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Feasibility of using administrative data for identifying medical reasons to delay hip fracture surgery: a Canadian database study

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ABSTRACT

Purpose Failure to account for medically necessary delays may lead to an underestimation of early surgery benefits. This study investigated the feasibility of using administrative data to identify the National Institute for Health and Care Excellence (NICE) 124 guideline list of conditions that appropriately delay hip fracture surgery.

Methods We assembled a list of diagnosis and procedure codes to reflect the NICE 124 conditions. The list was reviewed and updated by an advanced clinical coder. The list was refined by five clinical experts. We then screened Canadian Institute for Health Information discharge abstracts for 153 918 patients surgically treated for a non-pathological first hip fracture between 1 January 2004 and 31 December 2012 for diagnosis codes present on admission and procedure codes that antedated hip fracture surgery. We classified abstracts as having medical reasons for delaying surgery based on the presence of these codes.

Results In total, 10 237 (6.7%; 95% CI 6.5% to 6.8%) patients had diagnostic and procedure codes indicating medical reasons for delay. The most common reasons for medical delay were exacerbation of a chronic chest condition (35.9%) and acute chest infection (23.2%). The proportion of patients with reasons for medical delays increased with time from admission to surgery: 3.9% (95% CI 3.6% to 4.1%) for same day surgery; 4.7% (95% CI 4.5% to 4.8%) for surgery 1 day after admission; 7.1% (95% CI 6.9% to 7.4%) for surgery 2 days after admission; and 15.5% (95% CI 15.1% to 16.0%) for surgery more than 2 days after admission. The trend was seen for admissions on weekday working hours, weekday after hours and on weekends.

Conclusion Administrative data can be considered to identify conditions that appropriately delay hip fracture surgery. Accounting for medically necessary delays can improve estimates of the effectiveness of early surgery.

Strengths and limitations of this study

- This study includes all hospital records of hip fracture surgeries performed in Canada over an 8-year period, as captured by an administrative database.
- The authors assembled the first comprehensive list of diagnosis and procedure codes to identify appropriate medical reasons for delaying hip fracture surgery.
- The list includes the National Institute for Health and Care Excellence 124 guideline conditions; other medical conditions may appropriately delay surgery.
- A chart review may be a better source for studying the prevalence of medical, non-medical and personal reasons for delay but is limited in the number of patients who could be evaluated.

INTRODUCTION

Hip fractures occur in older adults as frequently as common cancers but with substantially worse outcomes.[1] Most patients undergo surgery to improve survival, restore mobility and potentially return to active, independent living.[2] However, surgical delays may diminish the therapeutic benefits of the surgical procedure by increasing patients' exposure to immobilisation and generalised inflammatory state.[3] This may lead to potentially fatal thromboembolic, cardiovascular and infectious complications.[4 5]

Previous research provides inconsistent evidence on the survival benefit of early surgery for hip fracture with reports of increased[6 7] and no increased[8–11] risk of inhospital death with longer waits. An important limitation of this literature lies in the lack of information on the reasons for delay. Delays may result from a lack of hospital resources or issues related to healthcare delivery, broadly referred to as *non-medical delays*.[12] On the other hand, the UK National Institute for Health and Care Excellence (NICE) 124 guideline recognises '*there are sometimes legitimate reasons for delay*' and lists conditions requiring correction preoperatively.[13] The guideline's experts noted that "*Provided these problems are sought and measures initiated to correct them are taken promptly the majority* [of patient presenting with hip fractures] *can be optimised within 24 hours*."[13] That is, some conditions requiring correction preoperatively may cause *medically necessary* surgical delays for at least one inpatient day.

Failure to differentiate patients with medically necessary and non-medical delays may lead to an underestimation of the benefit of early surgery. Siegmeth *et al* and Orosz *et al* suggest excluding unfit patients from timing–outcome analysis on the premise that patients with medically necessary delays may be less likely to die with longer wait times than if they received early surgery.[14 15] However, medical reasons for delaying hip fracture surgery are not readily available in administrative databases. Therefore, this study sought to determine the feasibility of identifying NICE 124 conditions from administrative discharge abstracts through the creation of specific algorithms.[13]

METHODS

Data source

We obtained Canadian Institute for Health Information (CIHI) discharge abstracts for all patients 65 years or older who were surgically treated for non-pathological first hip fracture between 1 January 2004 and 31 December 2012 in all Canadian hospitals, except for the province of Quebec. The abstracts were selected using procedure codes for hip fracture surgery (Canadian Classification of Health Intervention (CCI): 1VA74^^, 1VA53^^, 1VC74^^, 1SQ53^^). Multiple abstracts linked by hospital transfers for the same patient were combined in one care episode.[16] The University of British Columbia Behavioural Research Ethics Board approved this study.

Diagnostic and procedures codes for NICE 124 conditions

We initially assembled a list of International Classification of Disease Canadian 10th Revision (ICD-10-CA) diagnosis codes and CCI codes matching conditions from the NICE 124 guideline (KS).[13] These include anaemia, anticoagulation, volume depletion, electrolyte imbalance, uncontrolled diabetes, uncontrolled heart failure, acute cardiac arrhythmia or ischaemia, acute chest infection or exacerbation of a chronic chest condition.[13] The list was reviewed and updated by an advanced clinical coder (SS). Subsequently five clinical experts (PG, JW, SM, EH, MD) refined the list of the codes to ensure capturing acute aspect of the NICE 124 conditions (eg, 'exacerbation of chronic chest condition' was linked to code for 'chronic obstructive pulmonary disease with acute lower respiratory infection'). Further, 'anaemia' was linked to code for 'transfusion'. We also identified all codes for complications of the NICE 124 conditions (eg, 'correctable cardiac ischaemia' was linked to code for 'acute myocardial infarction'). We included ICD-10-CA and CCI codes approved by at least one clinical expert (see online supplementary file 1).

Box 1 Identifying medically necessary reasons for delaying hip fracture surgery

- ► Created algorithms of diagnostic and procedures codes associated with National Institute for Health and Care Excellence 124 conditions.
- ► Screened discharge abstracts for diagnostic codes present on admission and for procedures codes that antedated hip fracture surgery.
- ► Classified discharge abstracts as having medically necessary reasons for delaying surgery.

Classifying CIHI discharge abstracts

We screened CIHI discharge abstracts for ICD-10-CA codes present on admission (type 1 diagnosis) and CCI codes that antedated hip fracture surgery. Diagnoses and procedure codes are included in the CIHI discharge abstracts as mandatory data elements to ensure national coverage.[17] We then classified the abstracts as having medical reasons for delaying surgery based on the presence of diagnostic codes only, diagnosis or procedure codes or diagnosis and procedure codes (box1). Specifically, we used diagnosis codes only for uncontrolled heart failure and acute chest infection; diagnosis or procedure codes for exacerbation of chronic chest conditions, correctable cardiac ischaemia, correctable cardiac arrhythmia, volume depletion and anticoagulation; and diagnosis and procedure codes for uncontrolled diabetes, anaemia and electrolyte imbalance (see online supplementary file 1). NICE 124 conditions include acute aspects of some chronic conditions, namely, diabetes, heart failure, cardiac ischaemia and cardiac arrhythmia. Classification of abstracts as having chronic conditions and acute aspects of those conditions do not need to be mutually exclusive.

Statistical analysis

Detailed description of the study population is available elsewhere.[18] We summarised baseline characteristics of the patient population using descriptive statistics. We estimated the prevalence of medically necessary delays by dividing the number of patients with diagnosis or procedure codes pointing to medical delays by the total number of surgically treated patients, multiplied by 100%, overall and by timing of surgery. Lastly, we estimated the prevalence of medically necessary delays in relation to timing of admission by timing of surgery.

RESULTS

Patient characteristics

A total of 153 918 patients were surgically treated for a non-pathological first hip fracture between 1 January 2004 and 31 December 2012. Most patients were women (73.4%), and almost half were 85 years or older (45.6%). Most patients were admitted from home without major comorbidity (heart failure, chronic obstructive pulmonary disease, ischaemic heart disease, hypertension, cardiac arrhythmia or diabetes) (43.6%).

Table 1 Specific National Institute for Health and Care Excellence 124 guideline conditions pointing to possible medical reason for delay to hip fracture surgery among surgically treated patients

Condition	Patients (n)	%	95% CI
Anaemia	198	0.1	(0.1 to 0.1)
Anticoagulation reversal	495	0.3	(0.3 to 0.3)
Volume depletion	1200	0.8	(0.7 to 0.8)
Electrolyte imbalance	38	0.0	(0.0 to 0.0)
Uncontrolled diabetes	1497	1.0	(0.9 to 1.0)
Uncontrolled heart failure	26	0.0	(0.0 to 0.0)
Correctable cardiac arrhythmia	796	0.5	(0.5 to 0.6)
Correctable cardiac ischaemia	1668	1.1	(1.0 to 1.1)
Acute chest infection	2375	1.5	(1.5 to 1.6)
Exacerbation of chronic chest condition	3679	2.4	(2.3 to 2.5)
At least one condition	10237	6.7	(6.5 to 6.8)

Reasons for medical delay

Overall, 10237 (6.7%; 95% CI 6.5% to 6.8%) surgically treated patients had diagnostic and procedure codes indicating possible medical reasons for delaying surgery (table 1). Most patients had only one medical reason for delay (84.9%). The most common reasons for medical delay were exacerbation of a chronic chest condition (35.9%), acute chest infection (23.2%), correctable cardiac ischaemia (16.3%), uncontrolled diabetes (14.6%) and volume depletion (11.7%).

The prevalence of medical reasons for delay among surgically treated patients increased with the time from admission to surgery: 3.9% (95% CI 3.6% to 4.1%) for same day surgery; 4.4% (95% CI 4.3% to 4.5%) for surgery within 1 day of admission; and 5.1% (95% CI 4.9% to 5.2%) for patients who underwent surgery within 2 days of admission. The prevalence of medical reasons for delay on each surgical day since admission also increased: 3.9% (95% CI 3.6% to 4.1%) for same day surgery; 4.7% (95% CI 4.5% to 4.8%) for surgery 1 day after admission; 7.1% (95% CI 6.9% to 7.4%) for surgery 2 days after admission; and 15.5% (95% CI 15.1% to 16.0%) for surgery more than 2 days after admission. The trend was seen for admissions on weekday working hours, weekday after hours and on weekends (table 2).

The prevalence of medical reasons for delay among surgically treated patients decreased with age, from 7.1% (95% CI 6.8% to 7.5%) in patients 65–74 years of age to 5.7% (95% CI 5.2% to 6.2%) in those 95 years or older. More men had a medical reason for delay (9.4%; 95% CI 9.1% to 9.7%) than women (5.7%; 95% CI 5.5% to 5.8%). The prevalence of medical reasons for delay among surgically treated patients was lowest among patients admitted from home without comorbidities (2.2%; 95% CI 2.0% to 2.3%) and highest among those admitted from home with comorbidity or home care (18.0%; 95% CI 17.5% to 18.4%). The prevalence of medical reasons for delay among surgically treated patients admitted from long-term care was about one-third lower than those admitted from home with comorbidity or home care (6.2%; 95% CI 6.0% to 6.5%).

DISCUSSION

Main findings

Overall, 6.7% of surgically treated patients had a medical condition that may necessitate delay to hip fracture surgery according to the NICE 124 guideline, with exacerbation of a chronic chest condition being the most prevalent. This proportion varied by time to surgery: from 3.9% for surgery on the day of admission to 15.5% for surgery more than 2 days of admission.

Comparison with other studies

In health services research, the appropriateness of a surgical intervention refers to its expected health benefit exceeding the expected harms by sufficient margin. Originally, measuring the appropriateness of an intervention was motivated by concerns that some patients were not receiving needed treatment.[19] In hip fracture care, we

Table 2 Prevalence of medically necessary delays to hip fracture surgery among surgically treated patients in relation to timing of admission by timing of surgery

	Timing of surgery			
Timing of admission	Same day	1 day after admission	2 days after admission	More than 2 days after admission
	% (95% CI)			
Overall	3.9 (3.6 to 4.1)	4.7 (4.5 to 4.8)	7.1 (6.9 to 7.4)	15.5 (15.1 to 16.0)
Weekday, working hours*	3.6 (3.2 to 3.9)	5.0 (4.6 to 5.3)	7.7 (7.1 to 8.3)	15.6 (14.7 to 16.6)
Weekday, after hours†	4.1 (3.7 to 4.5)	4.6 (4.4 to 4.9)	6.7 (6.3 to 7.1)	15.4 (14.7 to 16.1)
Weekend‡	3.9 (3.6 to 4.3)	4.5 (4.3 to 4.8)	7.3 (6.8 to 7.8)	15.6 (14.8 to 16.4)

*08:00 to 17:00 on Monday, Tuesday, Wednesday, Thursday or Friday.
†After 17:00 on Monday, Tuesday, Wednesday or Thursday or before 08:00 on Tuesday, Wednesday, Thursday or Friday.
‡Saturday, Sunday or before 08:00 on Monday or after 17:00 on Friday.

are concerned that real-life care delivery results in some patients not undergoing surgery at the most beneficial time.[20] Despite the lack of robust evidence about the benefit of early surgery for the wide range of patients seen in clinical practice, physicians and hospitals managers are making decisions every day about patient priority for operating room access. In fact, Lizaur-Utrilla *et al* argued for preoperative optimisation of the patient's condition with sufficient medical treatment rather than being bound by a general benchmark for timing of surgery.[21]

More information on the underlying reasons for delay is required when determining whether patients benefit from early, or indeed delayed, surgery. Here we assembled a list of diagnosis and procedure codes to identify medical reasons for delay and classified discharge abstracts according to the presence of these codes. In a recent prospective study of 7020 patients, Bretherton and Parker reported that 5.2% of patients aged 60 years or more, surgically treated for non-pathological hip fracture within 72 hours of admission, presented with at least one NICE 124 condition, which may appropriately delay surgery.[22] This is comparable to our reported proportion of 5.1% for patients who underwent surgery within 2 days of admission. We noted an increase in the prevalence of medical reasons for delay on each surgical day since admission. This trend was consistent across admission times, which may suggest robustness of our classification of NICE 124 conditions based on diagnostic and procedure codes.

The proportion of medical reasons for delay varied by patient characteristics. In keeping with previous literature, we found that more men had medical reasons for delay than women.[23] This may be explained by poorer adherence to medication for chronic conditions for men compared with women.[24] We also noted more medical reasons for delay among patients admitted from home with comorbidity or home care when compared with those admitted from long-term care. This may suggest poorer control of chronic conditions among older adults in the community, when compared with those supported in long-term care.[25] Alternatively, this may reflect different coding bias for patients admitted from the community versus long-term care.[26] In contrast to previous literature, we noted a higher proportion of medical reasons for delay among younger patients when compared with older patients.[27] The trend reported here may reflect survival bias whereby those with less comorbidities survive into their later years.[28]

Future research

Here we focused on the feasibility of using administrative data to identify appropriate conditions for delaying hip fracture surgery as listed in the NICE 124 guideline.[13] However, other medical conditions may also appropriately delay hip fracture surgery. For example, Siegmeth and colleagues included gastrointestinal haemorrhage, uncontrolled hypertension and need for echocardiography.[14] Deveraux and colleagues proposed an even more extensive list inclusive of frank pulmonary oedema, respiratory failure requiring mechanical ventilation, pulmonary artery hypertension, home oxygen therapy with concomitant clopidogrel, bacteraemia, hereditary or acquired coagulopathy, thrombocytopenia, deep venous thrombosis with vena cava filter, acute stroke, recent subarachnoid haemorrhage, impaired consciousness of unknown origin, new-onset seizure, hyponatraemia, hypokalaemia, hypernatraemia, hyperkalaemia or acidosis.[3] It can also be argued that patients or their caregivers may choose to delay surgery for personal reasons.[29] A study assessing the appropriateness of timing of hip fracture surgery at the level of medical history, presentation and test results, as well as personal reasons, is needed to integrate the available evidence with the combined judgement of clinical practitioners and patients and their families to critically evaluate and improve patient selection for early hip fracture surgery.

Limitations

We identified medical reasons for delay from the ICD-10-CA diagnosis codes and CCI procedures codes present in the CIHI discharge abstracts. The methods are generalisable to other settings that code hospital diagnoses and procedures with ICD-10 and CCI codes. We previously provided code conversions for settings that code diagnoses and procedures with ICD-9 Clinical Modification (ICD-9-CM).[30] These conversion tables will enable settings that code with ICD-9-CM to implement the methods presented here.

We did not validate the presence of medical reasons for delay in medical records. Our estimate of the proportion of patients requiring anticoagulant reversal is lower than 8% reported by a study of the UK National Hip Fracture Database.[31] This may be due to the absence of information relating to medications such as warfarin or clopidogrel in the discharge abstracts. Our estimate of the proportion of patients with anaemia is also lower than the 10% reported by a recent systematic review.[32] We selected type 1 (on admission) diagnostic codes only as the timing of postadmission diagnoses were not available, so we could not distinguish between postadmission diagnoses before or after hip fracture surgery. This may have led to an underestimation of the prevalence conditions diagnosed after admission, such as anaemia.

Although procedures, rather than conditions, delay surgery, for some of the NICE conditions, only diagnostic codes were available. This may help to explain why our estimates of the proportion of patients with uncontrolled heart failure, arrhythmia and electrolyte imbalance are also lower than the 3% reported by chart review.[33] Our estimates of the proportion of patients with cardiac ischaemia, uncontrolled diabetes and volume depletion are similar to those reported by chart review.[33] While we estimate that 1% of patients present with volume depletion, it is likely that this proportion is much higher.[33] Chronic volume depletion is common in older people secondary to diuretic use and reduced fluid intake.[34] Standard care after hip fracture includes fluid resuscitation from admission to surgery.[35] Therefore, a formal diagnosis of dehydration or other volume depletion may not be documented in the medical records for coders to abstract.[36] Using prospective data collection may provide a better vehicle to determine the prevalence of medical, non-medical and personal reasons for delay but would be limited in the number of patients who could be evaluated.

We included codes approved by at least one clinical expert. This is the most conservative rule, which could produce different results as compared with a conclusion from consensus or majority. There were 37 patients without ICD-10-CA codes whom we classified as having no medical delay. We focused on medical reasons for delaying hip fracture surgery. The methods described here may also be applicable outside of hip fracture care. Finally, we identified medical reasons for delay. We did not report non-medical reasons such as resource availability, hospital type or volume, which may contribute to surgical delay.

CONCLUSION

Administrative data may be used to identify patients presenting with conditions that appropriately delay hip fracture surgery. Accounting for these medically necessary delays may improve estimates of the effectiveness of early surgery. Future research is needed to generate consensus on what constitutes an appropriate medical reason for delay. This will enable improved patient selection for early hip fracture surgery.

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