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Days alive and at home after hip fracture: a cross-sectional validation of a patient-centred outcome measure using routinely collected data

Daniel I McIsaac ,[1,2] Robert Talarico,[2,3] Angela Jerath,[4] Duminda N Wijeysundera [4,5]

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For numbered affiliations see end of article.

Correspondence to
Dr Daniel I McIsaac, Anesthesiology & Pain Medicine, University of Ottawa Faculty of Medicine, Ottawa, ON K1H 8M5, Canada; dmcisaac@toh.on.ca

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ABSTRACT

Background Days alive and at home (DAH) is a patient centered outcome measureable in routinely collected health data. The validity and minimally important difference (MID) in hip fracture have not been evaluated.

Objective We assessed construct and predictive validity and estimated a MID for the patient-centred outcome of DAH after hip fracture admission.

Methods This is a cross-sectional observational study using linked health administrative data in Ontario, Canada. DAH was calculated as the number of days alive within 90 days of admission minus the number of days hospitalised or institutionalised. All hospital admissions (2012–2018) for hip fracture in adults aged >50 years were included. Construct validity analyses used Bayesian quantile regression to estimate the associations of postulated patient, admission and process-related variables with DAH. The predictive validity assessed was the correlation of DAH in 90 days with the value from 91 to 365 days; and the association and discrimination of DAH in 90 days predicting subsequent mortality. MID was estimated by averaging distribution-based and clinical anchor-based estimates.

Results We identified 63 778 patients with hip fracture. The median number of DAH was 43 (range 0–87). In the 90 days after admission, 8050 (12.6%) people died; a further 6366 (10.0%) died from days 91 to 365. Associations between patient-level and admission-level factors with the median DAH (lower with greater age, frailty and comorbidity, lower if admitted to intensive care or having had a complication) supported construct validity. DAH in 90 days after admission was strongly correlated with DAH in 365 days after admission (r=0.922). An 11-day MID was estimated.

Conclusion DAH has face, construct and predictive validity as a patient-centred outcome in patients with hip fracture, with an estimated MID of 11 days. Future research is required to include direct patient perspectives in confirming MID.

BACKGROUND

Hip fractures are common among older people, with a yearly incidence of 10 per 1000 for women and 5 per 1000 for men >65 years of age.[1] As populations age, hip fractures continue to be an important public health issue. One in four patients with hip fracture experience a serious in-hospital medical or surgical complication, one in four die within a year, and one in two either die or experience a new admission to long-term care.[2 3] While preventing hip fractures must be a key focus in improving the health of older adults, improving care and outcomes for older people who do experience a hip fracture is also a top priority.

Given the large number of hip fractures that occur, population-level studies of hip fracture care and outcomes are common.[4–9] While core outcome sets (ie, an agreed minimum set of outcomes that should be measured and reported in all clinical trials of a specific disease or trial population[10]) have been developed for patients with hip fracture, mortality is the only core outcome measure typically available in population-level data.[11 12] Furthermore, other routinely available population-level outcomes (eg, length of stay) are not patient-centred. Patient-reported outcomes that reflect function, disability and quality of life are particularly important for older people; however, beyond limited examples in elective surgery,[13] routinely collected data, such as health administrative records, do not reliably capture such measures.[14] Recent advances have led to the development of patient-centred outcomes that can be measured in linked health administrative data. Specifically, days alive at home (DAH) has been identified as a

patient-centred[15] and high priority outcome for older people,[16] which can also be accurately ascertained from population-based and health administrative data. DAH has recently been validated in elective surgery and other conditions.[17–20] This outcome provides a count of days where an individual is both alive and not institutionalised (ie, in an acute care hospital, rehabilitation centre or nursing facility). Although distinct from a patient-reported outcome, which is a direct report from a patient about how they feel or function in relation to their health condition,[21] DAH has distinct advantages over traditional measures derived from routinely collected data as it contains more information than binary measures (such as in-hospital mortality, non-home discharge or readmission), while incorporating the postdischarge trajectory, which simple hospital length of stay metrics cannot.[20]

While DAH has been validated in elective surgery,[17 18] this outcome measure has not been evaluated in patients with hip fracture, who differ substantially from elective surgery patients in their baseline characteristics, hospitalisation courses and recovery trajectories.[22] Furthermore, no minimally important difference (MID) in DAH has been proposed. Therefore, we conducted a population-based cross-sectional study to validate DAH as a patient-centred outcome in patients with hip fracture and estimate an MID.

METHODS

Design and setting

This was a population-based cross-sectional study using linked health administrative data in Ontario, Canada. In Ontario, hospital, physician and postacute care services are provided through a universal health insurance plan that covers all residents. A protocol was preregistered at the Center for Open Science (osf.io/mnvx4/). Reporting follows the recommendations for observational research using routinely collected data, as well as for Bayesian analyses.[23–26] Healthcare data in Ontario are collected using standardised methods and are stored at ICES (formerly known as the Institute for Clinical Evaluative Sciences), an independent research institute. For the current study, data were linked deterministically using encrypted, patient-specific identifiers across the following databases: Discharge Abstract Database (DAD; acute care hospitalisation details including diagnoses, procedures and length of stay); Ontario Health Insurance Plan (OHIP; physician service claims); National Ambulatory Care Reporting System (all emergency and outpatient care); Continuing Care Reporting System (long-term and respite care); National Rehabilitation Reporting System (designated rehabilitation hospitals/beds); Ontario Drug Benefits Database (ODB; prescription drug claims); and Registered Persons Database, which captures all death dates for residents of Ontario. The second author, an ICES analyst, accessed the data and performed all analyses.

Cohort

We identified all Ontario residents aged 50 and older on the day of their hip fracture admission using International Classification of Diseases-Tenth Edition (ICD-10-CA) hip fracture diagnostic code S72 (an age cut-off of 50 is often used as most hip fractures in older people are fragility-related instead of high-energy trauma-specific).[4 27] Reabstraction studies demonstrate high levels of agreement when identifying patients with hip fracture (kappa 0.95; positive predictive value 0.95, 95% CI 0.94 to 0.97).[28] We created a patient-level analytic data set by including the first fracture for each individual during our study period (1 April 2012–31 March 2018).

Outcome

For each individual, we calculated the number of DAH in the 90 (primary outcome) and 365 (secondary outcome) days after their fracture (DAH_{90}, DAH_{365}). Because we anticipated that many patients with hip fracture would have hospital and institutional lengths of stay >30 days,[6] we did not evaluate DAH_{30} as it is unlikely to be a plausibly responsive outcome metric in patients with hip fracture. DAH values were calculated by obtaining the number of days alive during each time window and then subtracting the number of days spent in an acute care hospital (index or readmission), rehabilitation or respite centre, or long-term care home. Individuals who died prior to discharge had DAH values of 0.

Covariates

We captured covariates that we postulated, based on clinical and epidemiological knowledge, may be associated with DAH.[29] Demographics were identified from the DAD and from the Canadian Census. Standard methods were used to identify Elixhauser comorbidities using ICD-10 codes from the DAD in the 3 years preceding surgery.[30] Preoperative residence in a long-term care facility was identified from the OHIP/ODB. A validated frailty index was calculated.[31] Surgical procedures for hip fracture and a unique identifier for each hospital, surgeon and anaesthesiologist were recorded from the DAD. Details of anaesthesia care that may impact DAH (primary anaesthesia type, receipt of a peripheral nerve block) were also recorded. Any in-hospital complications[32 33] or intensive care unit (ICU) admissions[34] were also captured from the index hospitalisation's DAD record.

Sample size

No sample size was prespecified. Instead, we included all available and eligible individuals during the study period. Based on experience with hip fracture data in Ontario,[6 7] we expected to identify approximately 10 000 hip fractures per year, or approximately 50 000 over the duration of the study period.

Missing data

Our primary approach was a complete case analysis. As no covariate had >0.4% missing data, we did not pursue sensitivity analyses using multiple imputation, which were prespecified if >1.0% data were missing.

Analysis

Descriptive statistics were computed for subgroups defined by being below the median DAH_{90} value versus at the median or higher. Between-group differences in characteristics were compared using standardised differences, with values >0.10 being considered substantive.[35] All regression analyses were conducted using the R programming language (R Foundation for Statistical Computing, Vienna, Austria) and the 'brms' package to allow a Bayesian framework for our analysis.[36] In brms, quantile regression is performed using the asymmetric Laplace distribution and probabilities of non-null associations estimated using the hypothesis function. As we had no strong knowledge to inform our choice of prior distributions, weakly informative prior distributions were used for all fixed effects, which allowed more efficient propagation of Markov Chain Monte Carlo sampling by focusing estimation on plausible values without placing substantial influence on estimated posterior distributions.[37] We tested the impact of prior distribution choice by repeating our main analysis with a non-informative prior distribution (ie, flat; normal distribution with a mean of 0 and SD of 10^6). A Bayesian approach allowed us to estimate 95% credible interval (CrI, which represents the range, based on our data and prior knowledge, with a 95% probability of containing the true value), as well as the probability of non-null associations between predictors and outcome.

Our validation analyses evaluated construct validity (how well an instrument measures a specific construct) and predictive validity (a submeasure of criterion validity), which reflects how well the instrument predicts future related outcomes.[38]

To assess construct validity, we estimated whether DAH measures differed in expected ways based on patient-level, clinician-level, intervention-level, admission-level and hospital-level factors available in our data. At the patient level, we estimated whether fewer DAH were experienced by older patients (with age expressed by decade), patients with greater frailty (with frailty expressed as a categorical variable: <0.10 (reference), >0.10–0.21, >0.21–0.45, >0.45), patients with multimorbidity (0 vs 1–2, vs ≥3 Elixhauser comorbidities[30]), patients with acute care hospitalisations in the year prior to fracture (vs none), patients with dementia,[39] male versus female, rural versus urban residency, and lower versus higher quintile of neighbourhood income.[40] At the clinician level, we estimated the extent that DAH measures varied by surgeon and anaesthesiologist (for those with surgical fixation). At the intervention level, we estimated whether DAH measures differed between operative and non-operative treatment, between types of surgical repair, between primary anaesthesia type (general, including combined general-neuraxial, vs isolated neuraxial), and by receipt versus non-receipt of a peripheral nerve block.[6 41] At the admission level, we estimated whether DAH measures varied by surgical wait (in those who had surgical fixation: <1 day, 1–2 days, >2 days postadmission), whether any complication occurred and whether a patient was admitted to ICU. At the hospital level, we estimated whether DAH measures varied by total hip fracture volume quintile and the extent of variation between hospitals.

We computed differences using unadjusted and adjusted quantile regression with the median (ie, 0.5 quantile) specified, as DAH distributions were expected to be skewed.[17 18] Three adjusted models were created. The first included terms for patient-level factors. The second combined patient-level, clinician-level, intervention-level, admission-level and hospital-level factors listed above with a random intercept for the index hospital. The third added surgeon and anaesthesiologist random intercepts to the second model but was limited to individuals who had surgical fixation (this allowed us to calculate intraclass correlation coefficients (ICC) for these random intercepts).

To assess predictive validity, we assessed the correlation between DAH_{90} and DAH_{365} using Spearman rank correlation (with this analysis limited to those who survived 90 days, as including those who did not survive to 90 days would upwardly bias the correlation coefficient estimate). Post-hoc, we calculated the correlation coefficient after subtracting the DAH_{90} value from the DAH_{365} value (as a high DAH_{90} value would upwardly bias the DAH_{365} value). Furthermore, for these individuals alive at the 90-day DAH ascertainment window, we calculated the ability of the quintile of DAH value in the 90-day period to discriminate subsequent mortality risk in the 365-day follow-up by calculating the c-statistic using Bayesian logistic regression. To test the impact of parameterising DAH_{90} as a quintile variable, we also repeated the predictive validity analysis with DAH_{90} as a restricted cubic spline with four knots.

Next, we estimated an MID. There are a variety of methods described for estimating MID, with no one technique thought to be superior.[42–44] As recommended we used multiple approaches (ie, anchor-based and distribution-based techniques) to estimate a final MID through averaging across techniques.[44–46] Distribution-based techniques included estimation of 0.3 times the SD and our initial protocol specified a 5% of the score range (as we had a sample consisting of the full population under study, we did not include methods involving the SEM).[47] However, post-hoc our team met to discuss the inconsistencies between 5% range estimates and all other anchor-based and

distribution-based estimates. As range-based distribution estimates specify 5%–10%,[47] we decided to proceed with 10% range (instead of a 5% range) as our second distribution-based estimate. For anchor-based techniques, our retrospective data did not contain patient preferences; therefore, we used what Guyatt and colleagues[43] describe as the single-step, population-focused approach based on disease-related criteria (or what has alternatively been called a clinical anchor).[48] With this approach, multiple anchors are required that should be interpretable and appreciably associated with the target outcome. For this study, we estimated the adjusted median difference in DAH at the group level between people who, during the index admission, were or were not admitted to the ICU (level 2 units: ie, high-dependency monitored areas with higher nurse to patient ratios, but no support for mechanical ventilation; or level 3 units: ie, providing full critical care functionalities, including mechanical ventilation), as well as the adjusted median difference in DAH at the group level between people who did or did not have a complication documented during the index admission. These were selected as each is validly captured in administrative data[32 34 49] and each represents a meaningful departure from an uneventful clinical course.[50–52] As MIDs could differ between relevant subgroups, we also estimated MIDs within prespecified groups (male vs female, frailty vs none (≤0.21 vs >0.21), long-term care prefracture versus home, and surgical versus non-surgical patients).

Because defining 'home' for an individual residing in a long-term care facility prefracture is not directly obvious, we performed sensitivity analyses to evaluate assumptions made regarding the definition of home for baseline long-term care residents. We recalculated our estimates of association between patient-level, clinician-level, intervention-level, admission-level and hospital-level factors and DAH measures after postdischarge long-term care days were redefined as 'home' for those living in long-term care at baseline. Our averaged MID was also re-estimated using this alternative definition of home for long-term care patients. Finally, based on post-hoc knowledge of the 5% range used to define our MID, and our subsequent decision that a 10% range was most applicable to this distribution and data, we also re-estimated our primary MID value using a 5% range criterion initially specified.

RESULTS

We identified 63 778 patients with hip fracture between 2012 and 2018. The mean and median numbers of DAH_{90} in the study period were 38 days (SD 33) and 43 days (IQR 0–68); values ranged from 0 to 87 (see distributions in online supplemental appendix figure 1). In the first 90 days after admission, 8050 (12.6%) people died, while a further 6366 (10.0%) died from days 91 to 365 postadmission. Compared with those with DAH_{90} values above the median, those with DAH_{90} values below the median were substantially older, lived with greater frailty and comorbidity, and were more likely to have been admitted to a long-term care home (table 1).

Validity of DAH_{90}

Unadjusted and multivariable adjusted analyses supported the construct validity of DAH_{90}, as postulated patient-level predictors had strong evidence of

Table 1 Cohort characteristics

	Below median days alive at home* (n=31 713)	Above median days alive at home* (n=32 065)	Absolute standardised difference
Age, mean (SD)	85 (9)	78 (11)	0.68
Female, n (%)	21 815 (68.8)	22 409 (69.9)	0.02
Rural, n (%)	3824 (12.1)	4533 (14.1)	0.06
Neighbourhood income quintile, n (%)			
Lowest	8151 (25.7)	7436 (23.2)	0.06
2	6917 (21.8)	6922 (21.6)	0.01
3	6046 (19.1)	6163 (19.2)	0.00
4	5369 (16.9)	5671 (17.7)	0.02
Highest	5103 (16.1)	5757 (18.0)	0.05
Frailty index, mean (SD)	0.26 (0.08)	0.21 (0.07)	0.72
Number of comorbidities, median (IQR)	2.00 (1.00–3.00)	1.00 (0.00–2.00)	0.44
Dementia, n (%)	8487 (26.8)	2398 (7.5)	0.53
Acute hospitalisation in previous year, n (%)	9702 (30.6)	6338 (19.8)	0.25
Prefracture long-term care residence, n (%)	9567 (30.2)	658 (2.1)	0.83
Surgical fixation, n (%)	28 336 (89.4)	28 907 (90.2)	0.03
In-hospital complication, n (%)	10 773 (34.0)	4932 (15.4)	0.44
ICU admission, n (%)	7847 (24.7)	203 (0.6)	0.78
Hospital annual hip fracture volume, mean (SD)	190 (91)	190 (93)	0.00

Median value was 43 days.
*All values represent the per cent of individuals above or below the median days alive at home value with the described characteristics, unless otherwise stated.
ICU, intensive care unit.

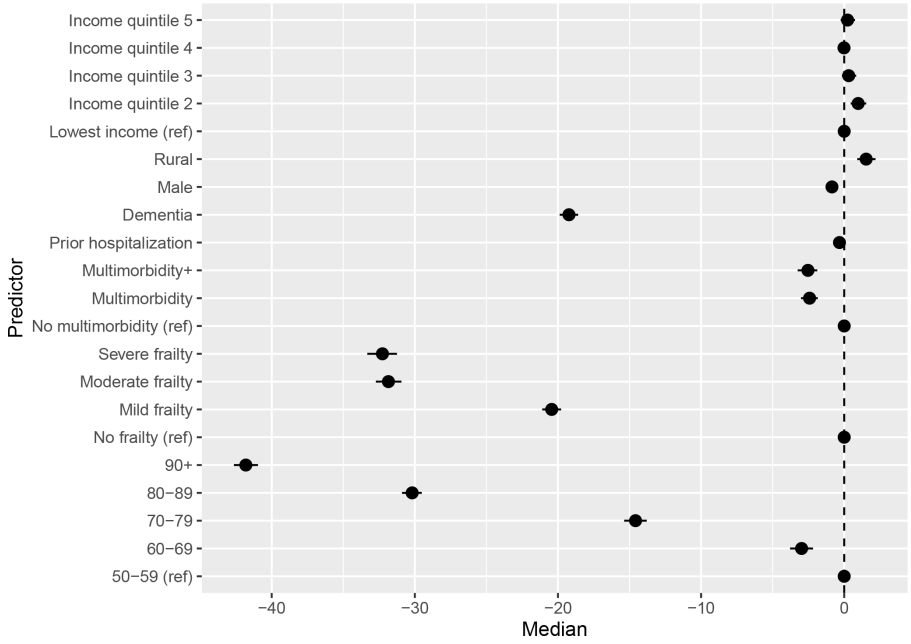

Figure 1 The forest plot depicts the median adjusted difference in days alive at home after hip fracture admission and the associated 95% credible intervals based on the highest probability density interval from the posterior distribution, with results adjusted for patient-level factors.

association (ie, 95% CrIs excluding 0) with DAH_{90} in a directionally expected manner, and in a dose–response fashion for increasing categories of age, frailty and comorbidity (figure 1; unadjusted estimates in online supplemental appendix table 1; adjusted estimates in online supplemental appendix table 2; Bayesian model diagnostics in online supplemental appendix table 3).

Adjusting for patient factors and clustering within hospitals, intervention-level factors were also associated with DAH_{90} in a directionally expected manner (eg, increased with surgical fixation, decreased with ICU admission and documentation of a complication). At the admission level, decreasing hospital volume of hip fracture care was associated with decreasing DAH_{90} (see all associations in figure 2 and online supplemental appendix table 4). Approximately 13% of variations in DAH_{90} were attributable to the index hospital ($ICC_{Hospital}$ 13.2%, 95% CrI 9.8% to 17.4%). In patients who had surgical fixation, the index hospital continued to explain approximately 13% of outcome

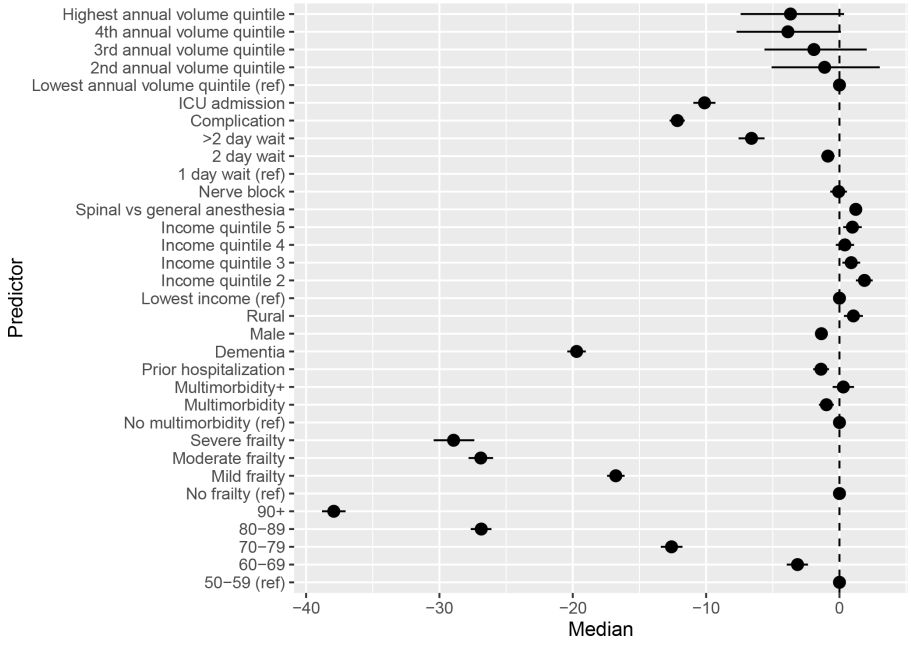

Figure 2 The forest plot depicts the median adjusted difference in days alive at home after hip fracture admission and the associated 95% credible intervals based on the highest probability density interval from the posterior distribution, adjusted for admission-level and procedure-level factors in those with surgical fixation. ICU, intensive care unit.

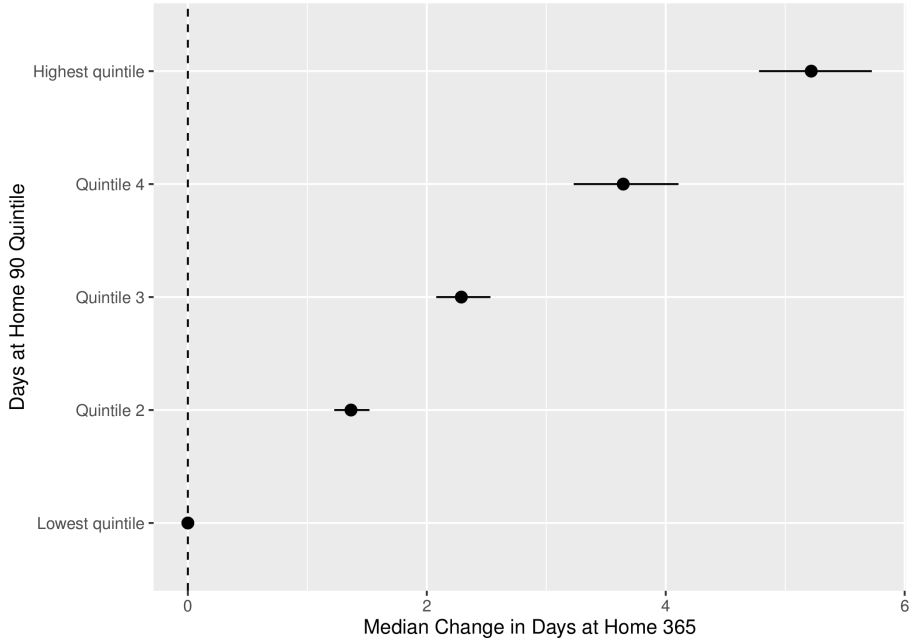

Figure 3 The forest plot depicts the median adjusted difference in days alive at home in the 365 days after hip fracture admission and the associated 95% credible intervals (based on the highest probability density interval from the posterior distribution) among patients with hip fracture who survived 90 days after admission, with the quintile of days alive at home in 90 days as the predictor.

variations ($ICC_{Hospital}$ 13.0%, 95% CrI 9.4% to 17.9%), with minimal variation attributable to surgeons or anaesthesiologists ($ICC_{Surgeon}$ 3.8%, 95% CrI 2.8% to 4.7%; $ICC_{Anaesthesiologist}$ 3.7%, 95% CrI 2.7% to 4.5%). Results using a non-informative prior were essentially unchanged (online supplemental appendix table 5).

When evaluating predictive validity, we found that DAH_{90} was highly correlated with DAH_{365} (correlation coefficient=0.922). The correlation was still strong, but attenuated, between the DAH_{90} and the DAH_{365-90} value (correlation coefficient=0.746). For patients who survived the first 90 days after admission, their quintile of DAH_{90} was strongly associated with subsequent death between 90 and 365 days after admission in a dose–response fashion (figure 3), although the quintile of DAH_{90} was not strongly discriminative of mortality in that time frame (c-statistic=0.68). Using a four-knot restricted cubic spline instead of a quintile parameterisation led to no change in discrimination (c-statistic=0.68).

Minimally important difference

Distribution-based techniques suggested an MID of 11 days based on 0.3 times the SD and 9 days based on 10% of the range of DAH_{90} values. Using clinical anchor-based techniques suggested an MID of 10 days based on requiring an ICU admission and 12 days based on experiencing a complication during the index hospitalisation; both anchors were appreciably associated with outcome (>99% probability of non-zero association). When averaged, our data supported a final MID of 11 days (see table 2; all values have been rounded to the nearest day to avoid exaggerated accuracy as DAH was measured only to the unit). The prespecified, but inconsistent with other data,

Table 2 Minimally important difference estimates

	Distribution estimates		Anchor estimates		
Group	SD×0.3	Range×0.10	ICU admission	Complication	Average
Overall	11	9	10	12	11
Subgroups					
Male	10	9	10	14	11
Female	11	9	10	11	10
No frailty	10	9	17	18	14
With frailty	10	9	10	9	10
Prefracture institutionalisation	6	9	1	1	4
No prefracture institutionalisation	10	9	13	20	13
Surgical fixation	11	9	16	14	13
No surgical fixation	10	9	10	12	10

Frailty: frailty index >0.21.
ICU, intensive care unit.

estimation using a 5% range resulted in an estimated MID of 9 days (see full estimates using 5% in online supplemental appendix table 7).

Table 2 provides distribution-based, anchor-based and averaged estimates of DAH_{90} for each prespecified subgroup. The subgroup MID estimates varied from 10 to 14 days, except for those who were in long-term care prior to admission, where the MID was estimated at 4 days.

Long-term care resident sensitivity analysis

When analyses were repeated with postadmission days in long-term care counted as DAH for individuals residing in long-term care preadmission, the median DAH_{90} value was 58. Associations supporting construct validity were directionally unchanged (online supplemental appendix table 8). The MID estimate was 14 days (online supplemental appendix table 7).

DISCUSSION

In this population-based cross-sectional analysis of linked health administrative data, we found that the number of days alive and at home after hip fracture admission had construct and predictive validity as a patient-centred outcome that can be captured from routinely collected electronic data sources. We further estimated that a difference of 11 days may represent an MID in DAH_{90} for patients with hip fracture, although this value may vary in certain clinically relevant subgroups and should be further evaluated with direct patient engagement. Overall, DAH_{90} may represent an important outcome for reporting, quality improvement and future registry-linked pragmatic trials in the growing population of older people with hip fractures.

Based on our findings, DAH_{90} could be an important outcome to guide care and inform trials in hip fracture populations as it can be routinely calculated using valid indicators in linked health administrative data. In other words, unlike codes for physical or cognitive function, codes for mortality, length of stay, discharge and readmission (which are combined to calculate DAH) are typically accurately captured in health data.[28] Furthermore, DAH incorporates the impact of complications, poor recovery and postdischarge events, making it patient and system relevant, while further supporting its face validity.[17] This may make DAH a particularly relevant outcome when evaluating the impact of care bundles or process change that may act through a variety of postulated mechanisms. DAH also likely has particular relevance in pragmatic and registry-linked trials, which can gain substantial efficiency through evaluation of interventions in real-world settings using outcomes that are routinely collected.[53–55] Patients, family members and caregivers may also benefit from knowing anticipated values of DAH at key points in the hip fracture admission. Older people have expressed substantial concerns about recovery time after hip fracture,[56] while caregivers often experience substantial burden during the transitional period after hip fracture.[57 58] Unfortunately, DAH may not be ascertainable in all sources of electronic and routinely collected data. In particular, health systems that lack linkage across different data sources (eg, between acute and long-term care) may not be able to obtain the variables necessary to compute DAH. Furthermore, registry data, such as those collected by the National Surgical Quality Improvement Program (NSQIP), do not extend beyond 30 postoperative days and do not include postdischarge place of residence.[59] Fortunately, data from the NSQIP geriatric pilot programme, which do include postdischarge residence, could facilitate incorporation of DAH as a routinely collected outcome in the future.[60 61]

Our findings should be considered in the context of previous validation studies of DAH in relation to perioperative settings, which have been conducted in a single-centre mixed surgery and urgency cohort,[17] and a population-based, elective non-cardiac surgery cohort.[18] First, unlike elective surgery where DAH has been defined within the first 30 days, we measured DAH values at 90 days, as almost 50% of patients with hip fracture were (expectedly) deceased or still institutionalised 1 month after admission. However, Jerath and colleagues[18] report of DAH_{90} values as a secondary outcome highlights the difference in postoperative trajectory between elective surgical and hip fracture patients (median DAH_{90} in elective surgery 86 vs 43 in hip fracture). Despite the differing temporal ascertainment windows, general trends in the association of patient characteristics are similar across DAH validation studies. For example, men typically experience fewer DAH than women, while those with higher comorbidity burden and older ages also have reduced DAH. Furthermore, similar to findings in elective surgery, a lower DAH value among survivors in a proximal ascertainment window (ie, DAH_{90}) was strongly correlated with more distal DAH values (ie, DAH_{365}) and was associated with higher risk of death in the subsequent follow-up period.[18] While we are not aware of previous estimates of variation in DAH at a hospital and provider level, our estimates of variation (13% at the index hospital, <4% attributable to providers) are similar to variation in mortality rates after complex elective surgery,[62] suggesting that most variations in these acute care outcomes are related to patient factors.

Finally, along with validating DAH_{90} in patients with hip fracture, our data also provide an MID estimate for the DAH_{90} outcome in this population. Using averaged anchor-based and distribution-based techniques, we estimated that an 11-day difference may represent an MID in patients with hip fracture. Use of a 10% range criterion (as opposed to the 5% that we prespecified) was thought to be more appropriate for patients with hip fracture, as 10% of the range of measured values (9 days) was more consistent with other prespecified

anchor and distributional estimates than the 4 days estimated using a 5% range (table 2). Fortunately, the averaged estimates of MID (9 days with a 5% range; 11 days with a 10% range) are not substantively different and support the need to estimate MIDs using multiple approaches. While previous validation studies have not investigated DAH MID values, available data suggest that values would likely differ substantially in elective surgery measured at 30 days. For example, averaging anchor values reported by Myles and colleagues[17] (eg, readmission (6 days), complication (~3.5 days)) with a 5% range distributional criterion (1.5 days) would suggest a value of approximately 3.5 days being minimally important. Finally, our MID estimates in clinically relevant subgroups were qualitatively consistent (10–14 days), except for individuals who resided in long-term care before admission. This is an important group who present substantial challenges in assigning days at home, as estimates will vary greatly depending on assignment of the institutional residence as 'home' after discharge. Based on our analysis, assigning days back in an institutional setting as being alive and at home may be the preferred approach, as the estimated MID (14) was more consistent with the overall and other subgroup estimates compared with treating such days as non-home (which led to an MID estimate of 4). Furthermore, anchor values informing the MID for those institutionalised before their fracture suggest that their trajectory may differ substantially, as complications and ICU admission resulted in only one fewer day alive at home, compared with 10 or more days away from home for those in the community before their fracture. Ultimately, the growing recognition of the value of patient engagement[63] speaks to the need for patient and caregiver perspectives to be added to statistical validation and data-based estimates of MID values. While reports exist of days spent at home having intrinsic value to patients,[15] direct patient engagement including quantitative and qualitative evaluation of patient preferences of DAH as an outcome compared with measures like short-term survival and length of stay is still required to understand its full value. Furthermore, patient-reported outcome scales included in current hip fracture core outcome sets (eg, mobility, activities of daily living, quality of life) could be considered as relevant anchors in future prospective MID estimations.[11]

Strengths and limitations

This study should be appraised considering its strengths and limitations. First, we followed a preregistered and prespecified protocol. We also identified our cohort and outcome using well-validated fields in our data sources. However, as health administrative data are not initially collected for research purposes, misclassification bias is possible. Established and valid methods were also used to identify patient-level and admission-level factors used in our construct validity analysis, but generalisability in structurally different health systems cannot be confirmed. Comorbidities were ascertained using a 3-year lookback; however, comorbidity ascertainment in administrative data can differ by lookback period.[64–67] As recommended, we estimated our MID value using the average of a variety of measurement techniques. However, our anchor-based methods could not incorporate direct patient-reported outcome measures, and substantial differences were present between two distributional inputs (4 days for 5% range, 11 days for 0.3 of the SD; although the impact on the averaged MID was not substantial). This further reflects the lack of patient participation in our study and the clear need to use these data as a starting point for future patient input into establishing an MID for DAH_{90} in hip fracture populations.

CONCLUSIONS

In a population-based cross-sectional analysis of patients with hip fracture, DAH in the 90 days after admission was found to have construct and predictive validity as a patient-centred outcome measure. Furthermore, an MID in this outcome was estimated to be 11 days. DAH may represent a useful and important outcome in future quality, research and reporting efforts aimed at improving hip fracture care and outcomes. However, direct patient engagement would help to clarify the importance and role and solidify MID estimates for older adults with hip fracture.

Author affiliations
[1]Anesthesiology and Pain Medicine, University of Ottawa Faculty of Medicine, Ottawa, Ontario, Canada
[2]Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada
[3]Clinical Epidemiology Program, Ottawa Hospital Research Institute, Ottawa, Ontario, Canada
[4]Anesthesia, University of Toronto Faculty of Medicine, Toronto, Ontario, Canada
[5]St Michael's Hospital Li Ka Shing Knowledge Institute, Toronto, Ontario, Canada

Twitter Daniel I McIsaac @mcisaac_d

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ORCID iDs
Daniel I McIsaac http://orcid.org/0000-0002-8543-1859
Duminda N Wijeysundera http://orcid.org/0000-0002-5897-8605

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