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Frailty predicts increased costs in emergent general surgery patients: A prospective cohort cost analysis

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ABSTRACT

Background: Aging populations have led to increasing numbers of seniors presenting for emergency surgery. Older patients are at a higher risk of postoperative complications, prolonged hospitalization, and increased institutionalization. We hypothesized that increased frailty would be a risk factor for increased health care costs in elderly surgical patients who have undergone emergency abdominal surgery.
Methods: A prospective cost analysis of emergency general surgery patients 65 years of age and older was conducted. Demographic and clinical characteristics were obtained. Preadmission Clinical Frailty Scale score and Clavien-Dindo postoperative complications were collected. Patients were followed for 6 months after discharge. Hospitalization costs were calculated using the Alberta Health Services (AHS) microcosting database; other costs were obtained from Alberta Health Services and Alberta Health databases. The primary outcome was total insured cost (2016 Can$). Multivariate generalized linear regression of log-transformed costs was conducted.
Results: Overall, 321 patients were enrolled. Mean age was 76.1 years (standard deviation 7.8), median Clinical Frailty Scale was 3, mean length of stay was 15.9 days (standard deviation 23.4), and 48% suffered a complication. Median total insured cost was Can$18,021 and median total cost was Can$26,739. Multivariate analysis found American Society of Anesthesiologists score (adjusted ratio [AR] = 1.24, P = .001), CFS (AR = 1.27, $P < .001$), major complications (AR = 2.11, $P < .001$), and minor complications (AR = 1.48, $P < .001$) lead to increased total insured costs.
Conclusion: Costs increased—after adjusting for age, comorbidities, and preadmission function as frailty—and American Society of Anesthesiologists score increased if minor or major complications occurred. The detection of frailty represents an opportunity to target risk-reduction strategies and interventions to improve outcomes and decrease cost.

Introduction

A higher proportion of people in our population are surviving into very-late life, resulting in a profound increase in the number of people presenting for surgery who are 65 years of age and older. During the past 5 years (2011–2016) the number of Canadians older than 65 years of age has increased by 20%, four times the overall population growth rate and the largest increase in 70 years.[1] For the first time in Canadian history there are more people 65 years of age and older than under 15 years.[1] The cohort of Canadians older than 65 years of age is projected to grow to 24% of the populations by 2036,[2] and, by 2050, 22% of all North Americans are projected be older than 65.[3]

Health care spending represented 17% of the US gross domestic product and 10% of Canadian gross domestic product in 2014,[4,5] and these costs are expected to increase. Surgery is most commonly performed on people older than the age of 65—more than half of all surgeries in the United States[6]—and represents a significant portion of health care spending.[7] Older patients are at a higher risk

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of postoperative complications, prolonged hospitalization, and increased dependency or institutionalization.[8,9] Surgical complications have been shown to increase both hospital and third-party payer costs per admission.[10,11]

Reducing health care costs requires identification of patient characteristics that increase the risk for adverse outcomes and the associated increased health care costs and identification of modifiable risk factors that might allow targeted interventions. Most cost-prediction models do not sufficiently predict cost after surgery. Of six preoperative risk stratification tools used in cardiac patients, none reliably predicted costs after surgery.[12] All models relied on age and none incorporated frailty, which is defined as a poor physiologic reserve-limiting response to acute physiologic insult. The presence of frailty has been shown, in a recent systematic review, to predict postoperative complications.[13] Postoperative complications also predict increased postoperative morbidity and mortality,[14–20] inhospital cost, and costs after discharge.[11,20,21]

We aim to identify risk factors for increased health care costs in elderly surgical patients who have undergone emergency abdominal surgery at one of two tertiary referral hospitals in Western Canada. Our study sites have enrolled patients into the Elder-friendly Approaches to the Surgical Environment (EASE) study[22] and have collected demographic, medical, and outcome data prospectively. We also have access to patient-level inpatient microcosting data, along with ambulatory care, physician billing, and patient expenses, which allow us to better develop risk-assessment models to predict increased health care cost and to identify patient-specific interventions that should be explored to improve outcomes.

Methods

Overview

Patients were prospectively enrolled in the EASE study (clinicaltrials.gov registration: NCT02233153), between January 2014 and September 2015, at our 2 study sites. Both centers are tertiary referral hospitals in Alberta and, combined, have more than 1,450 patient beds and receive more than 1 million unique patient visits per year. The EASE study, a quality improvement initiative, received ethics approval from the University of Alberta Research Ethics Board (Pro00047180) and the University of Calgary Conjoint Research Ethics Board (REB140729). Older patients, ≥65 years of age, undergoing emergency general surgery were consecutively screened for eligibility, and excluded if they were transferred from another medical service, underwent elective or trauma surgery, had a Clinical Frailty Scale (CFS)[23] score greater than 6, experienced a major language barrier, or resided outside of Alberta, Canada.

We present in this report a post-hoc analysis of prospectively collected data. Informed consent was obtained from all patients who provided outpatient follow-up. Demographic and clinical characteristics were obtained through follow-up interviews and detailed chart reviews. Variables collected included demographic data, preadmission living situation, Charlson comorbidity index, and discharge destination. Preoperative frailty was assessed using the CFS based on patients' preadmission functional status. Surgical intervention, length of stay, postoperative complications, and clinical outcomes were recorded in the EASE database. Complications were assessed by two independent clinicians and defined as minor (Clavien-Dindo 1-2) and major (Clavien-Dindo 3-5). Patients were followed for 6 months after discharge from their index admission or until death.

Health care resource costing

Costs were obtained retrospectively with ethics approval (Pro00061609). Hospitalization costs were calculated using AHS microcosting database (a patient-level costing database that provides total direct cost [nurses, doctors, drugs, etc]), indirect cost (overhead, transportation, electrical, etc), and total cost per patient. The microcosting database records all hospital resource utilization, including operating time and disposable medical products, used by each patient. Microcosting is the gold standard for economic evaluations because it accounts for the value of resources not directly reflected in unit medical costs and can serve as a proxy for opportunity costs.[24] When microcosting data were not available, admission costs were calculated using AHS Discharge Abstract Database (DAD) Resource Intensity Weighted (RIW) costing data multiplied by the cost of a standard hospital stay from the Canadian Institute of Health Information. Patients that were transferred to a subacute, rehabilitation, or community hospital were noted in our EASE database. The cost of these admissions was included in the total cost of the index admission. If data were not available to calculate a cost category, they were excluded from analysis of the subcost.

The cost of readmission was calculated using microcosting when it was available and RIW data when it was not. Patients missing from both the microcosting and DAD databases were assumed to be lost to follow-up and were excluded from the analysis. The EASE database readmission data were compared with our microcosting and DAD databases to find the number of readmissions that were unable to be costed. Average length of stay, average cost per admission, and number of readmissions was also noted.

Drug costs were estimated based on the provincial Pharmaceutical Information Network. Prescriptions dispensed to each enrolled patient were recorded and costed. It was assumed that all patients were covered by the Alberta Blue Cross Coverage for Seniors Program. Medications covered by the Blue Cross Seniors Program were recorded as a government expense; less than required 30% copayment to a maximum of Can$25 per dispensed item. It was assumed that the plan only covered the least costly alternative. Chemotherapeutic drugs are fully covered within our jurisdiction. Their cost was considered a government expense. Drugs that are not covered were recorded as being paid by the patient. Drugs that are covered by the government were costed based on published provincial reimbursement rates,[25] and uncovered drugs were assigned a price based on market rates. Linkage was performed by matching drug identification numbers.

The cost of ambulatory care encounters, including emergency room visits, was calculated using RIW. All visits that occurred up to 6 months from index discharge were recorded. Physician claims were assessed using Alberta Health physician billing data. All physician visits from the index admission date to the end of the 6-month follow-up period were noted. Salaried physicians who were paid Can$0 were assigned the reimbursement rate published by the Alberta Health Care Insurance Plan[26,27] for the 2015 to 2016 fiscal year. Physician costs were divided into index admission, readmission, and outpatient billing categories and by billing service (surgical, medical, primary care).

The economic costs of lost employment or volunteer hours; care provided to the patient after discharge by family and friends, private nurses, allied health professionals; alternative care and medical products (paid by the patient) were recorded using the validate Health Resource Utilization Inventory.[28]

Statistical analysis and modeling

The primary outcome was total insured cost (costs covered by the single-payer health insurance program) during the entire enrollment period. Costs were adjusted for inflation to 2016 Can$, which was valued at Can$1.34 to $1 on December 31, 2016. The distribution of demographic, clinical, and cost data was assessed using means and standard deviation (SD) for continuous variables

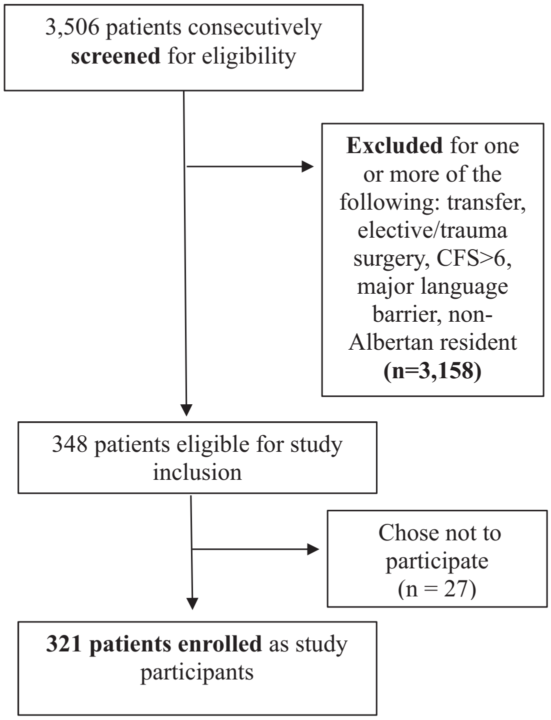

Fig 1. Patient screening and recruitment.

Table I
Demographic and clinical characteristics of enrolled patients*

	All enrolled patients	
Patient demographics		
Total patients	321	
Age in years, mean (SD)	76.1	7.7
Sex, male	176	55%
Minority race	84	26%
Married	215	67%
Living independently before admission	231	72%
Clinical characteristics		
BMI, mean (SD)	27.1	6.1
CCI, mean (SD)	1.6	1.8
To regular ward postoperatively	274	85%
ASA 3 or higher	194	60%
Surgical site		
Appendix	35	11%
Pancreatobilliary	77	24%
Hernia	51	16%
Intestinal	138	43%
Stomach or rectum	8	2%
Other	3	1%
Ostomy created or revised	31	10%
Cancer/tumor	15	5%
Postoperative data		
Length of stay, mean (SD)	15.9	23.4
Major complication (Clavien 3-5)	48	15%
Minor complication (Clavien 1-2)	144	45%
Inpatient mortality	14	5%
6-month mortality	31	11%
Readmission within 6-months	100	34%

SD, standard deviation; *BMI*, body mass index.
* All data presented as *n* (%) unless otherwise stated.

and count data for categorical variables. Data from both research sites were compared and then pooled for analysis. Cost of index admission, readmission, physician billing, ambulatory care, prescription medical, and costs identified with the Health Resource Utilization Inventory, along with total insured and total patient-covered costs are presented as mean and SD along with median and interquartile ranges. Clinical and demographic characteristics were assessed in univariate analysis (Fisher exact or χ^2 tests for categorical variables and *t* tests for continuous variables). Cost data were assessed for normality using skewness and kurtosis testing. When the cost distribution was non-normal, it was log transformed and reassessed.

Univariate generalized linear regression was used to assess the association of individual demographic and clinical variables with cost. Variables identified as significant in univariate exploratory analysis were included in multivariate regression analysis. Multivariate generalized linear regression was then used to model the effect on cost by the variables identified in univariate analysis. An additional regression analysis was performed without any postoperative variables (minor and major complications). Bayesian information criterion was used to test goodness of fit. Insignificant variables were left in the multivariate model if they improved the fit of the overall model. Regression outputs were back transformed from logarithmic results into adjusted ratios (AR). Analyses were done in STATA 14 (StataCorp LLP, College Station, TX, USA).

Results

Overall, 3,506 patients were screened. After assessing patients for exclusion and inclusion criteria, 321 patients were enrolled (Fig 1). Mean age was 76.1 years (SD 7.8), 55% were male, 26% were visible minorities, and 72% were living independently before admission. Cohort demographic and clinical results are presented in Table I. The median CFS was 3, mean Charlson comorbidity index (CCI) was 1.6, and American Society of Anesthesiologists (ASA) score was 3 or higher in 60% of patients. The most common surgical intervention site was intestinal (43%), mean length of stay was 15.9 days (SD 23.4), 45% suffered a minor complication, 15% suffered a major complication, 5% died during their index admission, and 34% were readmitted at least once during the 6-month follow-up.

Median total insured cost was Can$18,021 (Table II). We observed was no significant difference in cost between sites ($P = .31$). Few differences existed between the two sites, with Calgary having had more visible minorities ($P < .001$), more gallbladder procedures ($P = .03$), fewer patients living independently before admission ($P < .001$), lower ASA scores ($P < .001$), and fewer ostomies ($P = .006$). Overall, 106 patients were readmitted. The median cost for patients with all costs reported was Can$26,739 per patient for inpatient care during readmissions. The public single-payer insurance program covered 83% of the total costs that were measured.

Based on univariate modeling, CFS, age, CCI,[29] ASA score,[30] major complications, minor complications, and the type of facility lived in before admission were included in the multivariate model. Hospital site was not significant in predicting overall cost, there were few differences in patient demographics between the two sites, and including it did not improve the overall fit of the model, so it was excluded from the multivariate model. Body mass index, sex, marital status, visible minority, smoking status, study site, and indwelling urinary catheter use after surgery were excluded based on univariate modelling. Multivariate analysis of log-transformed cost categories identified several significant drivers of cost (Table III). The significant drivers of total prescription cost were CCI, which resulted in a 29% increased cost for each single-unit increase in the CCI score (AR 1.29, $P < .001$) and a 40% increased cost for each rise in ASA score (AR 1.40, $P = .02$). ASA, CFS, and both major and minor complications led to increased costs in physician billing, index admission costs, total inpatient costs (including readmission), and total insured costs

Table II
Mean and median cost (Can$ 2016) for index admission, readmission, ambulatory care, physician billing, prescription, and total patient costs

	n	Mean Can$	Median Can$	SD Can$	IQR Can$	
Index hospital cost	316	31,143	15,616	49,794	10,641	30,619
Index physician billing	306	3,882	2,497	5,441	1,732	4,068
Total index cost	306	35,706	18,224	55,415	12,773	35,070
Readmission hospital cost	106	28,349	11,876	27,680	6,233	29,402
Readmission physician billing	94	3,301	2,016	5,378	755	3,719
Total readmission cost	94	32,818	17,116	46,031	7,726	33,722
Total ambulatory care cost	314	2,526	1,323	5,203	311	2,794
Total physician billing	317	5,488	3,646	6,201	2,318	6,612
Total prescription cost	293	2,186	516	10,975	186	1,384
Total patient costs	297	3,027	303	8,077	99	1,866
Total insured cost	289	34,197	18,021	43,137	11,599	36,129
Total cost—all costs reported	98	40,400	26,739	45,667	15,661	51,149

SD, standard deviation; *IQR*, interquartile range.

Table III
Generalized linear regression models for log-transformed subcosts and total insured cost with adjusted ratios for log-transformed costs (Can$)

	Rx cost ($n = 293$)			Physician billing cost ($n = 318$)			Index inpatient cost ($n = 253$)			Total inpatient cost ($n = 317$)			Total government cost ($n = 291$)		
BIC	−835			−1,578			−1,667			−1,530			−1,447		
	AR	CI	*P*	AR	CI	*P*	AR	CI	*P*	AR	CI	*P*	AR	CI	*P*
Age	1.00	0.97–1.02	.74	1.00	0.99–1.01	.79	1.01	0.99–1.01	.34	0.99	0.98–1.01	.46	1.00	0.98–1.01	.50
ASA	1.40	1.05–1.88	**.02**	1.32	1.15–1.51	**< .001**	1.31	1.18–1.44	**< .001**	1.21	1.04–1.41	**.01**	1.24	1.09–1.42	**.001**
CCI	1.29	1.15–1.45	**< .001**	1.05	0.99–1.11	.09	0.99	0.95–1.03	.58	0.97	0.91–1.03	.28	1.03	0.98–1.08	.30
CFS	1.00	0.83–1.20	.98	1.13	1.04–1.23	**.004**	1.16	1.09–1.24	**< .001**	1.31	1.20–1.44	**< .001**	1.27	1.17–1.38	**< .001**
Major complication	0.68	0.36–1.29	.23	1.70	1.29–2.25	**< .001**	2.25	1.83–2.76	**< .001**	2.47	1.82–3.36	**< .001**	2.11	1.58–2.82	**< .001**
Minor complication	1.22	0.82–1.83	.33	1.36	1.13–1.65	**.002**	1.70	1.48–1.96	**< .001**	1.56	1.27–1.93	**< .001**	1.48	1.24–1.78	**< .001**
preadmission living	1.15	0.77–1.70	.49	0.91	0.75–1.10	.33	0.96	0.84–1.11	.58	0.86	0.70–1.06	.15	0.85	0.72–1.02	.09

Minor complication, Clavien 1-2; *Major complication*, Clavien 3-5; *BIC*, Bayseian information criterion; *AR*, adjusted ratio.

(Table III). Major complications led to the largest single increase for physician billing (AR 1.70, $P < .001$), index inpatient cost (AR 2.25, $P < .001$), total inpatient cost (AR 2.47, $P < .001$), and total insured cost (AR 2.11, $P < .001$). However, for each increase in CFS score, costs increased by an AR of 1.13 to 1.31 for physician billing, index and total inpatient costs, and total insured costs, resulting in a larger total increase. The generalized linear model was unable to fit our measured ambulatory-care cost. In the model of ambulatory-care costs, CCI was significant (AR 1.19, $P = .03$); however the Bayesian information criterion was very high (−68), suggesting it did not fit well. Age and the patients' preadmission living circumstances (living independently, assisted living, or long-term care) did not significantly increase costs in any of the multivariate models; however, including them in the model did improve the fit, and both were significant in univariate generalized linear regression models.

Reanalysis of the models with only preadmission variables found an overall slightly poorer fit for physician billing, index admission cost, total inpatient cost, and total insured cost (Table IV). ASA (1.40, $P = .02$) and CCI (AR 1.29, $P < .001$) remained significant for prescription cost and ASA, and frailty remained significant for physician billing, index inpatient cost, total inpatient cost, and total insured cost.

Mean total insured costs increased with frailty (Fig 2), along with physician billing, total index admission cost, total inpatient cost, and total insured cost. Costs increased with frailty whether patients experienced minor or major complications. However, when a complication did occur, the resulting increase in costs was higher in patients with greater frailty (Table V).

Discussion

We have conducted a cost analysis using the gold standard for costing health care expenditures and found that frailty, major and minor complications, and ASA score predict increased cost of care for elderly patients undergoing emergency general surgery.

Table IV
Generalized linear regression models using preadmission variables only for log-transformed subcosts and total insured cost with adjusted ratios for log-transformed costs (Can$)

	Rx cost ($n = 293$)			Physician billing cost ($n = 318$)			Index inpatient cost ($n = 253$)			Total inpatient cost ($n = 317$)			Total government cost ($n = 291$)		
BIC	−841			−1,569			−1,625			−1,490			-1,427		
	AR	CI	*P*	AR	CI	*P*	AR	CI	*P*	AR	CI	*P*	AR	CI	*P*
Age	1.00	0.97–1.02	.89	1.00	0.98–1.01	.50	1.00	0.99–1.01	.96	0.99	0.98–1.00	.18	0.99	0.98–1.00	.22
ASA	1.40	1.05–1.87	**.02**	1.42	1.24–1.63	**< .001**	1.48	1.31–1.67	**< .001**	1.37	1.16–1.90	**< .001**	1.38	1.19–1.59	**< .001**
CCI	1.29	1.15–1.44	**< .001**	1.05	0.99–1.12	.08	0.99	0.95–1.04	.79	0.97	0.91–1.04	.41	1.03	0.97–1.59	.32
CFS	0.99	0.83–1.19	.95	1.15	1.05–1.26	**.002**	1.19	1.10–1.28	**< .001**	1.35	1.21–1.49	**< .001**	1.28	1.17–1.40	**< .001**
preadmission living	1.16	0.79–1.72	.45	0.93	0.77–1.14	.50	1.01	0.85–1.19	.93	0.89	0.71–1.12	.33	0.89	0.73–1.08	.24

Minor complication, Clavien 1-2; *Major complication*, Clavien 3-5; *BIC*, Bayseian information criterion; *AR*, adjusted ratio.

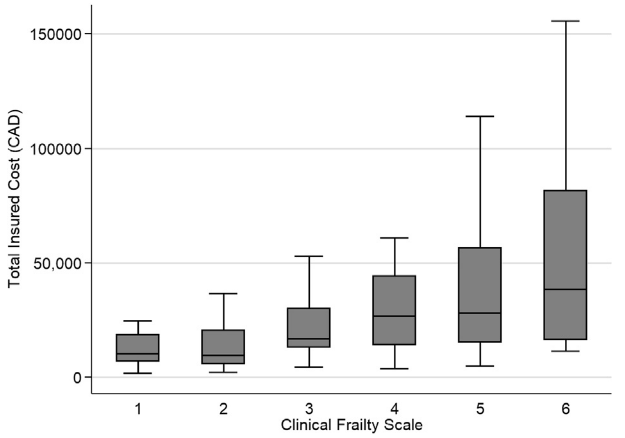

Fig 2. Total insured cost (Can$ 2016) throughout 6 months by Clinical Frailty Scale score.

Development of a major complication led to the single largest increase in cost for patients, but the cumulative effect of increasing frailty led to a larger overall effect. In contrast, after controlling for complications, frailty, preoperative living situation, ASA score, and comorbidities, age itself did not significantly affect any of our cost models.

Frailty has been increasingly recognized as a significant source of morbidity and mortality in both medical and surgical patients. The use of the CFS allowed rapid assessment, no additional training or equipment, and correlates well with the much more labor-intensive frailty index.[23] This study has examined the effect of frailty, using the CFS, on health care costs using a prospective cohort of emergency general surgical patients.

Elsewhere, Bailey et al[31] examined the relationship between inpatient cost with frailty, complications, and loss of independence in a similar population. They identified a significant increase in cost with an increasing frailty index, but only extensively explored the relationship between increased costs and complications and had a smaller sample size. Frailty appears to be the most significant driver of increased cost. In our study, total cost of inpatient care increased roughly 31% for each increase in frailty level after controlling for age, ASA score, complications, independent living, and comorbidities. In fact, frailty predicted increased cost in all but 2 categories examined—prescription costs and ambulatory-care visit costs. However, it may be that these outpatient costs are not well captured among the frailest patients, given the fact that many reside and receive care in assisted living facilities.

The finding that costs increase with both frailty and complications is not surprising. However, this study is a unique analysis of prospectively collected gold-standard patient-costing data in a population at a high probability for both inpatient and outpatient health care utilization. Like Bailey et al,[31] this study found that age did not affect cost once adjusted for frailty, complications, comorbidities, and preoperative independence in any of our cost models. This suggests that age is less important than a patient's frailty status and medical condition before admission. Frailty is a multidimensional condition that increases an individual's susceptibility to complications, and, from a health care economics perspective, complications lead to increased costs. We propose that complications are on the causal pathway between frailty and cost, in that frailty leads to increased complications, which drives up health care costs.

Robinson et al[7] have examined frailty and cost after elective colorectal surgery.[7] Their costing technique was not as robust as that employed here and their sample size was much smaller; however, they also identified the increased costs associated with increasing frailty. They also found that frailty in older people predicts increased complications[32] and increased postoperative institutionalization after surgery requiring postoperative intensive care admission.[20]

Many studies have reported that increasing frailty predicted increasing complications.[20,31,33] Of interest, this study found that costs increased with the degree of frailty regardless of whether the patient experienced a complication. Costs increases were larger when a complication occurred, but even in the absence of any complication, this relationship held (Table IV). Targeted interventions focused on frail patients may help reduce the incidence of frailty-related health care complications and costs. Two systematic reviews have shown that comprehensive geriatric assessment, which is used to assess and manage geriatric patients admitted with acute illnesses, improves patient outcomes and reduces cost burden.[34,35] More recently, in light of new evidence highlighting the detrimental impact of hospital-related muscle loss after emergency surgery,[14,36] postoperative exercise interventions have been suggested as a promising approach. One pilot study of a patient reconditioning program demonstrated the feasibility, safety, and efficacy of a frailty-tailored exercise intervention.[37]

Programs like the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) aim to improve outcomes through the reporting of performance results. ACS-NSQIP can also be used to calculate a modified frailty index (mFI), which is commonly used for research. However, not all fields required for calculating the mFI are currently mandatory data collection elements within ACS-NSQIP. In fact, 5 of the 11 variables originally used to generate the mFI have been missing since 2012,[38] limiting its usefulness. An updated mFI is under development, but it has not been validated in most surgical populations.[39] Reporting on quality identifies areas where modifying care may improve outcomes, but without implementing targeted interventions that actually result in improved care for those at highest risk, programs like ACS-NSQIP will not be optimally effective.

Finally, it is important to note that although frailty increases with advancing age, when age and frailty were included in models, only frailty remained statistically significant. Most research examining elderly surgical patients, including large retrospective database studies, use age as a proxy for increasing frailty. This may not be an appropriate assumption. We have shown that frailty predicts increasing costs better than age and results in age having little significant impact on our primary outcome. Tools should be developed to estimate frailty within large patient databases to

Table V
Total insured cost (Can$ 2016) by clinical frailty scale score and complications

Frailty	No complication		Minor complication		Major complication	
	n	Insured cost Can$	*n*	Insured cost Can$	*n*	Insured cost Can$
1	8	9,302	7	24,294	0	NA
2	36	10,956	19	22,604	7	33,151
3	64	17,558	42	41,236	13	70,489
4	26	39,181	34	41,292	9	69,712
5	21	25,431	20	74,294	6	168,469
6	12	30,115	22	72,158	13	116,477

allow better characterization of patient risk for research and risk-prediction modeling.

Our study is limited by several factors. First, preoperative assessment of frailty was only performed with one tool, the CFS. Therefore, we cannot comment on the discriminatory strength of other commonly used assessment tools. Second, the population studied is predominantly Caucasian in an urban setting. As such, generalizing our findings to a diverse population may not be appropriate. Third, we applied univariate regression to select the variables for our final model. This may have resulted in the inclusion of more variables than necessary; univariate analysis may identify predictors as significant, which a multivariate approach (ie, backward or stepwise regression) identifies as insignificant. Finally, not all of our enrolled patients had index admissions with microcosting data. Some patients ($n = 61$ of 318) were costed using a well-described, but less-accurate, technique based on RIW data. Most readmissions occurred at hospitals that required RIW costing because only select hospitals in our jurisdiction have microcosting capabilities.

In conclusion, frailty, postoperative complications, and ASA score are important predictors of increasing cost of surgical care in the elderly. Total insured cost increases 27% for each increase on the CFS scale. In addition, a major complication led to a doubling of costs during 6 months of care. Identifying frailty and developing interventions specifically to address frailty status are critical to improving the care of our aging population and to contain our growing health care costs. Targeting frailty may also help reduce frailty-related postoperative complications, further reducing the cost of postoperative care.

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Conflicts of interest

There are no conflicts to declare for any author.

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