Alive and at home: Five-year outcomes in older adults following emergency general surgery

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BACKGROUND: While the short-term risks of emergency general surgery (EGS) admission among older adults have been studied, little is known about long-term functional outcomes in this population. Our objective was to evaluate the relationship between EGS admission and the probability of an older adult being alive and residing in their own home 5 years later. We also examined the extent to which specific EGS diagnoses, need for surgery, and frailty modified this relationship.

METHODS: We performed a population-based, retrospective cohort study of community-dwelling older adults (age, ≥65 years) admitted to hospital for one of eight EGS diagnoses (appendicitis, cholecystitis, diverticulitis, strangulated hernia, bowel obstruction, peptic ulcer disease, intestinal ischemia, or perforated viscus) between 2006 and 2018 in Ontario, Canada. Cases were matched to controls from the general population. Time spent alive and at home (measured as time to nursing home admission or death) was compared between cases and controls using Kaplan-Meier analysis and Cox models.

RESULTS: A total of 90,245 older adults admitted with an EGS diagnosis were matched with controls. In the 5 years following an EGS admission, cases experienced significantly fewer months alive and at home compared with controls (mean time, 43 vs. 50 months; $p < 0.001$). Except for patients operated on for appendicitis and cholecystitis, all remaining patient subgroups experienced reduced time alive and at home compared with controls ($p < 0.001$). Cases remained at elevated risk of nursing home admission or death compared with controls for the entirety of the 5-year follow-up (hazard ratio, 1.17–5.11).

CONCLUSION: Older adults who required hospitalization for an EGS diagnosis were at higher risk for death or admission to a nursing home for at least 5 years following admission compared with controls. However, most patients (57%) remained alive and living in their own home at the end of this 5-year period. (*J Trauma Acute Care Surg.* 2021;90: 287–295. Copyright © 2020 American Association for the Surgery of Trauma.)

LEVEL OF EVIDENCE: Epidemiological, level III.
KEY WORDS: Emergency general surgery; older adults; outcomes; function.

Emergency general surgery (EGS) conditions, such as appendicitis, cholecystitis, and bowel obstruction, account for 1 of every 14 hospitalizations in the United States and pose a significant burden for patients and health care systems worldwide.[1–8] Older adults (age, ≥65 years) represent 40% of hospitalizations for EGS conditions, and this proportion will rise significantly over the next decade.[9]

As with any surgical condition, accurate estimates of the risks associated with EGS conditions and procedures are critical to facilitate patient counseling, selection of patients who might benefit from surgical intervention, and the development of quality improvement initiatives. However, gaps in our knowledge related to outcomes of older adults with EGS conditions are significant. First, prior literature has focused on short-term outcomes such as 30-day morbidity and mortality; the long-term impact of EGS conditions on the lives of older adults is unknown.[10–16] Second, past studies have focused largely on mortality.[10,12,14,16,17] However, many older adults value quality in addition to quantity of life; prior research has shown that older adults would refuse a treatment that resulted in a poor functional outcome even if the alternative was death.[18–21]

An outcome considered meaningful by many older adults is the ability to reside at home for as long as possible, a concept frequently described as "aging in place."[22] Prior work has shown a strong preference in older adults for remaining in their own home rather than moving into an assisted living facility or nursing home.[21,23] As such, time at home following an illness has emerged as an important patient-centered outcome in older adults and has been used in the palliative care and cardiovascular literature.[24–28] However, for most EGS conditions and procedures, the long-term odds of an older patient remaining alive and in their own home is not known.[29]

The lack of evidence surrounding the long-term, patient-centered outcomes of older patients following an EGS admission limits surgeons' abilities to effectively counsel their patients, may lead to decision making that is not patient centered and limits efforts to identify interventions that may lead to improved post-EGS functional outcomes. The objective of this study was to evaluate the association between EGS admission and the probability of an older adult being alive and living in their own home 5 years later. In addition, we evaluated the extent to which specific EGS diagnoses, need for surgery, and frailty modified this relationship.

PATIENTS AND METHODS

We performed a population-based retrospective cohort study of all community-dwelling older adults admitted to hospital for an EGS diagnosis in the province of Ontario between April 1, 2006, and March 31, 2018. The use of health administrative data in this project was authorized under section 45 of Ontario's *Personal Health Information Protection Act*, which does not require additional review by a research ethics board.[30]

Setting

Ontario is Canada's most populous province (population, 14.3 million) and contains Canada's largest metropolitan area (Toronto; population, 6 million). Residents of Ontario have universal health insurance funded by the provincial government; this insurance program funds medically necessary physician and

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hospital services, home care, and nursing home care. Nursing homes provide older adults with 24-hour nursing and personal care once their needs can no longer be safely met through publicly funded community-based services.

Data Sources

Our study cohort was derived from linked administrative data held at ICES including patient demographics, emergency department (ED) visits, hospital admissions, publicly funded home care services, publicly funded nursing home services, and physician services in the province (Supplemental Digital Content, Supplementary Table 1, http://links.lww.com/TA/B839). ICES is an independent, nonprofit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and demographic data, without consent, for health system evaluation and improvement. Data sets were linked using unique encoded identifiers and analyzed at ICES. The population-based data used in this study have been estimated to capture 100% of ED visits in Ontario.[31]

Study Population

We identified all older adults (age, ≥65 years) admitted to all hospitals in Ontario between April 1, 2006, and March 31, 2018, for one of eight EGS conditions: appendicitis, cholecystitis, diverticulitis, hernia with obstruction and/or strangulation, bowel obstruction, peptic ulcer disease, intestinal ischemia, or perforated viscus. Emergency general surgery conditions were identified using *International Classification of Diseases, Tenth Revision*, *Canada* diagnosis codes available in the hospital discharge abstract (Supplemental Digital Content, Supplementary Table 2, http://links.lww.com/TA/B839). To ensure that we captured only patients presenting emergently, all admissions without a preceding ED record were excluded. We limited the cohort to community- dwelling individuals by excluding patients residing in (or accepted to, but not yet residing in) a publicly funded nursing home at the time of their EGS admission.

Patient Characteristics

Baseline characteristics collected for each patient included age, sex, rural location of residence, comorbidities, the presence of frailty, socioeconomic status, marginalization, and prior use of home care services. Rurality was stratified using the "rural and small town" definition used by Statistics Canada.[32] Comorbidity and frailty were measured using the Johns Hopkins Adjusted Clinical Group (ACG) System version 10 (The Johns Hopkins University, Baltimore, MD), a population/patient case-mix adjustment system based on physician billing, ED visit, and hospital admission data.[33] Patients were stratified into six resource utilization bands (RUBs) derived from the ACG system that provide a relative measure of the individual's expected consumption of health

TABLE 1. Baseline Characteristics of Patients (Cases) and Controls

	All Cases (N = 90,245)	All Controls (N = 90,245)	Standardized Difference	Cases Undergoing Surgery (n = 36,974)	Cases With Baseline Frailty (n = 9,388)
Age, mean ± SD	77.20 ± 7.24	77.19 ± 7.22	0	76.28 ± 6.97	81.13 ± 6.86
Female sex, n (%)	49,046 (54.3%)	49,046 (54.3%)	0	20,078 (54.3%)	5,515 (58.7%)
Rural, n (%)	11,905 (13.2%)	11,905 (13.2%)	0	4,563 (12.3%)	900 (9.6%)
Receipt of recent home care, n (%)	9,288 (10.3%)	9,288 (10.3%)	0	2,715 (7.3%)	3,008 (32.0%)
Frailty, n (%)	9,388 (10.4%)	9,388 (10.4%)	0	3,110 (8.4%)	—
RUB, n (%)					
0	840 (0.9%)	840 (0.9%)	0	480 (1.3%)	0 (0.0%)
1	391 (0.4%)	391 (0.4%)	0	231 (0.6%)	0 (0.0%)
2	2,494 (2.8%)	2,494 (2.8%)	0	1,327 (3.6%)	0 (0.0%)
3	35,363 (39.2%)	35,363 (39.2%)	0	16,362 (44.3%)	867 (9.2%)
4	24,927 (27.6%)	24,927 (27.6%)	0	9,760 (26.4%)	2,079 (22.1%)
5	26,230 (29.1%)	26,230 (29.1%)	0	8,814 (23.8%)	6,442 (68.6%)
Neighborhood income quintile, n (%)					
1	18,857 (20.9%)	18,666 (20.7%)	0.01	7,561 (20.4%)	2,273 (24.2%)
2	19,265 (21.3%)	19,303 (21.4%)	0	7,880 (21.3%)	1,939 (20.7%)
3	17,723 (19.6%)	17,593 (19.5%)	0	7,183 (19.4%)	1,798 (19.2%)
4	17,439 (19.3%)	17,304 (19.2%)	0	7,221 (19.5%)	1,739 (18.5%)
5	16,961 (18.8%)	17,379 (19.3%)	0.01	7,129 (19.3%)	1,639 (17.5%)
EGS diagnosis, n (%)					
Appendicitis	6,878 (7.6%)	—		5,968 (16.1%)	305 (3.2%)
Cholecystitis	19,767 (21.9%)	—		9,146 (24.7%)	1,695 (18.1%)
Diverticulitis	22,196 (24.6%)	—		2,192 (5.9%)	2,640 (28.1%)
Hernia	7,307 (8.1%)	—		6,070 (16.4%)	784 (8.4%)
Obstruction	27,333 (30.3%)	—		9,503 (25.7%)	3,097 (33.0%)
Peptic ulcer disease	1,588 (1.8%)	—		1,141 (3.1%)	207 (2.2%)
Bowel ischemia	3,261 (3.6%)	—		1,579 (4.3%)	423 (4.5%)
Perforated viscus	1,915 (2.1%)	—		1,375 (3.7%)	237 (2.5%)
Underwent surgery, n (%)	36,974 (41.0%)	—		—	3,110 (33.1%)

TABLE 2. Mean Number of Months Alive and at Home (95% CI) for Cases and Matched Controls (Restricted Mean Survival Time, Evaluated at 5 Years/60 Months)

	All Patients			
	Overall	**Low Risk**	**Intermediate Risk**	**High Risk**
Cases	42.7 (42.6–42.9)	49.8 (49.6–50.1)	40.9 (40.7–41.1)	30.1 (29.4–30.7)
Controls	50.0 (49.9–50.1)	51.9 (51.7–52.1)	49.2 (49.0–49.4)	48.9 (48.4–49.3)
Difference	7.3 (7.1–7.4)	2.1 (1.8–2.4)	8.3 (8.0–8.5)	18.8 (18.0–19.6)
	Patients Undergoing Surgery			
	Overall	**Low Risk**	**Intermediate Risk**	**High Risk**
Cases	44.7 (44.4–44.9)	53.6 (53.3–53.8)	40.6 (40.3–41.0)	29.5 (28.6–30.3)
Controls	51.5 (51.4–51.7)	53.7 (53.5–53.9)	50.2 (50.0–50.5)	49.2 (48.6–49.7)
Difference	6.9 (6.6–7.1)	0.1 (−0.2–0.5)	9.6 (9.2–10.0)	19.7 (18.7–20.7)
	Patients With Baseline Frailty			
	Overall	**Low Risk**	**Intermediate Risk**	**High Risk**
Cases	27.5 (27.0–28.0)	33.4 (32.3–34.4)	27.1 (26.5–27.6)	17.5 (15.9–19.0)
Controls	34.8 (34.3–35.2)	36.5 (35.5–37.5)	34.2 (33.7–34.7)	35.1 (33.6–36.6)
Difference	7.2 (6.6–7.9)	3.1 (1.6–4.6)	7.1 (6.3–7.9)	17.6 (15.4–19.8)

Low risk: appendicitis and cholecystitis.
Intermediate risk: diverticulitis, hernia with obstruction and/or strangulation, and bowel obstruction.
High risk: peptic ulcer disease, intestinal ischemia, and perforated viscus.

services. Increasing RUB level corresponds with greater comorbidity burden and expected health care utilization. Frailty, as defined by the ACG system, is a dichotomous variable based on the presence of at least one diagnosis for a condition associated with medical frailty.[33,34] The ACG system has been used extensively to study health resource utilization and surgical outcomes.[35–38] Marginalization was characterized using the Ontario Marginalization Index, a multidimensional measure of various components of health and social well-being based on location of residence.[39] This tool has been used extensively in the health services literature to account for social determinants of health and differential access to health care in Ontario, including residential instability, material deprivation, dependency, and ethnic concentration.[40–42] Use of home care services was defined as receipt of publicly funded, in-home, long-term supportive care in the 90 days before EGS admission and was used as a measure of baseline patient function. Short-term in-home nursing care, such as that needed for postoperative wound or drain care, was not included in this definition.

In addition to patient baseline characteristics, we captured parameters related to in-hospital care. Patients were characterized based on whether they underwent surgery or were managed nonoperatively, whether they were admitted to an intensive care unit (ICU) at any time, and whether they required mechanical ventilation. Receipt of surgery, ICU admission, and need for mechanical ventilation were captured using physician billing codes available in the administrative data.

Outcomes

The primary outcome of interest was time spent alive and at home in the 5 years following admission for an EGS condition, measured as time to nursing home admission or death. Acceptance to a nursing home but remaining at home while awaiting placement was considered equivalent to nursing home admission. Our rationale was that acceptance to a nursing home is indicative of declining patient function to the point where the patient is no longer safe to live at home. Secondary outcomes were hospital length of stay, ICU days, ventilator days, and mortality (in-hospital and over the study period).

Matched Controls

The relationship between admission for an EGS condition and the probability of remaining alive and living in one's own home may be confounded by a patient's baseline health status and other characteristics. Therefore, we matched study patients 1:1 with controls from the general population who were not admitted for an EGS admission before matching. Patients and controls were matched based on age ±2 years, sex, ACG RUB, frailty, Ontario Marginalization Index quintiles, rurality, and any use of home care services in the prior 90 days.

Statistical Analysis

Descriptive statistics were used to report baseline patient and injury characteristics. Means and SDs or medians and interquartile ranges (IQRs) were calculated for continuous variables, as appropriate. Absolute and relative frequencies were calculated for discrete variables. All variables were compared using standardized differences, where a standardized difference of greater than 0.1 represented a meaningful difference between groups.[43]

Kaplan-Meier curves were used to plot the time spent alive and at home for cases and controls over time while accounting for censoring. The stratified log-rank test was used to test for a difference between case and control survival times. Restricted mean survival times (henceforth referred to as mean times) and 95% confidence intervals (CIs) were used to quantify the mean time spent alive and at home across groups for 5 years.[44,45] Cox proportional hazard models were used to estimate the hazard ratio (HR) for admission to nursing home or death associated with

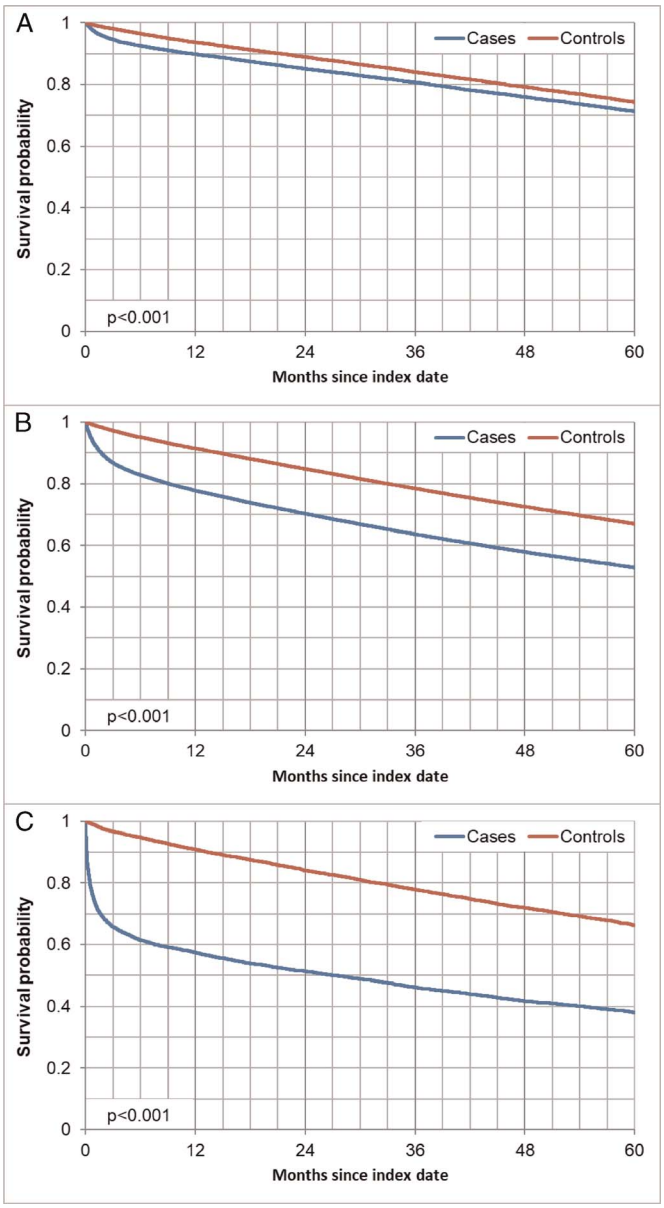

Figure 1. Kaplan-Meier plots showing time spent alive and living at home, comparing all cases and matched controls. A, low risk diagnoses; B, intermediate risk diagnoses; C, high risk diagnoses.

being an EGS patient compared with a matched control. Because of the increased risk for early (perioperative) mortality in the EGS cohort, interaction terms between the primary exposure and time were used to allow for the nonproportionality of the hazards over time. As such, HRs are reported separately for months 1 to 3, 4 to 6, 7 to 12, and 13 to 60 following EGS admission, which represent the true HR averaged over this period.

We performed two subgroup analyses in (1) patients who underwent surgery during their index admission and (2) patients with baseline frailty. In addition, all analyses were stratified to account for the heterogeneity of the included EGS diagnoses. Patients were stratified into three diagnostic groups: (1) low risk (appendicitis and cholecystitis), (2) intermediate risk (diverticulitis, hernia with obstruction and/or strangulation, and bowel obstruction), and (3) high risk (peptic ulcer disease, intestinal ischemia, and perforated viscus). While these groupings were chosen based on clinical considerations, they correlated well with in-hospital mortality (Supplemental Digital Content, Supplementary Table 3, http://links.lww.com/TA/B839).

All analyses were performed using SAS software (version 9.4; SAS Institute Inc., Cary, NC). Two-sided p values of <0.05 were considered statistically significant.

RESULTS

A total of 90,245 older adults admitted for an EGS condition were identified and matched 1:1 with controls (Supplemental

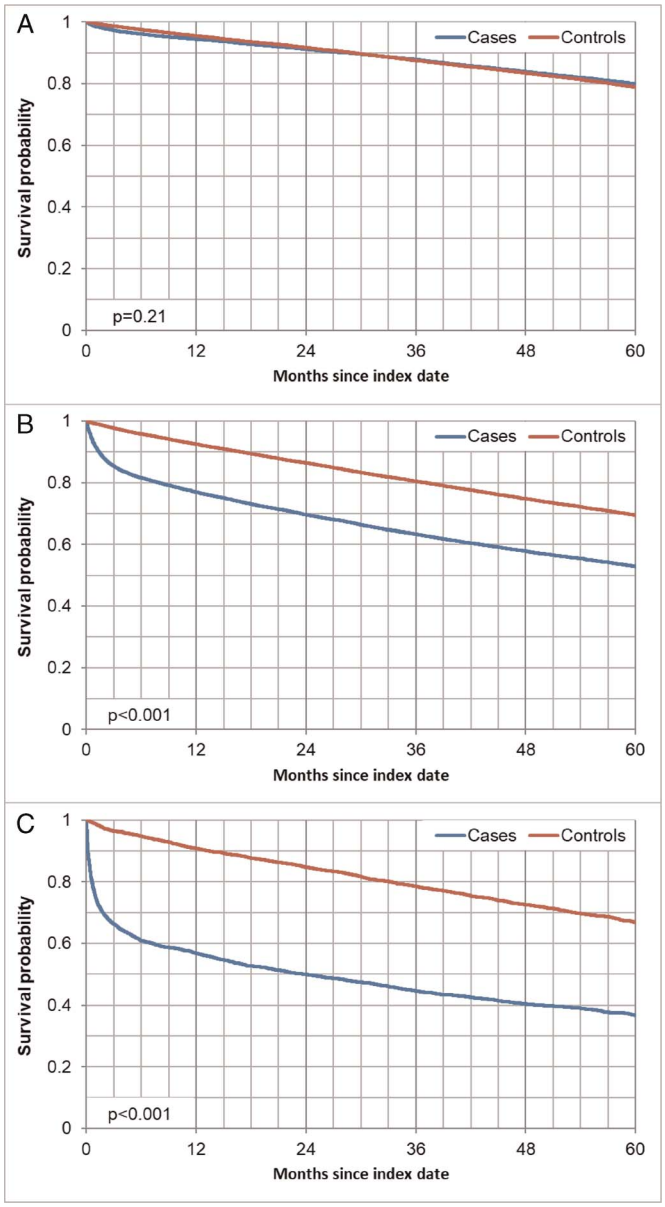

Figure 2. Kaplan-Meier plots showing time spent alive and living at home, comparing cases that underwent surgery and matched controls. A, low risk diagnoses; B, intermediate risk diagnoses; C, high risk diagnoses.

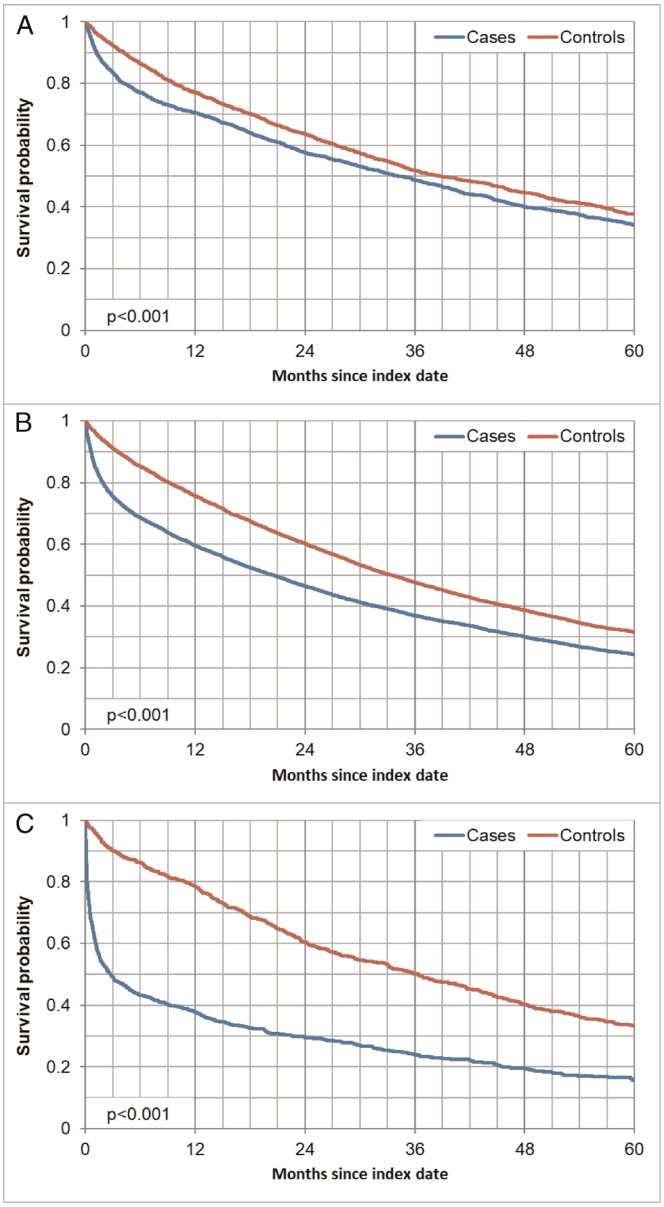

Figure 3. Kaplan-Meier plots showing time spent alive and living at home, comparing cases with baseline frailty and matched controls. A, low risk diagnoses; B, intermediate risk diagnoses; C, high risk diagnoses.

Digital Content, Supplementary Fig. 1, http://links.lww.com/TA/B839). Among patients, the mean ± SD age was 77.2 ± 7.2 years, and 54.3% (n = 49,046) were female. At the time of admission, 10.3% (9,288) were receiving home care, and 10.4% (n = 9,388) were frail (Table 1).

The most common EGS diagnoses were bowel obstruction, diverticulitis, and cholecystitis. Forty-one percent (n = 36,974) of patients underwent an operation during their admission, although there was considerable variation in this rate by admitting diagnosis (Table 1; Supplemental Digital Content, Supplementary Table 3, http://links.lww.com/TA/B839). Among those who underwent surgery, the most common procedures were cholecystectomy, surgery for bowel obstruction without resection, and appendectomy.

The median hospital length of stay was 5 days (IQR, 3–10 days), and in-hospital mortality was 6.8% (n = 6,132). An ICU stay was required for 14.5% (n = 13,071) of patients, with a median ICU stay of 4 days (IQR, 2–8 days). Mechanical ventilation was required for 8.9% (n = 7,990) of patients, with a median number of ventilator days of 3 (IQR, 2–6) (Supplemental Digital Content, Supplementary Table 4, http://links.lww.com/TA/B839). In-hospital mortality among patients with at least 1 ICU day was 25.7% (n = 3,353).

Mortality

Focusing only on mortality, the mean time spent alive for 5 years was 45.5 months (95% CI, 45.4–45.7) for cases and 52.6 months (95% CI, 52.5–52.7) for controls, a difference of 7.0 months (95% CI, 6.9–7.2) (Supplemental Digital Content, Supplementary Table 5, http://links.lww.com/TA/B839).

Time Alive and at Home

After 5 years of follow-up, 57% of cases and 69% of controls remained alive and at home. Patients admitted for an EGS condition spent significantly less time alive and at home than matched controls. Overall, the mean time spent alive and at home for 5 years (60 months) was 42.7 months (95% CI, 42.6–42.9 months) for cases and 50.0 months (95% CI, 49.9–50.1 months) for controls, a difference of 7.3 months (95% CI, 7.1–7.4 months) (Table 2), and was similar across subgroups. Specifically, patients who underwent surgery spent 44.7 months (95% CI, 44.4–44.9 months) alive and at home, compared with 51.5 months (95% CI, 51.4–51.7 months) among controls, a difference of 6.9 months (95% CI, 6.6–7.1 months). Among patients with baseline frailty, the average time spent alive and at home was 27.5 months (95% CI, 27.0–28.0 months) compared with 34.8 months (95% CI, 34.3–35.2 months) among controls, a difference of 7.2 months (95% CI, 6.6–7.9 months) (Table 2). Finally, except for patients admitted for a low-risk diagnosis who underwent surgery, cases spent significantly less time alive and at home than controls across all EGS risk strata (Table 2, Figs. 1–3). Overall, as well as in subgroup analyses, patients admitted with a high-risk diagnosis had the greatest difference in time alive and at home compared with controls (Table 2, Figs. 1–3).

As patient age increased, so too did the difference in mean time spent alive and at home between cases and controls. Patients aged 65 to 74 years experienced a mean of 5.8 fewer months (95% CI, 5.5–6.0 months) alive and at home compared with matched controls (Supplemental Digital Content, Supplementary Table 6, http://links.lww.com/TA/B839). Patients aged 75 to 84 years experienced a mean difference of 7.7 months (95% CI, 7.4–8.0 months), while patients aged 85 years or older experienced a mean difference of 9.4 months (95% CI, 8.9–9.9 months).

Risk of Nursing Home Admission or Death

We compared the risk of admission to a nursing home or death among cases and controls using Cox proportional hazards models. In the first 3 months postadmission, cases had a fivefold higher risk of admission to a nursing home or dying compared with controls (HR, 5.11; 95% CI, 4.89–5.35). While the risk of nursing home admission or death decreased the longer an individual remained alive, patients who had experienced an EGS admission remained at elevated risk compared with controls for the entirety of the 5-year follow-up (years 2–5; HR, 1.17;

95% CI, 1.15–1.19) (Fig. 4). Like the overall cohort, the risk of nursing home admission or death in patients who underwent surgery remained significantly elevated over the entire study period (Supplemental Digital Content, Supplementary Fig. 2, http://links.lww.com/TA/B839). However, while the risk of nursing home admission or death among patients with frailty was significantly elevated compared with controls in the first-year postadmission, the risk beyond 1 year returned to baseline (Supplemental Digital Content, Supplementary Fig. 3, http://links.lww.com/TA/B839). Finally, in stratified analyses, the risk of nursing home admission or death remained elevated for the entirety of the study period (5 years) across EGS risk strata, except for those who underwent an operation for a low risk diagnosis. Among those who underwent surgery for a low risk diagnosis, the risk of nursing home admission or death was significantly elevated only over the first 6 months following EGS admission before returning to baseline (Supplemental Digital Content, Supplementary Fig. 2, http://links.lww.com/TA/B839).

DISCUSSION

In this population-based analysis of long-term outcomes in older adults following admission for an EGS-related diagnosis, we showed that most older adults remained alive and at home for several years (on average, 3.5 years) following their admission for an EGS condition. Even among the highest risk group (frail patients admitted with a high-risk condition), nearly 40% remain alive and living in their own home at 1-year postadmission. However, compared with matched controls, older adults admitted for an EGS condition experienced an elevated risk of death or admission to nursing home that persisted for at least 5 years postadmission.

Although mortality is an important outcome, quality (rather than quantity) of life is the most important outcome for the majority of older adults.[18–21] In particular, the ability to remain at home represents a critical patient-centered outcome that is meaningful to older adults.[21,23] Many older adults would choose a palliative approach to care rather than face a future living in an institutionalized setting with profound disability.[18,19,46] Our data quantify these important outcomes for patients and provide information critical to patient-centered perioperative decision making.

Prior studies, including those derived from the American College of Surgeons National Surgical Quality Improvement Program, have demonstrated the significant impact of EGS on older adults.[47,48] Emergency general surgery, compared with elective surgery, has been independently associated with both increased morbidity and mortality among older adults.[49] Contemporary work suggests in-hospital morality of 7% to 12% and 1-year mortality of 30% to 38% following EGS in older adults.[16,37,50,51] Our findings reflect similar rates of in-hospital and 1-year mortality and extend our knowledge of patient outcomes to the 5-year mark.

The mean overall difference in time spent alive and at home was 7 months when comparing cases and controls. This result suggests that, while EGS admission is, by definition, an acute event, it has long-term implications for patients, more akin to a chronic health condition or comorbidity. However, the difference between cases and controls varied significantly across EGS risk strata, reflecting the heterogeneity of the underlying diagnoses and patients' baseline health. The overall difference between cases and controls may be less relevant to patients than the outcomes seen in specific subgroups. However, both our primary outcome and subgroup analyses demonstrate that a majority of patients admitted with EGS conditions, including those undergoing surgery and those with underlying frailty, spend significant time alive and at home following their admission.

The risk of admission to nursing home or death was elevated across all risk strata and subgroups until at least 6 months postadmission. This finding reinforces data from prior studies that suggest that older surgical patients may require 6 to 12 months to reach a new functional baseline and highlights the importance of measuring patient outcomes well beyond 90 days postadmission.[11,15,50,52] Certain subgroups returned to their baseline risk of admission to nursing home or death during the study period. Patients with low risk EGS diagnoses experienced 6 months of elevated risk before returning to a baseline or below baseline level of risk for nursing home admission or death. This finding should encourage routine treatment of such patients despite advanced age, comorbidity, and frailty. Patients with frailty returned to a baseline risk of admission to nursing home or death at 1-year postadmission. This likely reflects the fact that, while EGS admission has an impact on frail patients in the short term, their long-term prognosis is dominated by the well-described effect of frailty.[37,53,54]

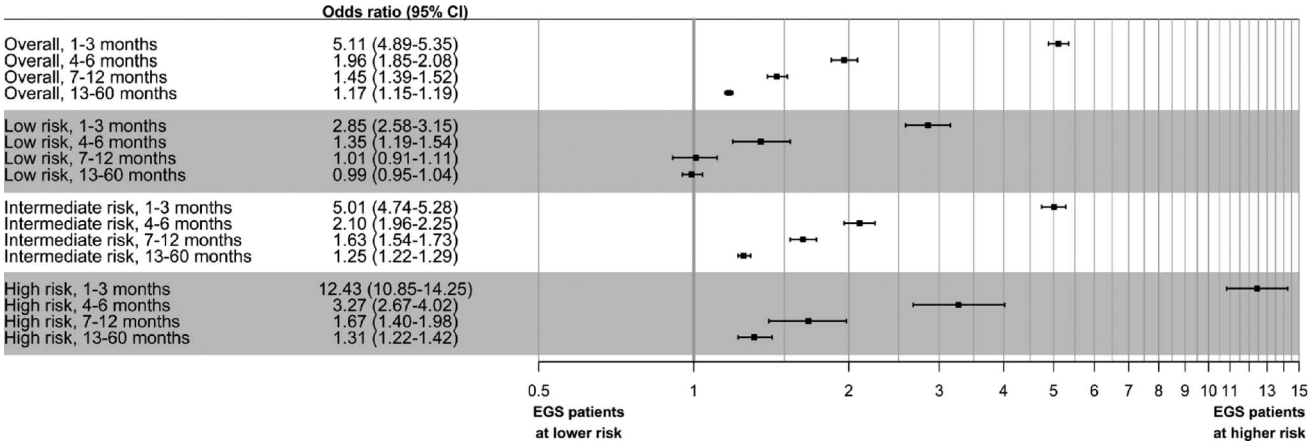

Figure 4. Hazard ratios (95% CI) for death or admission to nursing home among all cases compared with matched controls.

Residential status was used in this study as a surrogate measure for functional independence. Admission to a nursing home in Ontario is funded by provincial health insurance for those who need 24-hour nursing and personal care, frequent assistance with activities of daily living, or constant supervision and once the need for such care can no longer be safely met through publicly funded community-based services. Thus, admission to a nursing home is an accurate measure of clinically significant functional decline. While time to nursing home admission may differ in other jurisdictions with different mechanisms for funding nursing home care, the underlying functional decline experienced by EGS patients would not be expected to differ compared with patients in Ontario. Furthermore, no matter jurisdiction, we would not expect a difference in the propensity for nursing home admission between cases and matched controls.

This study has several limitations. Because of the nature of administrative data, we did not have a direct measure of patients' baseline functional status. Instead, we relied on residential location, frailty, and need for long-term home care as surrogate markers for function when matching cases and controls. Thus, it is possible that our analyses are impacted by unmeasured differences in baseline function between our cases and controls such as their abilities to perform activities and instrumental activities of daily living. Second, while formal nursing home care is publicly funded, some patients may have transitioned from their own homes into privately funded retirement homes. While retirement home status is not currently available in the administrative data, this mode of support is far less common in Ontario. Furthermore, we attempted to address this limitation by matching patients and controls on socioeconomic status; in doing so, we do not expect a significant difference in transitions to retirement home care among cases and controls. Third, there is a potential for immortal time bias in our analyses; patients cannot experience admission to nursing home while still admitted to hospital. For patients with prolonged hospital admissions, we may be overestimating the length of time spent in one's own home. However, most patients experienced a hospital admission of 5 days or less. Finally, although our data provide estimates of long-term outcomes based on patient and illness characteristics known early in admission (admitting diagnosis, frailty, undergoing surgery), in-hospital factors (such as prolonged mechanical ventilation) that are likely to significantly impact the probability of death and admission to nursing home are not incorporated into the present analyses.

In conclusion, older adults who require hospital admission for an EGS diagnosis are at significantly increased risk for admission to nursing home or death compared with matched controls for at least 5 years following admission. Emergency general surgery admission, for any diagnosis, decreases time spent alive and at home by 7 months, on average. However, most patients remain alive and living in their own home for several years following admission. Given the significant impact of EGS admission on long-term outcomes, patients should be cited realistic probabilities regarding their long-term outcomes at presentation to the ED as part of the informed consent process. Patient, disease, and treatment factors should be considered in this process because all appear to affect outcomes. Future work should focus on designing structures and processes of care to decrease the long-term risks experienced by patients discharged home following an EGS admission.

AUTHORSHIP

M.P.G., A.B.N., and B.H. conceived the research question, and all authors participated in designing the study. M.P.G. and A.H. participated in data acquisition. All authors contributed to data analysis. M.P.G. and B.H. drafted the article, which all authors contributed to revising.

DISCLOSURE

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