



BMJ Open Postsurgery paths and outcomes for hip fracture patients (POST-OP HIP PATHS): a population-based retrospective cohort study protocol

Chantal Backman ^{1,2,3}, Soha Shah,⁴ Colleen Webber ^{2,3}, Luke Turcotte,⁵ D I McIsaac,^{2,6} Steve Papp,⁷ Anne Harley,⁴ Paul Beaulé,⁷ Véronique French-Merkley,⁴ Randa Berdusco,⁷ Stephane Poitras,⁸ Peter Tanuseputro^{2,3}

To cite: Backman C, Shah S, Webber C, *et al.* Postsurgery paths and outcomes for hip fracture patients (POST-OP HIP PATHS): a population-based retrospective cohort study protocol. *BMJ Open* 2022;**12**:e065599. doi:10.1136/bmjopen-2022-065599

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2022-065599>).

Received 10 June 2022

Accepted 23 November 2022



© Author(s) (or their employer(s)) 2022. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to

Dr Chantal Backman;
chantal.backman@uottawa.ca

ABSTRACT

Introduction Hip fracture patients receive varying levels of support posthip fracture surgery and often experience significant disability and increased risk of mortality. Best practice guidelines recommend that all hip fracture patients receive active rehabilitation following their acute care stay, with rehabilitation beginning no later than 6 days following surgery. Nevertheless, patients frequently experience gaps in care including delays and variation in rehabilitation services they receive. We aim to understand the factors that drive these practice variations for older adults following hip fracture surgery, and their impact on patient outcomes.

Methods and analysis We will conduct a retrospective population-based cohort study using routinely collected health administrative data housed at ICES. The study population will include all individuals with a unilateral hip fracture aged 50 and older who underwent surgical repair in Ontario, Canada between 1 January 2015 and 31 December 2018. We will use unadjusted and multilevel, multivariable adjusted regression models to identify predictors of rehabilitation setting, time to rehabilitation and length of rehabilitation, with predictors prespecified including patient sociodemographics, baseline health and characteristics of the acute (surgical) episode. We will examine outcomes after rehabilitation, including place of care/residence at 6 and 12 months postrehabilitation, as well as other short-term and long-term outcomes.

Ethics and dissemination The use of the data in this project is authorised under section 45 of Ontario's Personal Health Information Protection Act and does not require review by a Research Ethics Board. Results will be disseminated through conference presentations and in peer-reviewed journals.

BACKGROUND

Hip fractures in older adults are a substantial cause of morbidity and mortality.¹ Worldwide, the incidence of hip fractures is projected to increase to approximately 2.6 million/year by 2025 and to 4.5 million/year by 2050.^{1–3} As the population ages, it is crucial to evaluate

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ We will identify the relationships between patient characteristics, acute episode of care and rehabilitation services.
- ⇒ We will use unadjusted and multilevel, multivariable adjusted regression models to identify predictors of rehabilitation setting, time to rehabilitation and length of rehabilitation.
- ⇒ Prespecified predictors in our models will include patient sociodemographics, baseline health and characteristics of the acute (surgical) episode.
- ⇒ We will examine outcomes after rehabilitation, including place of care/residence at 6 and 12 months postrehabilitation.

the healthcare needs of hip fracture patients in order to improve the quality of care they receive. Best practice guidelines recommend that older hip fracture patients receive geriatric rehabilitation no later than postoperative day 6.^{4–9} Despite this evidence, hospitals are facing challenges with timely referrals of patients to geriatric rehabilitation due to patient complexities (eg, cognitive impairment, multimorbidities) and to system capacity.¹⁰ In some cases, when resources are scarce, access to geriatric rehabilitation is non-existent. Lack of rehabilitation services is associated with decreased functional status, mortality, failure to return to independent living or readmission.^{11–13} Patients often experience gaps in postoperative care including delays and variation in rehabilitation services.

Studies have identified considerable variation in hip fracture care across different countries.^{14–16} Recent research by Pitzul *et al*^{10 11} examined the discharge destination of older hip fracture patients in Ontario, Canada between April 2008 and March 2013. That study identified 49 unique postacute

care pathways and variation among health regions in postacute discharge destinations. There are gaps in care and patients often do not experience optimal outcomes after hip fracture. We hypothesise that there will be significant variation in posthip fracture rehabilitative care, with variations in care associated with both patient sociodemographic (eg, age, sex, neighbourhood income) and baseline health (eg, functional and cognitive performance, frailty, comorbidities) characteristics. Further, we expect that there will be subgroups of patients, identified by both sociodemographic and baseline health characteristics, who may benefit differentially from different types of postacute care.

Our study builds on previous work that has described practice variations for hip fracture patients in Ontario.^{10 11} We aim to understand factors that are driving those practice variations and their impact on patient outcomes. Specific objectives are:

- ▶ To characterise the associations between baseline characteristics (eg, age, sex, neighbourhood income, rurality, functional and cognitive performance, frailty, comorbidities), acute episode of care (surgery) characteristics and postacute rehabilitation care settings.
- ▶ To examine the associations between baseline characteristics, acute episode of care (surgery) characteristics and time to initiation of rehabilitation, as well as length of rehabilitation services.
- ▶ To evaluate how postacute rehabilitation care settings, time to initiation of rehabilitation as well as length of rehabilitation services are associated with place of care/residence at 6 and 12 months postsurgery, as well as other short-term (return to the emergency department, hospital readmissions) and long-term (new long-term care admission, days at home, health service utilisation, costs, functional status, health-related quality of life, cognition) outcomes.

METHODS

Study design and data source

We will conduct a retrospective cohort study using population-based linked administrative health data available at ICES (previously known as the Institute for Clinical Evaluative Sciences). ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyse healthcare and demographic data, without consent, for health system evaluation and improvement.

For this study, we will develop our data analytical plan from several databases including the Discharge Abstract Database, Registered Persons Database, Ontario Health Insurance Claims database, Continuing Care Reporting System, Ontario Census (CENSUS), Postal Code Conversion File, Resident Assessment Instrument-Home Care and inter Resident Assessment Instrument-Home Care, National Rehabilitation Reporting System, Home Care Database, Assistive Devices Programme and National Ambulatory Care Reporting System. Our study reporting will follow the relevant reporting guidelines.^{17 18}

Study cohort

All individuals with a unilateral hip fracture aged 50 and over who underwent surgical repair in Ontario, Canada between 1 January 2015 and 31 December 2018 will be included. These individuals will be identified using International Classification of Disease 10th Edition (ICD10CA) codes S72.0 (fractures of neck of femur), S72.1 (pertrochanteric fractures) or S72.2 (subtrochanteric fractures). We will exclude individuals with pathological fractures (ICD10CA M8445), malignant neoplasm (ICD10CA C0-C9) and Paget's disease (ICD10CA M880, M88, M888).

Exposure

The main exposure is postacute rehabilitation care services. Postacute rehabilitation services include rehabilitation settings (eg, geriatric rehabilitation, short-term rehabilitation, slow-pace rehabilitation, convalescent care, home-based rehabilitation), time to initiation of rehabilitation, as well as rehabilitation length of stay (LOS).

Outcomes

Our primary outcome is place of care/residence at 6 and 12 months postsurgery (eg, death, acute hospital, long-term care, rehabilitation, home with support, home no support).¹⁹ Our secondary outcomes are return to the emergency department within 90 days of hospital discharge (and reason), hospital readmissions with 90 days of discharge (and reason), new long-term care admission, an adjusted validated day alive at home indicator,²⁰ survival at 6 and 12 months, health service utilisation (eg, follow-up visits with family physicians or specialists, new or increased home care services) and healthcare costs across the system using a costing macro developed at ICES.²¹ For patients discharged home with home care, complex continuing care or long-term care, we will additionally capture functional status at rehabilitation discharge (eg, self-care, sphincter control, transfers, locomotion, communication, social cognition), cognition level and health-related quality of life.

Covariates/potential confounders

The following variables will be examined as potential predictors and/or confounders:

Sociodemographic characteristics: Age at hospital admission, sex, marital status, geographical location (eg, census areas, rurality (ICES Macro: %getdemo)), living situation prior to admission (eg, home without home care, home with home care, in long-term care), neighbourhood income quintile. For home care and long-term care patients, we will also examine presence of caregiver, caregiver type, caregiver living status and caregiver distress prior to acute index admission date.

Baseline health characteristics: Prior fall resulting in an emergency department visit or acute care admission, comorbidities (using the Health System Performance Research Network multimorbidity macro),²² frailty status

(using a validated, accumulating deficits frailty index (%getpFI Macro)).²³ For home care and long-term care patients, we will also capture weight-bearing status and prefracture functional status based on activities of daily living (ADLs) and instrumental ADLs, cognition level and health-related quality of life.

Characteristics of acute episode of care: Type of surgical intervention, surgery day of the week, acute LOS, days from hospital admission to surgery, postsurgery LOS, post-operative complications defined as any in-hospital patient safety events using a validated set of ICD-10 indicators.²⁴

Characteristics of rehabilitation services: Type of therapy services received (eg, physical therapy, occupational therapy, recreational therapy, social worker), rehabilitation intensity (minutes per day) and rehabilitation frequency (days per week) and discharge location following rehabilitation.

The data variables, sources and codes are described in online supplemental appendix 1.

Data analysis

Sample size

We will include all individuals who meet the study inclusion criteria defined above. Based on the average number of hip fractures per year in Ontario (n=13 000), we estimate that we will have a study population of approximately 52 000 hip fracture patients.

For objectives 1 and 2: To characterise the associations between baseline characteristics, acute episode of care (surgery) and postacute rehabilitation care settings (Obj. 1) as well as time to rehabilitation initiation and length of rehabilitation (Obj. 2)

We will use descriptive statistics to summarise the socio-demographic, baseline health and acute episode of care characteristics of patients according rehabilitation setting (Obj. 1) as well as time to initiation of rehabilitation, and length of rehabilitation (Obj. 2). We will compare differences in outcomes using unadjusted and multilevel, multivariable adjusted regression models. Multivariable models will adjust for clustering at the acute hospital level using generalised estimating equation (GEE) methods. Variables that will be analysed include sociodemographics, baseline health and acute episode of care characteristics. Regression models will be chosen based on the outcome format (eg, multinomial logistic regression for rehabilitation setting, log-gamma regression for length of rehabilitation) and Cox proportional hazards models for time to rehabilitation initiation).

For objective 3: To evaluate how postacute rehabilitation care settings, time to initiation of rehabilitation as well as length of rehabilitation services are associated with place of care/residence at 6 and 12 months postsurgery as well as other short-term and long-term outcomes

We will use descriptive statistics to describe patient outcomes, including place of care/residence at 6 and 12 months postsurgery and other short-term (return to the emergency department, hospital readmissions) and

long-term (new long-term care admission, days at home, health service utilisation (eg, follow-up visits with family physicians or specialists, new or increased home care services) and healthcare costs) outcomes. For patients discharged home with home care, complex continuing care or long-term care, we will describe functional status, cognition level and health-related quality of life outcomes.

We will estimate the unadjusted and adjusted association of postacute rehabilitation care settings, time to initiation of rehabilitation as well as length of rehabilitation on outcomes using regression models chosen to align with outcome form (eg, ordinal logistic regression for the ordinal primary outcome, binary logistic regression for dichotomous outcomes, Cox proportional hazards models for time-to-event outcomes). Time-to-event outcomes will account for mortality as a competing risk as required. All model building will be based on clinical relevance according to the specific research question being evaluated. Variables will be chosen a priori as confounders for adjustment in multivariable models based on clinical knowledge and evidence that they are likely to be associated with the exposure and/or outcome and not on the causal pathway between the exposure and outcome. Fully adjusted models will be reported, and we will account for clustering by acute care hospital (index admission) using GEE in all analyses. While we expect missing data to be minimal, we will explore procedures to handle missing predictor variables in multivariable models, including complete case analysis and imputation procedures.

All data processing and statistical analysis will be performed by ICES Analysts in SAS (SAS V.9.4, SAS Institute).

Patient and public involvement

The study consists of a retrospective analysis of secondary data collected from ICES linked databases. There will be no direct patient involvement.

Ethics and dissemination

The use of the data in this project is authorised under section 45 of Ontario's Personal Health Information Protection Act and does not require review by a research ethics board. Results will be disseminated through conference presentations and in peer-reviewed journals. We will also organise an end-of-grant meeting with researchers, knowledge users and clinicians to review findings, discuss opportunities for further investigations, and identify the next steps for the development of clear guidelines on the postacute pathways.

CONCLUSION

While hip fractures are relatively common in older adults, we do not know how best to support their postacute care needs. There is little evidence regarding the types of rehabilitation care individuals should receive, and how the care received is influenced by clinical (eg, frailty) and non-clinical (eg, supports at home) characteristics.

Neither is there evidence for what characteristics constitute effective rehabilitation, nor whether different patients would benefit from different rehabilitation services. This research fills these knowledge gaps by documenting variations in care and short-term and long-term outcomes postsurgery for hip fracture patients using linked population-level clinical and administrative databases held at ICES.

With the evidence generated by this study, we will begin the development of postacute pathways that will directly impact the care provided to these patients across the province as well as identify resource allocation based on the number of patients in a region. This research will support personalised decision-making around postacute care by identifying those patients most likely to benefit from specific types of rehabilitation.

Author affiliations

- ¹School of Nursing, University of Ottawa, Ottawa, Ontario, Canada
²Clinical Epidemiology Program, Ottawa Hospital Research Institute, Ottawa, Ontario, Canada
³Bruyère Research Institute, Ottawa, Ontario, Canada
⁴Care of the Elderly, Bruyère Continuing Care, Ottawa, Ontario, Canada
⁵University of Waterloo, Waterloo, Ontario, Canada
⁶University of Ottawa Department of Anesthesiology, Ottawa, Ontario, Canada
⁷Orthopaedic Surgery, Ottawa Hospital, Ottawa, Ontario, Canada
⁸School of Rehabilitation Sciences, University of Ottawa, Ottawa, Ontario, Canada

Contributors CB was responsible for drafting the manuscript. CB, CW, LT, DM, PT contributed to the proposed analytical plan. All authors (CB, SS, CW, LT, DM, SP, AH, PB, VF-M, RB, SP and PT) were involved in the design of the project and critically appraised and edited the manuscript. All authors (CB, SS, CW, LT, DM, SP, AH, PB, VF-M, RB, SP and PT) read and approved the final manuscript.

Funding Funding was received from the Bruyère Academic Medical Organisation (BAMO) Innovation fund (BAM-22-01).

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Chantal Backman <http://orcid.org/0000-0001-7431-8159>
 Colleen Webber <http://orcid.org/0000-0001-9193-5386>

REFERENCES

- Veronese N, Maggi S. Epidemiology and social costs of hip fracture. *Injury* 2018;49:1458–60.
- Gullberg B, Johnell O, Kanis JA. World-Wide projections for hip fracture. *Osteoporos Int* 1997;7:407–13.
- Downey C, Kelly M, Quinlan JF. Changing trends in the mortality rate at 1-year post hip fracture - a systematic review. *World J Orthop* 2019;10:166–75.
- Health Quality Ontario. Quality Standards. hip fracture care for people with fragility fractures. Toronto, ON: health quality Ontario, 2017. Available: <https://www.hqontario.ca/portals/0/documents/evidence/quality-standards/qs-hip-fracture-clinical-guide-en.pdf>
- Health Quality Ontario & Ministry of Health and Long-Term Care. Quality-Based procedures: clinical Handbook for hip fracture. Toronto, on: health quality Ontario, 2013. Available: https://www.health.gov.on.ca/en/pro/programs/ecfa/docs/qbp_hipfracture.pdf
- Reyes BJ, Mendelson DA, Mujahid N, et al. Postacute management of older adults suffering an osteoporotic hip fracture: a consensus statement from the International geriatric fracture Society. *Geriatr Orthop Surg Rehabil* 2020;11:215145932093510–5.
- National Institute for Health and Care Excellence. Hip fracture overview, 2020. Available: <http://pathways.nice.org.uk/pathways/hip-fracture>
- American Academy of orthopaedic surgeons. management of hip fractures in the elderly, 2015. Available: https://www.orthoguidelines.org/go/auc/default.cfm?auc_id=224956&actionxm=Terms
- Rehabilitative Care Alliance. *Rehabilitative care best practices for patients with hip fracture*, 2018.
- Stolee P, Elliott J, Byrne K, et al. A framework for supporting post-acute care transitions of older patients with hip fracture. *J Am Med Dir Assoc* 2019;20:414–9.
- Pitzul KB, Wodchis WP, Carter MW, et al. Post-Acute pathways among hip fracture patients: a system-level analysis. *BMC Health Serv Res* 2016;16:275.
- Pitzul KB, Wodchis WP, Kreder HJ, et al. Discharge destination following hip fracture: comparative effectiveness and cost analyses. *Arch Osteoporos* 2017;12:87.
- Alberta health services BJH SCN post-acute care of hip fracture. optimizing the post-acute continuum of care following a hip fracture white paper, 2019. Available: <https://www.albertahealthservices.ca/assets/about/scn/ahs-scn-bjh-hip-white-paper.pdf>
- Papanicolas I, Figueroa JF, Schoenfeld AJ, et al. Differences in health care spending and utilization among older frail adults in high-income countries: ICCONIC hip fracture persona. *Health Serv Res* 2021;56 Suppl 3:1335–46.
- Blankart CR, van Gool K, Papanicolas I, et al. International comparison of spending and utilization at the end of life for hip fracture patients. *Health Serv Res* 2021;56 Suppl 3:1370–82.
- Wodchis WP, Or Z, Blankart CR, et al. An international comparison of long-term care trajectories and spending following hip fracture. *Health Serv Res* 2021;56 Suppl 3:1383–93.
- Vandenbroucke JP, von Elm E, Altman DG, et al. Strengthening the reporting of observational studies in epidemiology (STROBE): explanation and elaboration. *Int J Surg* 2014;12:1500–24.
- Benchimol EI, Smeeth L, Guttman A, et al. The reporting of studies conducted using observational Routinely-collected health data (record) statement. *PLoS Med* 2015;12:e1001885.
- Qureshi D, Tanuseputro P, Perez R, et al. Place of care trajectories in the last two weeks of life: a population-based cohort study of Ontario decedents. *J Palliat Med* 2018;21:1588–95.
- Mclsaac DI, Talarico R, Jerath A, et al. Days alive and at home after hip fracture: a cross-sectional validation of a patient-centred outcome measure using routinely collected data. *BMJ Qual Saf* 2021. doi:10.1136/bmjqs-2021-013150. [Epub ahead of print: 30 Jul 2021].
- Wodchis WP, Austin PC, Henry DA. A 3-year study of high-cost users of health care. *CMAJ* 2016;188:182–188.
- Mondor L, Maxwell CJ, Bronskill SE, et al. The relative impact of chronic conditions and multimorbidity on health-related quality of life in Ontario long-stay home care clients. *Qual Life Res* 2016;25:2619–32.
- Mclsaac DI, Wong CA, Huang A, et al. Derivation and validation of a generalizable preoperative frailty index using population-based health administrative data. *Ann Surg* 2019;270:102–8.
- Mclsaac DI, Hamilton GM, Abdulla K, et al. Validation of new ICD-10-based patient safety indicators for identification of in-hospital complications in surgical patients: a study of diagnostic accuracy. *BMJ Qual Saf* 2020;29:209–16.