

Postoperative protocols for older adults undergoing emergency surgery: a scoping review

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Background: As the population of older adults expands, it is becoming increasingly crucial to develop perioperative protocols to meet their physiologic, functional, and cognitive demands after emergency surgery. We sought to identify protocols that improve the disposition, length of stay, and overall health outcomes of older adults undergoing emergency intracavitary, noncardiac surgery.

Methods: Embase, Cochrane, and MEDLINE databases were searched, and results were deduplicated and uploaded to Covidence. We reviewed studies for postoperative interventions that reduced delirium, maintained functional status, and reduced length of stay in older patients undergoing emergency surgery. We included studies involving patients aged 65 years and older undergoing emergency intracavitary, noncardiac surgeries. Abstracts and full texts were reviewed by 2 reviewers. Data were extracted on the postoperative interventions used and the resulting patient outcomes.

Results: We included 6 studies, which involved patients undergoing emergency general, urology, and vascular surgery. Interventions included a multidisciplinary approach, early involvement of a geriatrician or hospitalist, targeted geriatric-led ward rounds, unique postoperative order sets, and volunteer-driven activities. Standard care included early removal of lines, early mobility, optimal hydration, and medication review. These interventions were associated with decreased length of stay, decreased postoperative complications, and increased likelihood of disposition to home and previous functional status. Frailty was correlated with worse outcomes.

Conclusion: Through multidisciplinary interventions, a successful postoperative protocol for older patients undergoing emergency surgery is helpful for improving patient outcomes. The implications of these findings will help guide our own quality-improvement initiative to improve these outcomes in this patient population at our institution.

Contexte : À mesure que la population âgée augmente, il devient de plus en plus crucial d'instaurer des protocoles peropératoires pour répondre à ses besoins physiologiques, fonctionnels, et cognitifs spécifiques après une chirurgie d'urgence. Nous avons voulu identifier les protocoles qui permettent d'améliorer la disposition, la durée du séjour hospitalier et les paramètres de santé globaux chez les adultes âgés soumis à une chirurgie d'urgence intracavitaire non cardiaque.

Méthodes : Nous avons interrogé les bases de données Embase, Cochrane, et MEDLINE, et les résultats ont été dédupliqués et téléchargés dans le logiciel Covidence. Nous avons passé en revue les études sur les interventions postopératoires aptes à réduire l'état confusionnel aigu, à maintenir le statut fonctionnel et à abréger la durée des séjours hospitaliers chez les personnes âgées soumises à une chirurgie d'urgence. Nous avons inclus les études qui regroupaient des patients de 65 ans et plus devant subir une chirurgie d'urgence intracavitaire non cardiaque. Deux examinateurs indépendants ont passé en revue les résumés et les textes intégraux et les données sur les interventions postopératoires utilisées et les paramètres obtenus chez la patientèle ont été extraites.

Résultats : Nous avons inclus 6 études ayant regroupé des patients soumis à des chirurgies d'urgence générales, urologiques, et vasculaires. Les interventions incluaient approche multidisciplinaire, implication hâtive de la gériatrie ou de la médecine hospitaliste, tournées des unités de soins ciblées en gériatrie, ensembles d'ordonnances postopératoires particulières, et activités des bénévoles. Les soins standards incluaient le retrait hâtif des cathéters, la mobilisation précoce, une hydratation optimale, et la revue des médicaments. Ces interventions ont été associées à un abrègement des séjours hospitaliers, à une diminution des complications postopératoires, et à une plus grande probabilité de congé à domicile et de retour au statut fonctionnel de départ. La fragilité a été mise en corrélation avec une détérioration des paramètres de santé.

Conclusion : Grâce à des interventions multidisciplinaires, un protocole postopératoire efficace pour la patientèle âgée soumise à une chirurgie d'urgence améliore efficacement les paramètres de santé. Ces conclusions aideront à orienter nos propres initiatives d'amélioration de la qualité des soins afin de rehausser les paramètres de santé chez cette population de malades dans notre établissement.

As our population of older adults expands, health care professionals are finding it necessary to develop standardized, perioperative management protocols to meet the physiologic, functional, and cognitive demands specific to this population. The popularity of this topic is growing as older patients are undergoing more invasive surgical procedures for cure or rescue.¹

Surgeons are no longer avoiding operating on the older patient, which emphasizes the role for perioperative, evidenced-based guidelines. The American College of Surgeons (ACS) Geriatric Surgery Verification program² and the Coalition for Quality in Geriatric Surgery's Hospital Standards to Promote Surgical Care of the Older Adult³ are quality-improvement initiatives that provide evidence-based and expert-driven perioperative recommendations to improve surgical care and outcomes for older adults in the elective setting. Alternatively, the ACS Emergency General Surgery Verification Program defines surgical standards for emergency surgery patients with some recommendations for the older patient.⁴ Areas of overlapping focus include identifying the frail patient, implementing a geriatric expertise service, managing delirium and dementia, establishing patient preferences and goals of care, managing medications, and promoting patient mobility and safe patient disposition. A key difference between emergency and elective surgical patients is the challenge with preoperative optimization for patients undergoing emergency general surgery. These patients ultimately rely on targeted postoperative care to see improvements in length of stay, return to pre-morbid functional status, and overall health outcomes.

The use of older adult-focused perioperative protocols involving pre- and postoperative comprehensive geriatric assessments and collaboration with allied health professionals has reduced length of stay and other relevant outcomes in the older patient in the elective setting.⁵ However, these resources for the older patient in the emergency setting have limitations, which creates challenges when developing a standardized protocol.

In this scoping review, we sought to identify postoperative protocols in the literature designed to improve the health outcomes of patients aged 65 years and older after emergency intracavitary, noncardiac surgery. A scoping review was appropriate, as our objective was to explore any evidence in this area, identify relevant themes, and highlight gaps that could be further researched either through focused systematic reviews or targeted prospective cohort studies. This evidence can inform institutions on how to optimize the care of their older adult population after emergency surgery and identify challenges with standardizing emergency, postoperative care in this vulnerable population. Our research question was, What are the postoperative interventions in the literature for patients aged 65 years and older after emergency intracav-

itary, noncardiac surgery that aim to improve patient health outcomes, patient recovery, and patient return to prehospital functioning?

METHODS

We report this scoping review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) Checklist recommendations along with updated scoping review methodologic guidance informed by JBI.^{6,7} The completed PRISMA-ScR checklist can be found in Appendix 1, available at www.canjsurg.ca/lookup/doi/10.1503/cjs.007822/tab-related-content). The protocol is registered with Open Science Framework. Literature searches of Embase, Cochrane, and MEDLINE were performed to identify existing postoperative protocols designed to improve return to preoperative functional status and reduce postoperative complications in the older adult undergoing emergency intracavitary, noncardiac surgery from inception to Sept. 21, 2021. Medical Subject Heading terms included "Aged," "Elderly," "Postoperative care," "Enhanced recovery after surgery," "Post-Op," "Emergencies," "Practice guidelines," "Quality Improvement," "Total Quality Management," "Quality assurance," and "Protocol." Results were deduplicated and uploaded to Covidence.⁸ Details regarding our search strategy can be found in Appendix 1.

Eligibility criteria

Studies were included if they involved patients aged 65 years and older who were admitted for emergency intracavitary, noncardiac surgical care. This included both operative and nonoperative admissions. The specialties identified and included were urology, vascular surgery, and general surgery. The studies must have also included descriptions of pharmacologic, nonpharmacologic, or multidisciplinary interventions used as part of a postoperative protocol. We did not select studies on the basis of outcomes measured because of heterogeneity across studies. Outcomes identified included incidence of postoperative delirium and complications, length of stay, surrogates for functional status and quality of life, or disposition. Study designs focused on quality improvement, before-after, prospective quasiexperimental or cohort, and randomized controlled trials. Studies must have been published in English.

We excluded review articles, meta-analyses, studies based on preadmission interventions, studies of elective surgery, and studies involving patients younger than 65 years or those that did not stratify and analyze by age group when all ages were included. However, review articles were checked for relevant references to be considered for inclusion.

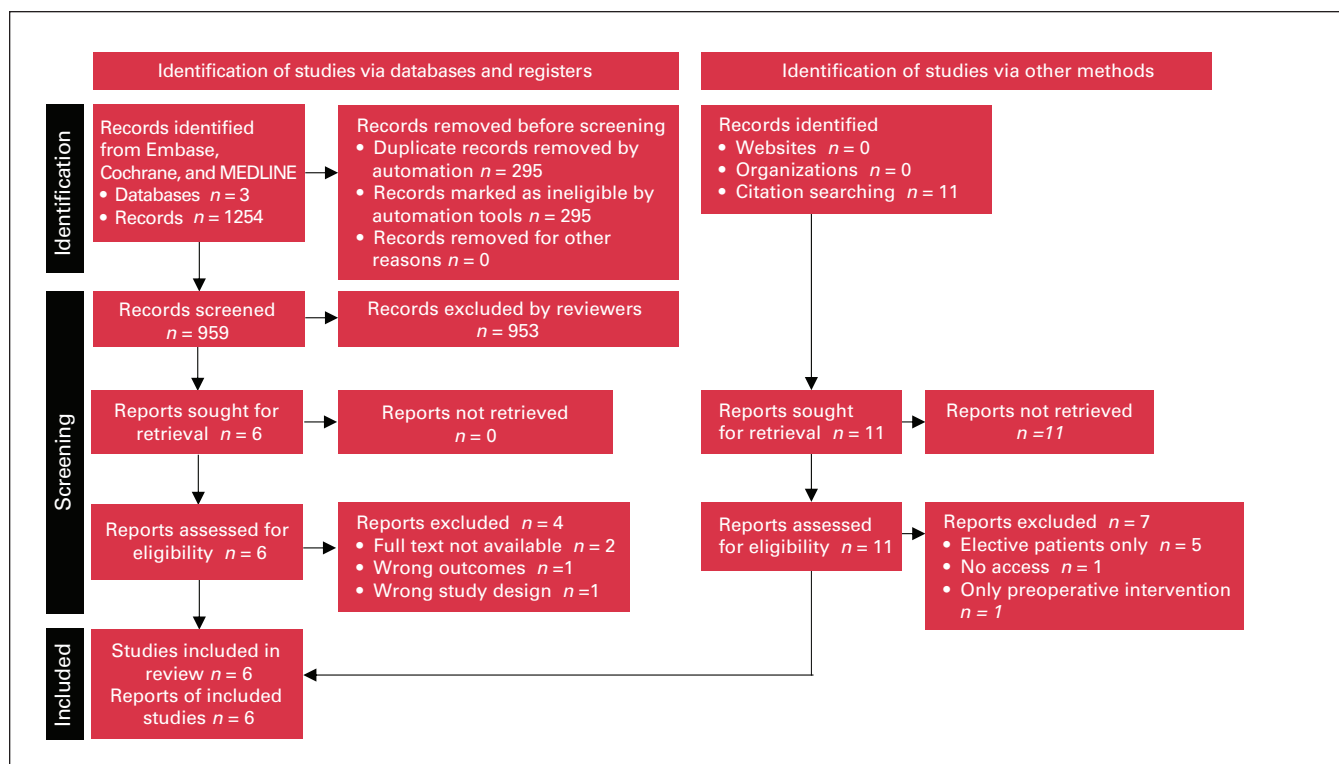


Fig. 1. PRISMA flowchart for study selection.

Data extraction and synthesis

Two independent assessors (B.G. and A.N.) reviewed the title and abstracts of retrieved publications based on inclusion and exclusion criteria outlined above. Disparities were discussed among assessors until an agreement was reached. Full texts were subsequently reviewed by the same assessors (B.G. and A.N.). References from included studies and review papers were also reviewed for relevant sources that met inclusion criteria. Through this method, we found 4 additional studies. From full-text publications, we extracted information on design, patient population, outcomes measured, description of the intervention, results, and conclusions. Finally, we implemented the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) method of quality analysis to establish the overall quality of each study.⁹⁻¹¹

RESULTS

The literature search identified 6 studies that met our inclusion criteria (Figure 1 and Table 1). Results are presented as a narrative synthesis organized first by interventions followed by outcomes. Overall, the outcomes measured either improved or remained unchanged after protocol implementation. Interventions were mostly consistent across studies, with some minor differences.

Interventions

The common interventions noted across the studies were multidisciplinary meetings, early involvement of geriatricians or hospitals, standardized admission order sets, patient-centred programs, and formal assessment of frailty.

Multidisciplinary meetings

A multidisciplinary approach was highlighted across the studies. Braude and colleagues,¹² Mudge and colleagues,¹⁶ and Bakker and colleagues¹⁴ used weekly multidisciplinary meetings to allow for dynamic patient care and address any current or anticipated issues with patients. This was also an opportunity for staff members to raise any concerns, both from a patient and intervention perspective. Braude and colleagues implemented targeted geriatric-led ward rounds allowing for further, more targeted interventions, and more frequent progress reports.¹² In 2 studies, formal multidisciplinary panels were created to help identify issues and develop a standardized pathway.^{12,15} The panels consisted of surgeons, hospitalists, nurses, social workers, physiotherapists, and occupational therapists.

Early involvement of geriatricians or hospitalists

Early involvement of a hospitalist or geriatrician was consistent across the studies. Engelhardt and colleagues¹⁵ involved a hospitalist to address complex medical conditions

Table 1 (part 1 of 3). Summary of included studies

Study	Study type; inclusion and exclusion criteria	Outcomes measured	No. of patients	Interventions	Results
Braude et al., 2017 ^{12*}	Phase quality improvement project with stepwise interventions Patients undergoing urology surgery aged > 65 yr and meeting 1 of the following criteria (130 patients): 1. Referred to POPS team 2. Emergency admission 3. Acute medical problem 4. Discharge-related problem 5. Length of stay > 7 d	Length of inpatient stay Medical or surgical postoperative complications 30-d readmission rate 30-d mortality Cancellation of surgery	Control: 112 (32 emergency) Intervention: 130 (41 emergency)	Phase 1: before-and-after study with initiation of daily board rounds, weekly multidisciplinary meetings, and twice-weekly targeted geriatrician-led ward rounds. Involved services: urology junior doctor, staff nurse, ward physiotherapy, and occupational therapy. Phase 2: Plan-do-study-act cycles and qualitative staff surveys to create a geriatric surgical checklist that helps to standardize the board rounds, identify geriatric syndromes and facilitate targeted interventions, improve teamwork and equity of care, and reduce duplication of handovers. Initially did not screen for frailty but in phase 2 through working groups created a checklist to identify those with geriatric syndrome risk factors. This was then embedded into routine clinical care using quality improvement.	Phase 1: Length of stay ↓ 19% (4.9 [n = 124] v. 4.0 [n = 101]; p = 0.01) Total postoperative complications decreased (24% [n = 101] v. 6% [n = 124] risk ratio 0.24, p = 0.001) Fewer cancellations of surgery (10% [n = 112] v. 5% [n = 130]; p = 0.12) due to avoidance of medical problems as opposed to administrative reasons. Subgroup analysis demonstrates no difference whether elective or emergency (p > 0.5). 30-d readmission (8% [n = 112] × 3% [n = 130]; p = 0.07) Phase 2: Staff understood their roles better in multidisciplinary meetings, had improved confidence with raising issues, reduced duplication of handovers and standardized identification of geriatric issues. Five daily meetings were eliminated between nurses, disposition coordinators and allied health and as more people were joining the board rounds. Board rounds remained at 30 min despite maintained POPS referrals, but cases changed to also include patients aged < 65 yr with more functional-related issues.
Koebrugge, et al., 2010 ^{13*}	Prospective study using high-standard delirium protocol No preintervention group; compared with existing literature Patients aged > 65 yr undergoing elective and emergency aortoiliac surgery (24/110 emergency patients) Excluded patients with Alzheimer disease or dementia	Postoperative delirium Length of ICU stay Length of hospital stay Postoperative complications Mortality	Control: none Intervention (n = 107, 22 emergency)	Providing hearing aids or glasses for those impaired. Photographs of relatives. Calendars in every room. Install familiar key points near all patients. No preoperative pharmacologic treatment. Does not screen for frailty. Instead uses Delirium Observation Scale of verbal and nonverbal behaviour 3 times daily. Geriatric consults for scores > 3. If deemed delirious after consultation, they would follow while in hospital and give advice to the surgical team daily, in addition to delirium work-up. No standardized or specific pathway. This study does not have emergency literature values to compare with, so not clear whether improved. But they did see improvements in the elective setting compared with previously published literature.	Patients with delirium were older (p = 0.01), had higher ASA scores (p = 0.01), lower diastolic blood pressure measurements (p = 0.03), and higher preoperative urea measurements (p = 0.02). They underwent longer operations (p = 0.01) and more often showed hemodynamic instability and blood loss (p < 0.01). Previous literature values are in the 20%–30% range and include only elective patients. Mortality rate 27.3% (emergency patients n = 22), and higher in patients developing delirium (p = 0.03). 59% of patients developed delirium after emergency surgery (n = 22), especially after laparotomy (compared with endovascular surgery) (p = 0.01). Delirious patients had longer ICU stay (p = 0.01), had longer length of stay (p < 0.01), and developed more complications (p < 0.01). Relative risk factors for delirium: advanced age and emergency surgery.

and palliative care specialists, should the patient meet a pre-determined set of criteria. Khadaroo and colleagues¹⁷ used a geriatric assessment team who would assess the patient within 48 hours of admission as per their unique postoperative order set. Bakker and colleagues¹⁴ and Koebrugge and colleagues¹³ would screen patients for frailty and involve a geriatrician if the patient screened positively for “frail” or “delirious.” This would then lead to a series of interventions through the CareWell in Hospital program¹⁴ or the high-standard delirium care protocol,¹³ respectively. Mudge and colleagues¹⁶ involved a senior medical practitioner to review patients and co-manage with other services.

Standardized admission order sets

Two of 6 studies created a targeted admission order set.^{15,17} These order sets standardized postadmission care and helped providers in avoiding treatments that can contribute to confusion and delirium. Most of these interventions are already well established in the elective setting.¹⁸ Engelhardt and colleagues¹⁵ developed a targeted discharge plan based on conversations with patients and their families regarding expected and realistic length of stay. They also had a multitiered frailty follow-up protocol in which the patients would be phoned at specific intervals after discharge to assess

Table 1 (part 2 of 3). Summary of included studies

Study	Study type; inclusion and exclusion criteria	Outcomes measured	No. of patients	Interventions	Results
Bakker et al., 2014 ^{14*}	<p>Before–after study</p> <p>Elective and emergency surgery</p> <p>Patients > 70 yr and frail with expected length of stay > 48 h</p> <p>Were able to begin intervening at least 48 h before admission</p> <p>Excluded: delirium at admission, refusal, logistic issues</p>	<p>Primary:</p> <p>Incidence of delirium</p> <p>Cognitive decline, and decline in ADLs during hospital stay</p> <p>Secondary:</p> <p>ADL performance at 3 mo</p> <p>postdischarge</p> <p>Readmission</p> <p>caregiver burden</p>	<p>Control:</p> <p>191 (120 surgical, 13% emergency)</p> <p>Intervention:</p> <p>195 (121 surgical, 22% emergency)</p>	<p>CareWell in Hospital program:</p> <p>Frailty review by a nurse, geriatric nurse, and then geriatrician (medication review and patient/family interviews), followed by comprehensive geriatric assessment and CareWell team verbal and written recommendations to the medical team, carefully categorized for clarity. The patient is followed closely while in hospital as part of a comprehensive geriatric assessment.</p> <p>Dynamic patient care via weekly multidisciplinary meetings with the entire health care team. Various stimulating activities with volunteers. Educational sessions to the nurses and physicians, and provision of continuous coaching.</p> <p>Screening for frailty but unclear how and if standardized.</p> <p>CareWell program: proactive and intensive support by CareWell geriatrics team for older, frail patients and increased awareness among nurses and physicians + team of volunteers to offer cognitively and physically stimulating activities.</p>	<p>Delirium and functional decline were highest among the surgical patients, but this was not statistically significant between before and after intervention groups.</p> <p>Significant improvement in ADLs at 3 mo and significant decrease in burden of care felt by informal caregivers.</p> <p>Surgical v. medical, not elective v. emergency.</p> <p>Surgical patients:</p> <p>Delirium: 13% ($n = 120$) v. 12% ($n = 121$), $p = 0.828$</p> <p>Cognitive decline: 19% ($n = 84$) v. 14% ($n = 96$), $p = 0.316$</p> <p>Physical decline: 41% ($n = 80$) v. 61% ($n = 98$), $p = 0.008$</p> <p>ADLs at 3 mo: 7.9% ($n = 62$) v. 9.5% ($n = 81$), $p = 0.035$</p> <p>Readmission < 1 mo: 11% ($n = 120$) v. 14% ($n = 121$), $p = 0.464$</p> <p>Caregiver burden of care: 3.1% ($n = 19$) v. 1.9% ($n = 26$), $p = 0.126$</p>
Engelhardt et al., 2018 ^{15*}	<p>Before–after study</p> <p>Patients aged > 65 yr who screened positive for frailty and emergency and nonoperative general surgery/trauma patients</p>	<p>Length of stay, loss of independence (decline in function or mobility, increased care needs at home, or discharge to nonhome destination), 30-d readmission rates</p>	<p>Control:</p> <p>11 emergency surgical</p> <p>Intervention:</p> <p>59 emergency surgical</p>	<p>Assessed frailty using trauma-specific and emergency general surgery–specific frailty indices.</p> <p>Discussions with the team, patient, and family about length of stay and disposition goals were held and documented.</p> <p>Early hospitalist consultation used to address complex medical needs.</p> <p>Expedited allied health involvement if increased risk of falls and difficulty with ADLs.</p> <p>Created geriatric-specific admission order sets.</p> <p>Standardized multitiered postdischarge follow-up schedule.</p>	<p>Length of stay: 9–6 d ($p = 0.4$)</p> <p>Readmissions decreased: 36.4%–10.2% ($p = 0.02$)</p> <p>Loss of independence: 100%–60% ($p = 0.01$)</p> <p>By prioritizing frail patients, other nonfrail geriatric patients may have had delays in their evaluation and thus worsened length of stay, loss of independence, or readmissions. However, these outcomes were not significantly different before or after the intervention.</p>
Mudge et al., 2020 ^{16†}	<p>Before–after study</p> <p>Patients aged > 65 yr undergoing emergency, elective, nonoperative vascular surgery</p> <p>More than half were urgent operations</p>	<p>Primary:</p> <p>Length of stay</p> <p>Discharge to usual residence</p> <p>Mortality data</p> <p>Delirium and functional decline</p> <p>Secondary:</p> <p>Serious medical complications, discharge destination, total hospital length of stay (definitive discharge)</p>	<p>Control:</p> <p>112 (59 emergency)</p> <p>Intervention:</p> <p>123 (68 emergency)</p>	<p>A medical doctor available 5 d/wk to review the patients and prioritize them for daily discussion with the surgical and nursing team. They would provide advice and support to junior doctors, help coordinate other consultations, supported daily huddles and weekly discharge planning meetings with the multidisciplinary team and assisted after-hours handover.</p> <p>The medical team conducted twice weekly joint rounds with surgeons.</p> <p>Eat Walk Engage program: created a monthly working group to identify care practices for older patients (focus on early mobility, nutrition, hydration, and meaningful cognitive activities).</p> <p>Availability of allied health assistant.</p>	<p>Functional decline: 39.7% v. 20.6% ($p = 0.02$)</p> <p>Delirium: 35.6% v. 16.2% ($p = 0.01$)</p> <p>Length of stay: 12.6 v. 9.3 d ($p = 0.02$)</p> <p>Patients discharged home or to usual care: 54.2%–67.6% ($p = 0.12$)</p>

recovery and progress.¹⁵ The standardized order set used by Khadaroo and colleagues¹⁷ had “intentional comfort rounding,” which is an assessment by nursing every 2 hours in terms of positioning, mobility, hydration, nutrition, pain control, and delirium prevention. The order set also included medication review, and patient and family education.¹⁷

Patient-centred programs

Bakker and colleagues¹⁴ and Mudge and colleagues¹⁶ tasked volunteers to provide cognitively stimulating interventions to the patients, such as puzzles and games. Khadaroo and colleagues¹⁷ integrated their BE-FIT (Bedside Reconditioning for Functional Improvements) program, which is a self-administered exercise program

Table 1 (part 3 of 3). Summary of included studies

Study	Study type; inclusion and exclusion criteria	Outcomes measured	No. of patients	Interventions	Results
Khadaroo et al., 2020 ^{17‡}	Before–after study, prospective, nonrandomized Patients aged > 65 yr undergoing emergency general surgery Excluded elective surgery/trauma patients, transfers, palliative, and nursing home residents	Proportion of patients who experienced a major postoperative in-hospital complication or death Death or readmission within 30 d and 6 mo of initial discharge, minor in-hospital complications, length of hospital stay, and requirement for alternative level of care at discharge	Preintervention 153 Postintervention 140	Integration of a geriatric assessment team, optimization of evidence-based elder-friendly practices through a standardized order set, promotion of patient-oriented rehabilitation (BE-FIT program), and early discharge planning (identify estimated discharge date at time of admission). Co-locating older patients to a single unit for better coordination of care. “Comfort rounds” and delirium screening by nursing staff. Proactive mobilization. Early removal of tubes and lines. Elderly-friendly appropriate medication use.	Increase in geriatric consultations from 6.5% (<i>n</i> = 153) v. 58.1% (<i>n</i> = 136) (<i>p</i> < 0.001) Decrease in use in urinary catheters (76.5% [<i>n</i> = 153] v. 63.6% [<i>n</i> = 140]), total parenteral nutrition (27.5% [<i>n</i> = 153] v. 13.6% [<i>n</i> = 140]), and quick to postoperative mobilization (46.4 v. 29.1 h, <i>p</i> < 0.05) Delirium reduced by half (25.5% [<i>n</i> = 153] v. 12.9% [<i>n</i> = 140], <i>p</i> = 0.006) Decrease in major postoperative complications or death by 19% (<i>p</i> < 0.001) and decrease in all complications by 19% (<i>p</i> < 0.001) at the intervention site (<i>n</i> = 153 v. <i>n</i> = 140) Median length of stay decreased by 3 d (10 v. 7, <i>p</i> = 0.001) Requirement for alternative level of care decreased by half (39.9% [<i>n</i> = 153] v. 20.7% [<i>n</i> = 140], <i>p</i> < 0.001) Death or readmission at 30 d and 6 mo were unchanged

ADLs = activities of daily living; ASA = American Society of Anesthesiologists; BE-FIT = Bedside Reconditioning for Functional Improvements; ICU = intensive care unit; POPS = Proactive Care of Older People Undergoing Surgery.
*From initial literature search.
†Thillainadesan J, Yumol MF, Suen M, et al. Enhanced recovery after surgery in older adults undergoing colorectal surgery: a systematic review and meta-analysis of randomized controlled trials. *Dis Colon Rectum* 2021;64:1020-1028.
‡Ellis G, Gardner M, Tsiachristas A, et al. Comprehensive geriatric assessment for older adults admitted to hospital. *Cochrane Database Syst Rev* 2017;9:CD006211.

patients perform postoperatively to improve recovery, reduce delirium, and return to baseline. Bakker and colleagues¹⁴ implemented the CareWell in Hospital program designed to improve patient-centred care for older patients and to educate health care professionals about providing care to older adults. This program also had trained volunteers offer activities for cognitive and physical stimulation to patients, with a goal to prevent perioperative complications, including hospital-associated delirium and functional decline.¹⁴

Formal frailty assessment

Frailty was specifically addressed by Engelhardt and colleagues¹⁵ and Bakker and colleagues.¹⁴ Engelhardt and colleagues used frailty indices validated for both emergency general¹⁹ and trauma surgery patients.²⁰ For 3 months, they prospectively screened for frailty in patients older than 65 years admitted for emergency general surgery, and subsequently, those who screened positive underwent the intervention.¹⁵ In the study by Bakker and colleagues, through the CareWell program,¹⁴ nurses would subjectively complete their own frailty screening based on 6 delirium risk factors — cognitive impairment, sleep deprivation, immobility, vision impairment, hearing impairment, and dehydration — followed by a more in-depth screening by the geriatric nurse.²¹

Loss of independence

In 4 of 6 studies, loss of independence, a surrogate for functional decline, was evaluated in several different ways. These

included assessing activities of daily living (ADLs) performance at 3 months postdischarge, caregiver burden, decline in function or mobility, increased care needs at home, discharge to nonhome destination, discharge to usual residence, and requirement for alternative level of care.¹⁴⁻¹⁷

Outcomes

Outcomes measured were variable across studies and representative of success or failure of the entire protocol. Two studies divided outcomes into primary and secondary.^{14,16} Below are the outcomes identified and the corresponding changes noted postintervention.

Length of stay

Length of stay was determined in 4 of the 6 studies.^{12,15-17} All showed an improvement in length of stay, although this finding was not statistically significant in 1 study. Braude and colleagues¹² found a significant decrease of 19% (4.9 v. 4.0 d, *p* = 0.01). Khadaroo and colleagues¹⁷ noted a significant decrease of a median of 3 days (10 v. 7 d, *p* = 0.001), and Mudge and colleagues¹⁶ found a significant decrease of 2 days (12.6 v. 9.3 d, *p* = 0.02). In the study by Engelhardt and colleagues,¹⁵ the improvement was not statistically significant; the authors noted a length of stay decrease from 9 to 6 days (*p* = 0.4).

Postoperative complications and surgery cancellations

Two of 6 studies compared postoperative complications, and both found significant decreases (range 19%–24%,

$p < 0.001$).^{12,17} Braude and colleagues¹² also noted fewer cancellations in surgeries due to medical issues, but this was not significant (10% v. 5%, $p = 0.12$).

Readmission rates, loss of independence, functional decline, and need for alternative level of care

Readmission rates were compared in 4 of 6 studies,^{12,14,15,17} and overall, these were improved after intervention. However, statistical significance was reached in only 1 study (36.4% v. 10.2%, $p = 0.02$).¹⁵ Loss of independence decreased significantly by 40% (100% to 60%, $p = 0.01$),¹⁵ functional decline was found to improve (39.7% v. 20.6%, $p = 0.02$),¹⁶ and need for alternative level of care decreased significantly by half (39.9% v. 20.7%, $p < 0.001$).¹⁷ Bakker and colleagues¹⁴ found a significant improvement in physical decline (41% v. 61%, $p = 0.008$) and ADLs at 3 months (7.9% v. 9.5%, $p = 0.035$), as well as a subjective decrease in burden of care for caregivers, although this was not significant (3.1% v. 1.9%, $p = 0.126$). Mudge and colleagues¹⁶ also noted an increase in discharge to usual or previous level of care, but this was not significant (54.2% to 67.6%, $p = 0.12$).

Delirium rates

Four studies evaluated delirium rates after their interventions.^{13,14,16,17} Koebrugge and colleagues¹³ found higher delirium rates (59%) in emergency patients as compared with rates in elective surgery described in the literature (29%–39%).²² The authors did not have preintervention values for comparison.¹³ Bakker and colleagues¹⁴ did not identify a difference in delirium pre- and postintervention (13% v. 12%, $p = 0.828$). Both Mudge and colleagues¹⁶ and Khadaroo and colleagues¹⁷ saw significant improvements in delirium after their respective interventions (35.6% v. 16.2%, $p = 0.01$;¹⁶ 25.5% v. 12.9%, $p = 0.006$).¹⁷

Quality of evidence (GRADE assessment)

Table 2 shows the assessment of the quality of evidence as per GRADE criteria, and Appendix 1 shows the quality analysis per study.¹¹ Overall, the studies are of low quality owing to their observational nature, indirectness of evidence, reporting and observer bias, and inability to control for confounders. There is no way to determine

causality given the lack of randomization and the implementation of multiple, concurrent changes. Observer and reporting bias is also present, as health care workers knew the changes being implemented were to improve these outcomes. Additionally, all patients meeting the criteria were enrolled in the study with no control group. Comparisons were made retrospectively to a smaller pre-implementation group.

DISCUSSION

Efforts to improve care for hospitalized older patients undergoing emergency surgery are still ongoing. Emphasis is placed on tailoring treatment based on geriatric expertise, transitional care, and disposition planning, as well as clear communication between care teams and patients and families. These concepts and the impact they have on a patient's course in hospital, and physical and functional outcomes are demonstrated in this review.

The multidisciplinary approach is well-established in many areas of health care and was consistent across all studies. Shared decision-making and using individual expertise from a variety of professional backgrounds has been clinically and economically effective both in surgical and medical environments.²³ The involvement of geriatricians alongside the multidisciplinary team has also been shown to be helpful.²⁴ A comprehensive geriatric assessment holistically evaluates the older person, including medical history, psychosocial circumstances, and functional status, and uses this information to form a multifaceted care plan to aim for return to prehospital functional status.²⁵ Orthopedic surgery was the first surgical specialty to integrate geriatricians into their care team. A meta-analysis of randomized controlled trials (RCTs) saw an improvement in functional status and increased return to prehospital place of residence after implementing comprehensive geriatric care for patients with hip fractures.²⁶ Geriatric care has also been beneficial for medical patients. A meta-analysis of RCTs compared comprehensive geriatric care with usual care for patients older than 65 years admitted to urgent care and found that patients in geriatric-designated wards who received comprehensive older-adult care were more likely to be living at home at their 12-month follow-up visit and had overall improved patient outcomes.²⁷ It is essential to include this in the care of patients undergoing emergency surgery.

Frailty is increasingly being included as a criterion for geriatric intervention, with many described tools providing objective measurements of functional reserve and identifying patients more prone to adverse outcomes.^{19,28–32} A systematic review and meta-analysis found that the presence of frailty is accurate in predicting postoperative mortality, complications, prolonged length of stay, and loss of independence, with a mortality rate as high as 24.7% among frail patients undergoing

Table 2. Summary of quality of evidence as per GRADE criteria

Study	Quality of evidence
Braude et al., 2017 ¹²	Low
Koebrugge et al., 2010 ¹³	Very low
Bakker et al., 2014 ¹⁴	Very low
Engelhardt et al., 2018 ¹⁵	Low
Mudge et al., 2020 ¹⁶	Low
Khadaroo et al., 2020 ¹⁷	Low

GRADE = Grading of Recommendations, Assessment, Development and Evaluation.

emergency abdominal surgery.¹ The 2019 report put forth by the ACS Geriatric Surgery Verification program recommends preoperative screening for high-risk characteristics as denoted by frailty tools. It further notes that these concerns should be addressed within 48 hours of admission if in the emergent setting.² By incorporating frailty, we can identify higher-risk patients within an already-vulnerable population, thereby shifting resources and preventing overburdening of geriatricians. This was demonstrated by Engelhardt and colleagues,¹⁵ who had hypothesized that prioritizing frail patients requiring emergency general surgery might delay evaluation and care for nonfrail patients needing emergency general surgery, leading to worse outcomes (e.g., length of stay, loss of independence, or readmissions) in that cohort. Instead, they found that outcomes for nonfrail patients did not drastically change even with resources shifted toward the patients screened as higher risk and frail.¹⁵ Frailty is likely a better target for interventions in the older adult than age, which is often arbitrary.

Finally, patient-centred short- and long-term outcomes are increasingly being recognized as a standard of quality in emergency surgical care, with loss of independence being one of the most important and clinically meaningful for patients after admission.³³ In 2016, Berian and colleagues found loss of independence to be significantly associated with readmission rates and postoperative complications in older surgical patients, and found that it was the strongest factor associated with death after discharge. They identified several risk factors associated with loss of independence, including age older than 75 years, previous fall history, length of stay, or emergency surgery.³⁴ Recently, patient income below national median has also been found to predict loss of independence, and perceived social support was found to be protective against loss of independence.³³ Bakker and colleagues¹⁴ were the only researchers who evaluated patient-reported outcomes at more than 30 days postdischarge and found improvements in 3-months-postdischarge ADLs and caregiver burden after implementation of their protocol.¹⁴ Maintaining pre-existing mobility and function through careful attention to postoperative care needs may also allow for early recognition of limited home resources, which could provide an opportunity to intervene through increasing social supports before discharge, thus reducing loss of independence.

Limitations

There are certain limitations inherent in before–after studies. Given that there are multiple interventions being implemented at once, establishing causality is impossible without randomization and controlling for confounders. Also, the likelihood of potentially unequal and unidentified confounders influencing the impact of the intervention is high and creates issues with generalizability.

As expected, preintervention data collection would stop once an intervention was implemented, resulting in smaller preintervention cohorts and consequently reduced power.^{14,15} Engelhardt and colleagues found that retrospectively screening for frailty was difficult given that only chart review was available for preintervention data collection. Retrospective frailty screening typically involved in-person interviews and self-reported data alongside electronic medical record documentation, which on its own has inherent variability.¹⁵

Given specifics of the centres in question, there is an issue of generalizability. Centres with a geriatric service may already have better preintervention outcomes than centres unfamiliar with geriatric services, which may need a longer study period to account for the learning curve. Even within a single centre, there may be existing practice variations between the individual providers or wards that may influence outcomes.

None of the studies formally report on patient-reported outcomes, which may be more clinically meaningful. Life-saving surgery may not always be the main patient priority if surgical morbidity is high.

Other limitations included the sample size of the individual studies and resulting statistical analysis. Samples tended to be small and even smaller when subgroup analysis was required. This could lead to loss or gain of statistical significance, creating bias and misinterpretation.

CONCLUSION

Older adults undergoing emergency general surgery is a rapidly growing area in health care. Standardized protocols and the associated patient benefits are well established in the elective setting. Conversely, thorough preoperative risk assessment and prehabilitation for older patients in the emergency setting is often not possible, creating challenges with postoperative recovery. A standardized protocol with an individualized multidisciplinary approach involving shared decision-making between the patient, their family, and the health care team may help improve outcomes in this patient population.

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References

- Kennedy CA, Shipway D, Barry K. Frailty and emergency abdominal surgery: a systematic review and meta-analysis. *Surgeon* 2022;20:e307-14.
- Geriatric Surgery Verification program. American College of Surgeons; 2019. Available: <https://www.facs.org/quality-programs/accreditation-and-verification/geriatric-surgery-verification/> (accessed 2024 Mar. 14).
- Berian JR, Rosenthal RA, Baker TL, et al. Hospital standards to promote optimal surgical care of the older adult: a report from the Coalition for Quality in Geriatric Surgery. *Annals of Surgery* 2018;267:280-90.
- Emergency General Surgery Verification Program. American College of Surgeons; 2022. Available: <https://www.facs.org/quality-programs/accreditation-and-verification/emergency-general-surgery/> (accessed 2024 Mar. 14).
- Daniels SL, Lee MJ, George J, et al. Prehabilitation in elective abdominal cancer surgery in older patients: systematic review and meta-analysis. *BJS Open* 2020;4:1022-41.
- Shamseer L, Moher D, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ* 2015;350:g7647.
- Page MJ, McKenzie PM, Bussuyt I, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71.
- Covidence: better systematic review management*. Melbourne: Covidence. Available: <https://www.covidence.org/>
- Schunemann HJ, Mustafa RA, Brozek J, et al. GRADE guidelines: 22. The GRADE approach for tests and strategies — from test accuracy to patient-important outcomes and recommendations. *J Clin Epidemiol* 2019;111:69-82.
- Schunemann HJ, Mustafa RA, Brozek J, et al. GRADE guidelines: 21 part 2. Test accuracy: inconsistency, imprecision, publication bias, and other domains for rating the certainty of evidence and presenting it in evidence profiles and summary of findings tables. *J Clin Epidemiol* 2020;122:142-52.
- Ryan RH, S. How to GRADE the quality of the evidence. Cochrane Consumers and Communication Group. 2016;Version 3.0.
- Braude P, Goodman A, Elias T, et al. Evaluation and establishment of a ward-based geriatric liaison service for older urological surgical patients: Proactive care of Older People undergoing Surgery (POPS)-Urology. *BJU Int* 2017;120:123-9.
- Koebrugge B, van Wensen RJ, Bosscha K, et al. Delirium after emergency/elective open and endovascular aortoiliac surgery at a surgical ward with a high-standard delirium care protocol. *Vascular* 2010;18:279-87.
- Bakker FC, Persoon A, Bredie SJH, et al. The CareWell in Hospital program to improve the quality of care for frail elderly inpatients: results of a before-after study with focus on surgical patients. *Am J Surg* 2014;208:735-46.
- Engelhardt KE, Reuter Q, Liu J, et al. Frailty screening and a frailty pathway decrease length of stay, loss of independence, and 30-day readmission rates in frail geriatric trauma and emergency general surgery patients. *J Trauma Acute Care Surg* 2018;85:167-73.
- Mudge AM, McRae P, Donovan PJ, et al. Multidisciplinary quality improvement programme for older patients admitted to a vascular surgery ward. *Intern Med J* 2020;50:741-8.
- Khadaroo RG, Warkentin LM, Wagg AS, et al. Clinical effectiveness of the elder-friendly approaches to the surgical environment initiative in emergency general surgery. *JAMA Surg* 2020;155:e196021.
- Deeken F, Sánchez A, Rapp MA, et al. Outcomes of a delirium prevention program in older persons after elective surgery: a stepped-wedge cluster randomized clinical trial. *JAMA Surgery* 2022;157:e216370-e.
- Orouji Jokar T, Ibraheem K, Rhee P, et al. Emergency general surgery specific frailty index: a validation study. *J Trauma Acute Care Surg* 2016;81:254-60.
- Joseph B, Pandit V, Zangbar B, et al. Validating trauma-specific frailty index for geriatric trauma patients: a prospective analysis. *J Am Coll Surg* 2014;219:10-7.e1.
- Inouye SK, Bogardus ST Jr, Charpentier PA, et al. A multicomponent intervention to prevent delirium in hospitalized older patients. *N Engl J Med* 1999;340:669-76.
- Balasundaram B, Holmes J. Delirium in vascular surgery. *Eur J Vasc Endovasc Surg* 2007;34:131-4.
- Davis MJ, Luu BC, Raj S, et al. Multidisciplinary care in surgery: Are team-based interventions cost-effective? *Surgeon* 2021;19:49-60.
- Shaw M, Pelecanos AM, Mudge AM. Evaluation of internal medicine physician or multidisciplinary team comanagement of surgical patients and clinical outcomes: a systematic review and meta-analysis. *JAMA Netw Open* 2020;3:e204088.
- Stuck AE, Siu AL, Wieland GD, et al. Comprehensive geriatric assessment: a meta-analysis of controlled trials. *Lancet* 1993;342:1032-6.
- Wang H, Li C, Zhang Y, et al. The influence of inpatient comprehensive geriatric care on elderly patients with hip fractures: a meta-analysis of randomized controlled trials. *Int J Clin Exp Med* 2015;8:19815-30.
- Ellis G, Whitehead MA, Robinson D, et al. Comprehensive geriatric assessment for older adults admitted to hospital: meta-analysis of randomised controlled trials. *BMJ* 2011;343:d6553.
- Joseph B, Zangbar B, Pandit V, et al. emergency general surgery in the elderly: Too old or too frail? *J Am Coll Surg* 2016;222:805-13.
- Goeteyn J, Evans LA, De Cleyn S, et al. Frailty as a predictor of mortality in the elderly emergency general surgery patient. *Acta Chir Belg* 2017;117:370-5.
- Kenig J, Mastalerz K, Lukasiewicz K, et al. The Surgical Apgar Score predicts outcomes of emergency abdominal surgeries both in fit and frail older patients. *Arch Gerontol Geriatr* 2018;76:54-9.
- Parmar KL, Law J, Carter B, et al. Frailty in older patients undergoing emergency laparotomy: results from the UK Observational Emergency Laparotomy and Frailty (ELF) Study. *Ann Surg* 2021;273:709-18.
- Lee KC, Streid J, Sturgeon D, et al. The impact of frailty on long-term patient-oriented outcomes after emergency general surgery: a retrospective cohort study. *J Am Geriatr Soc* 2020;68:1037-43.
- Renne A, Proaño-Zamudio JA, Pinkes N, et al. Loss of independence after traumatic injury: a patient-centered study. *Surgery* 2023;174:1021-5.
- Berian JR, Mohanty S, Ko CY, et al. Association of loss of independence with readmission and death after discharge in older patients after surgical procedures. *JAMA Surg* 2016;151:e161689.