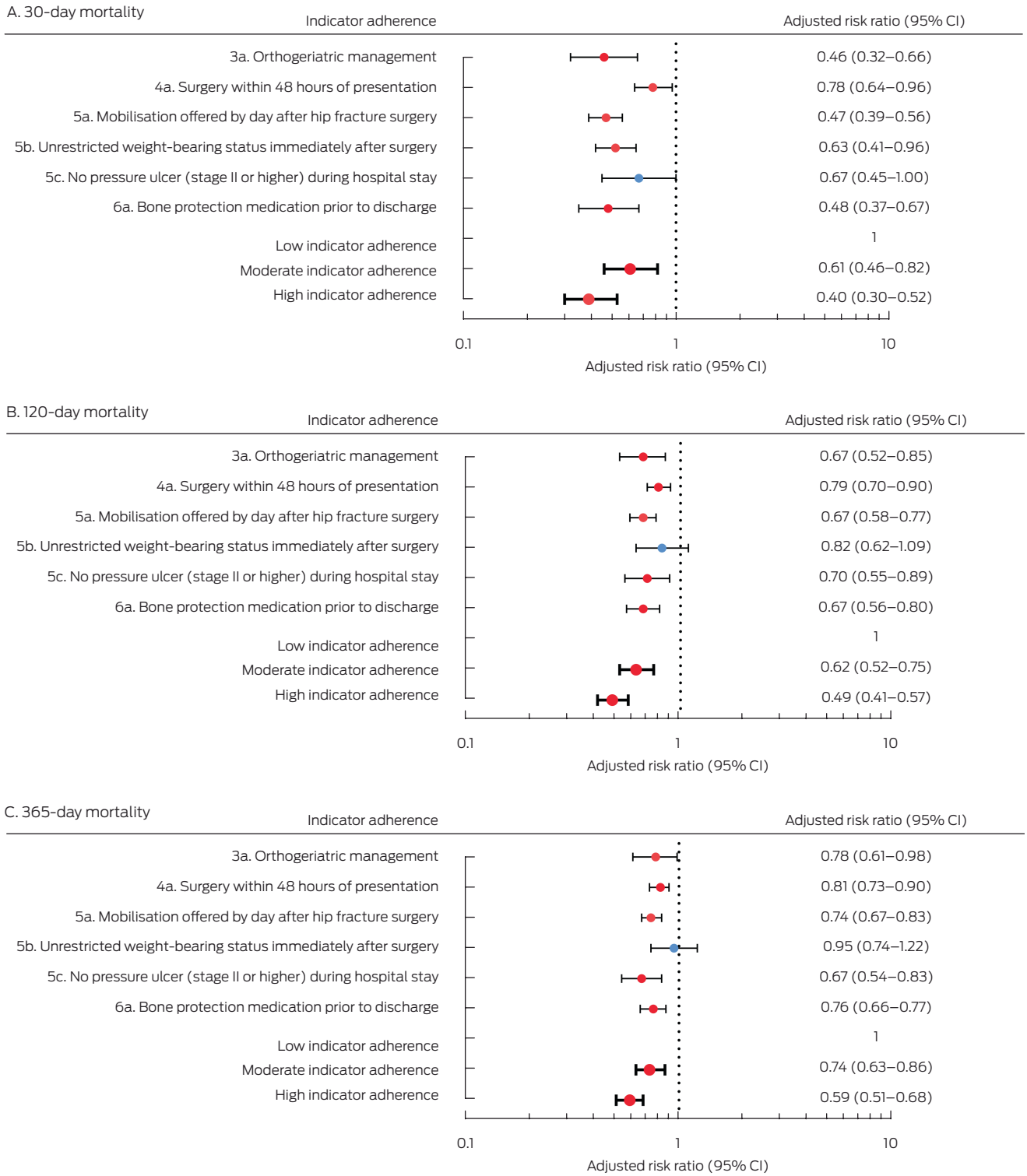
Unadjusted mortality was lowest for high indicator adherence hip fractures and greatest for low indicator adherence fractures at 30 days (high adherence, 4.1%; moderate adherence, 6.8%; low adherence, 10.8%), 120 days (high adherence, 11.7%; moderate adherence, 16.3%; low adherence, 25.2%), and 365 days (high adherence, 20.2%; moderate adherence, 27.5%; low adherence, 36.3%) (Box 2). Thirty-day mortality risk was lower for high (aRR, 0.40; 95% CI, 0.30–0.52) and moderate indicator adherence hip fractures (aRR, 0.61; 95% CI, 0.46–0.82) than for low indicator adherence hip fractures, as was 120-day risk (high adherence: aRR, 0.49 [95% CI, 0.41–0.57]; moderate adherence: aRR, 0.62 [95% CI, 0.52–0.75]) and 365-day risk (high adherence: aRR, 0.59 [95% CI, 0.51–0.68]; moderate adherence: aRR, 0.74 [95% CI, 0.63–0.86]). Orthogeriatric care (365 days: aRR, 0.78; 95% CI, 0.61–0.98) and offering mobilisation by the day after surgery (365 days: aRR, 0.74; 95% CI, 0.67–0.83) were associated with lower risk of mortality at each time point, as was surgery within 48 hours of presentation (365 days: aRR, 0.81; 95% CI, 0.73–0.90) (Box 3). The sensitivity analysis that included data for all fractures, regardless of the completeness of indicator adherence data, yielded similar results) (Supporting Information, table 1).

Discussion

We found that adherence to evidence-informed clinical quality indicators has a significant survival benefit for people aged 50 years or older who undergo surgery after a hip fracture. Short term mortality risk was 60% lower when five or six of the quality indicators were achieved, and 40% lower when four indicators were met, highlighting the cumulative impact of a number of care processes in hip fracture care and the need for a multidisciplinary approach to high quality care.

Time to surgery has consistently been identified as an important determinant of survival for people with hip fracture,[8] even after adjusting for delays related to comorbidity and acute illness. In Australia, the target has been surgery within 48 hours of presentation,[11] but the revised

3 Adherence to ACSQHC hip fracture clinical care standards and mortality risk, for 7951 hip fractures in people aged 50 years or older who underwent surgery in 21 New South Wales hospitals after hip fractures, 2015–2018 (complete case analysis): multivariable Poisson regression analyses*



ACSQHC = Australian Commission on Safety and Quality in Health Care; CI = confidence interval. * 30-day mortality: excludes 153 patients admitted after 30 November 2018; 120-day mortality: excludes 676 patients admitted after 31 August 2018; 365-day mortality: excludes 2,632 patients admitted after 31 December 2017. ◆

ACSQHC standard now stipulates surgery within 36 hours,[19] as also recommended in the United Kingdom, with evidence that this is associated with lower peri-operative complication and mortality rates.[8,20] Surgery was undertaken within 48 hours of presentation for more than 95% of high indicator adherence fractures in our study, but it was not for one-quarter of all fractures. Access to operating theatres is among the problems that need to be overcome to ensure that older people with hip fractures do not wait in bed, in pain and fasting, for unacceptably long periods.

Orthogeriatric care is associated with better outcomes after hip fracture surgery, including lower mortality.[9,21] In Australia, access to geriatricians is good in most hospitals that offer hip fracture surgery, but the model of care varies between hospitals, from shared care to intermittent review. Our findings included short and moderate term survival benefits of an orthogeriatric model of care (up to twelve months after surgery).

Similarly, early mobilisation is increasingly recognised as an important contributor to better outcomes after hip fracture surgery, including lower mortality[22] and lower post-surgery complication rates, including those of chest infection, thromboembolic disease, and pressure injuries.[23] In our study, patients were offered mobilisation within one day of surgery for 86% of fractures (and after 97% of high indicator adherence fractures), but the mobilisation measure used during the study period did not record whether people were actually mobilised. ANZHFR data indicate that the availability of weekend physiotherapy is increasing and that hospital clinicians recognise the importance of encouraging people to leave bed early to maximise the likelihood of meaningful functional recovery, as well as potentially reducing the length of hospital stay.

Secondary fracture prevention was the most poorly achieved quality indicator. Providing patients with treatment for osteoporosis on discharge from acute care was recorded for only 29% of high indicator adherence fractures, and 20% of all fractures, despite strong evidence for the value of treating osteoporosis and reducing fracture risk, as well as some evidence for a survival benefit for people treated for osteoporosis after hip fracture.[24,25] A recent ANZHFR sprint audit identified several reasons for this neglect of secondary fracture prevention, including patient-related factors (low vitamin D levels, need for dental procedures) and the reluctance of hospitals to fund treatments for a condition deemed to be a chronic disease. In our study, bone protection therapy was associated with lower mortality at all time points, indicating the need for greater awareness of the survival benefits and importance of initiating timely treatment.

The large sample size in our population-based study ensured that it was representative of all hip fractures in Australia, and that our findings are generalisable to other areas in Australia with similar demographic characteristics. Linkage of the registry data to hospital admissions and residential aged care data facilitated adjustment for comorbidity and accurate ascertainment of pre-fracture residential status, each of which is an important risk factor for death after hip fracture surgery. Linkage to death registry data facilitated accurate ascertainment of longer term mortality (longer than 120 days) than data routinely collected by hip fracture registries. The lower mortality risk following fractures with high adherence to the acute care standards — 60% at 30 days and 50% at 120 days — was consistent with the improved survival associated with high adherence to national clinical care standards in England and Wales[14] and Scotland,[12] and adherence to the standard of surgery within 48 hour in Norway.[15] Ours is the first study to report a survival benefit as long as one year after surgery was associated with adherence to clinical care standards that encompass a comprehensive approach to care.

While improving overall patient survival is important, assessments of health care should incorporate other measures meaningful to patients.[26] Health-related quality of life scores decline significantly after a hip fracture; they improve by 120 days, but remain lower than prior to the fracture.[27,28] Encouragingly, a multicentre cohort study in twenty United Kingdom hospitals found that the cumulative attainment of several Best Practice Tariff indicators was associated with clinically relevant improvement in health-related quality of life scores four months after hip fracture.[13] Although EQ-5D-5L data (a standardised measure of health-related quality of life) are collected by the ANZHFR, their reporting is not compulsory, and the available data are insufficient for robustly assessing the impact of attainment of care standards on health-related quality of life.

Limitations

Some limitations are inherent to all analyses of registry and administrative data. To minimise the impact of the large proportion of missing data for some adherence measures, we excluded two acute care indicators for which data were not collected across the entire study period. Their exclusion was unlikely to influence our estimates of the influence of adherence to care standards on mortality, as they were not statistically associated with mortality during the two years for which data were available (2017, 2018) (data not shown). Further, we restricted our main analysis to fractures for which complete data were available for the six included indicators, excluding 14% of hip fractures. While this complete case approach could bias our analysis, the sensitivity analysis that included all fractures yielded similar results; further, the only misclassification bias in the sensitivity analysis attributable to missing data would affect the non-adherence group and reduce the difference in outcomes between the two groups. We are therefore confident that the differences between the groups in our main analysis are robust and are generalisable to hip fractures in other Australian jurisdictions.

Identification of other medical conditions relied on the quality of International Statistical Classification of Disease and Related Health Problems, tenth revision, Australian modification (ICD-10-AM) coding in the data we analysed, which depends on clinicians accurately identifying and recording these conditions in medical records. Despite controlling for factors known to influence mortality, uncontrolled confounding remains possible, including by factors such as general improvements in hospital care for older people (eg, better recognition and treatment of delirium) and changes to the coding of medical conditions. However, we attempted to adjust our analyses for temporal changes. We analysed data only to 2018, in part a reflection of the difficulty of timely linkage of datasets in Australia, a problem that needs to be overcome to maximise the benefits of clinical quality registries.

Conclusion

We found that clinical care for almost two-thirds of hip fractures attained a high level of adherence to acute care clinical indicators. High level adherence was associated with 60% lower short term mortality, and moderate level adherence with 40% lower mortality; survival benefits were also evident one year after hip fracture surgery. That care for one-third of hip fractures did not achieve a high level of adherence to recommendations indicates that the delivery of hip fracture care needs to be improved, which could in turn improve health outcomes for people with hip fractures.

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Competing interests: Lara Harvey is a member of the ANZHFR Research Sub-committee. Morag Taylor is a parttime data analyst at the ANZHFR and a member of the ANZHFR Research Sub-committee. Ian Harris is a past and inaugural co-chair of the ANZHFR. Rebecca Mitchell is a member of the ANZHFR Steering Group, chairs the ANZHFR Data Sub-committee, and is a member of the ANZHFR Research Sub-committee. Ian Cameron is a member of the ANZHFR Steering Group. Jacqueline Close is an inaugural and current co-chair of the ANZHFR.

Data sharing: The data for this population-based linked data study will not be shared as we do not have ethics approval to do so. ■

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Supporting Information

Additional Supporting Information is included with the online version of this article.