The American Surgeon
2022, Vol. 88(3) 439–446

DOI: 10.1177/00031348211048838
journals.sagepub.com/home/asu
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Emergency General Surgery Procedures and Cost of Care for Older Adults in the State of Maryland

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Abstract

Background: Older adults (OAs) ≥ 65 years of age, representing the fastest growing segment in the United States, are anticipated to require a greater percentage of emergency general surgery procedures (EGSPs) with an associated increase in health care costs. The aims of this study were to identify the frequency of EGSP and charges incurred by OA compared to their younger counterparts in the state of Maryland.

Methods: A retrospective review of the Maryland Health Services Cost Review Commission from 2009 to 2018 was undertaken. Patients undergoing urgent or emergent ESGP were divided into 2 groups (18-64 years and ≥65 years). Data collected included demographics, APR-severity of illness (SOI), APR-risk of mortality (ROM), the EGSP (partial colectomy [PC], small bowel resection [SBR], cholecystectomy, operative management of peptic ulcer disease, lysis of adhesions, appendectomy, and laparotomy), length of stay (LOS), and hospital charges. *P*-values ($P < .05$) were significant.

Results: Of the 181,283 patients included in the study, 55,401 (38.1%) were ≥65 years of age. Older adults presented with greater APR-SOI (major 37.7% vs 21.3%, extreme 5.2% vs 9.3%), greater APR-ROM (major 25.3% vs 8.7%, extreme 22.3% vs 5.3%), underwent PC (24.5% vs 10.9%) and SBR (12.8% vs 7.0%) more frequently, and incurred significantly higher median hospital charges for every EGSP, consistently between 2009 and 2018 due to increased LOS and complications when compared to those ≤65 years of age.

Conclusion: These findings stress the need for validated frailty indices and quality improvement initiatives focused on the care of OAs in emergency general surgery to maximize outcomes and optimize cost.

Key Takeaways

- Cost of care for older adults (≥65 years of age) undergoing emergency general surgery procedures (partial colectomy, small bowel resection, cholecystectomy, operative management of peptic ulcer disease, lysis of adhesions, appendectomy, and laparotomy) is significantly higher than their younger counterparts.
- The increase in cost is due to increased hospital length of stay and post-operative complications.
- There is a need for the validation of frailty indices and the development of quality improvement initiatives in older adults to reduce complication and hospital length of stay.

Introduction

The United States (US) Census Bureau projects that the number of older adults (OAs), defined as individuals who are ≥65 years of age,[1] will grow by 55% between 2010 and 2050,[2] therefore accounting for 21% of the population. At present, more than 40% of all in-patient operations are performed on patients ≥65 years of age.[3,4] As this population continues to grow, there has been an expected increase in the incidence of OAs requiring emergency general surgery procedures (EGSPs). It has been well established that OAs experience a disproportionally

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higher rate of mortality, complications, and failure to rescue, along with increased length of stay when undergoing EGSPs, as compared to their younger counterparts.[5-7]

Over the course of a decade, emergency general surgery (EGS) admissions and EGSPs in the United States have increased by 27.5% and 32.3%, respectively.[8] The reported mean cost per EGS admission requiring surgical intervention within 2 days of admission was $13,241 between 2008 and 2011.[5] In the future, EGS costs are projected to increase by 45%, from $28.4 billion in 2010 to $41.2 billion by 2060, largely due to the aging population.[9]

A 2016 retrospective review of data from the National Inpatient Sample for adults ≥18 years of age with primary EGS diagnoses, based on the American Association for the Surgery of Trauma (AAST) definition, who underwent urgent or emergent operative procedures within 2 days of admission, identified the top 7 EGSPs accounting for 80% of all admissions, deaths, complications, and in-patient costs. These included partial colectomy, small bowel resection (SBR), cholecystectomy, operative management of peptic ulcer disease (PUD), lysis of peritoneal adhesions (LOA), appendectomy, and laparotomy.[5]

As this demographic shift unfolds, hospitals throughout the United States will continue to face the unique challenges associated with the operative management, complications, and costs for OAs in the EGS setting. To date, no studies have evaluated the distribution of the 7 EGSPs that account for 80% of the national EGS operative burden in the United States nor the cost associated with these procedures for OAs. The aims of this study were to identify the frequency of the 7 most common EGSPs in OAs, as well as, the charges incurred, and to compare these findings to those of their younger counterparts within the state of Maryland.

Methods

Study Population

Approval was obtained from the University of Maryland Institutional Review Board. This was a retrospective review using the Maryland State Health Services Cost Review Commission (HSCRC) database to examine hospital encounters for patients ≥18 years of age who underwent selected EGSPs between 2009 and 2018.

Database and Emergency General Surgery Procedures

The HSCRC database captures demographic, financial (payor source and total charges), and clinical data for all surgical patients within the state of Maryland who undergo same-day outpatient procedures and those who are admitted post-operatively. The AAST has defined criteria for identification of EGSPs using the International Classification of Disease-9 Modification codes.[10] Using these criteria, the following 7 EGSPs, performed in an urgent or emergent fashion, were selected for analysis: appendectomy (ICD-9-CM 47.0x), cholecystectomy (51.2x), partial colectomy (45.7x), small bowel resection (45.6x), peritoneal adhesiolysis (54.5x), surgical management of peptic ulcer disease (44.4x) both perforation and hemorrhage, and exploratory laparotomy (54.1x).[11]

Covariates

Patients were divided into 4 groups: 18-64 (young), 65-74 (young-old), 75-84 (middle-old) and ≥85 (old-old). Data collected included demographics, Charlson Comorbidity Index (CCI), hospital size, payor status, frequency of the 7 EGSPs of interest, median overall and hospital-specific charges (room, operating room, laboratory, imaging, medications, and therapy), hospital length of stay (HLOS), intensive care unit (ICU) length of stay, and post-operative complications including pneumonia, respiratory failure, myocardial infarction, acute kidney injury, urinary tract infections, sepsis, and venous thromboembolism (VTE).

In addition to CCI, severity of illness (SOI) and risk of mortality (ROM) data were collected from the HSCRC data set. The SOI score is based on the All Payer-Related (APR) Diagnosis Related Groups from the Center for Medicaid and Medicare Services and the ROM data are based on APR Diagnosis-Related Group codes, patient diagnoses, and surgical procedures performed.[12] Both the APR-ROM and APR-SOI are divided into minor, moderate, major, and extreme.

The primary outcome of interest was median hospital charges in the 18-64 vs ≥ 65 years age group. Secondary outcomes were hospital-specific charges, HLOS, complication rates, and in-hospital mortality in each age group.

Statistical Analysis

Frequencies and proportions were reported for categorical variables. For continuous measurements, means and standard deviations were computed when data were normally distributed. Medians and interquartile ranges (IQR, 25th to 75th percentile) were presented for non-normal data. Hospital charges for each year were reported at the 2019 dollar level. Patients may undergo more than one EGSP, so the prevalence of all EGSPs combined will be greater than 100%.

Though the database represents the population of hospital information in Maryland, statistical tests were presented to demonstrate that small differences may yield highly significant results. The Student's t test, Wilcoxon's rank-sum statistic, and Kruskal-Wallis test were computed when appropriate. A *P*-value below .05 was considered statistically significant.

Results

A descriptive summary of patients' characteristics is provided in Table 1. Of the 181,283 patients included in the study, 55,401 (30.6%) were ≥65 years of age. Of that group, 7376 (13.3%) were ≥85 years of age. Older adults presented with a higher APR-severity of illness (major 37.7% vs 21.3% and extreme 5.2% vs 9.3%, $P < .001$), a higher APR-risk of mortality (major 25.3% vs 8.7%, and extreme 22.3% vs 5.3%, $P < .001$), a higher CCI, and utilized governmental insurance payor coverage (90.3% vs 29.6%, $P < .001$) when compared to those ≤65 years of age. (Table 1)

Table 2 represents the prevalence of the 7 EGSPs performed in the state of Maryland between 2009 and 2018 for all adults ≥18 years of age. Overall, the 3 most commonly performed EGSPs were cholecystectomy (33.7%), LOA (32.9%), and appendectomy (17.6%). The least performed EGSP was surgical management of PUD (1.9%). Older adults underwent partial colectomy (24.5% vs 10.9%), SBR (12.8% vs 7.0%), and surgical management of PUD (3.0% vs 1.5%) more frequently and appendectomy (7.0% vs 21.6%) much less frequently than their younger counterparts. The remainder of the EGSPs were similarly distributed among both groups.

Laparotomy, SBR, and partial colectomy accounted for the highest overall in-patient charges for those 18-64 and ≥65 years of age. However, when comparing median hospital charges incurred for those 18-64 years of age for the OAs over the 10-year period, accounting for inflation over time, OAs incurred significantly higher median hospital charges for every EGSP. (Table 3) Median charges for OAs who underwent LOA, appendectomy, and cholecystectomy were 71.4%, 45.4%, and 43.4% higher than that for their younger counterparts, respectively.

To determine the specific hospital charges that could account for the overall increased cost of care for OAs, the annual median charges within each category (room, operating room, medications, imaging, labs, and therapy) were collected from the HSCRC database and compared among the different age groups. (Figure 1) The majority of total hospital costs per EGSP were related to room and operating room charges. While operating room charges remained somewhat constant, room charges increased considerably across the age groups for each EGSP.

The overall median HLOS for the 65-74 age group was twice as long (6 vs 3, $P < .001$), and for the ≥85 group, was 3 times as long (9 vs 3, $P < .001$) when compared to those <65 years of age. For EGSP-specific length of stay, those who underwent laparotomy, SBR, and partial colectomy experienced longer HLOS when compared to the other EGSPs in all age groups. Nonetheless, there was an overall increase in HLOS among OAs when compared to their younger counterparts across all EGSPs. (Table 4)

Fifteen percent of the cohort was admitted to the ICU for management. The trend was toward an increased ICU LOS for OAs early on. Additionally, with increasing age, an increased ICU LOS was associated with a significant increase in mortality (7% vs 11.6% vs 14.8% vs 17.9%, $P < .001$), reducing the overall ICU LOS in OAs. (Figure 2)

Cardiac, pulmonary, renal, and VTE complications occurred more frequently in those ≥65 years of age and 40% of OAs experienced at least one complication vs only 21% of their younger counterparts. Finally, in-hospital mortality increased with increasing age, with the ≥85 years of age experiencing the highest mortality rate when compared to those <65 years of age (9.7% vs 1.3%, $P < .001$). (Table 5)

Discussion

To our knowledge, this study is the first to use an administrative state-wide hospital population-based database to compare the frequency of as well as hospital charges and outcomes for the 7 EGSPs associated with the highest burden of post-operative morbidity and mortality in EGS comparing younger vs OAs over a 10-year period. The top 3 EGSPs in the overall population were cholecystectomy, LOA, and partial colectomy. Of note, OAs underwent partial colectomy, SBR, and surgical management of PUD more frequently and appendectomy less frequently than their younger counterparts. In the state of Maryland, OAs incurred higher hospital charges, experienced longer HLOS, and increased postoperative complications when compared to those <65 years of age.

In our study, laparotomy, SBR, and partial colectomy accounted for the highest hospital charges across both age groups with OAs incurring higher charges across all 7 EGSPs when compared to their younger counterparts. Furthermore, OAs experienced a substantially higher increase in charges when compared to those <65 years of age when undergoing LOA, cholecystectomy, and appendectomy during the same 10-year period. When evaluating the hospital-specific charges to determine which component contributed most to the overall cost, room charges were identified as the primary culprit. These typically include a base fee (the room, dietary services, nursing care, routine disposable and/or reusable equipment, and other miscellaneous supplies) which is compounded by the HLOS. Older adults experienced a significantly increased HLOS across all 7 EGSPs which likely accounted for the higher overall charges seen in this population.

Many of the surgical indications that require urgent and emergent colonic resections such as obstructing colorectal cancers, colonic ischemia, diverticulitis, sigmoid volvulus, and *Clostridium difficile* colitis are considered diseases of the aging.[13] The physiologic changes of aging, including both global debilitation and a dysfunctional immune system, may contribute to a delay in diagnosis

Table 1. Characteristics of Patients Undergoing EGSP Aged 18-64 vs ≥ 65 Years.

	Total n = 181,283	18-64 n = 125,882	≥65 n = 55,404	*P*-value
Gender, n (%)				
Male	69,153 (38.1)	45,347 ()36.0	23,806 (43.0)	<.001
Female	112,130 (61.9)	80,535 (64.0)	31,595 (57.0)	
Age groups, n (%)				
18-64		125,882 (100)		
65-74			28,820 (52.0)	
74-84			19,205 (34.7)	
≥85			7,376 (13.3)	
Race, n (%)				
White	110,149 (60.8)	70,190 (55.8)	39,959 (72.1)	<.001
Black	50,086 (27.6)	38,868 (30.9)	11,218 (20.2)	
Asian	4,122 (2.3)	2,894 (2.3)	1,228 (2.2)	
Other	13,363 (7.4)	11,498 (9.1)	1,865 (3.4)	
APR-SOI[a], n (%)				
Minor	39,761 (21.9)	35,224 (28.0)	4,437 (8.2)	<.001
Moderate	68,203 (37.6)	52,168 (41.4)	16,035 (28.9)	
Major	47,682 (26.3)	26,796 (21.3)	20,886 (37.7)	
Extreme	25,637 (14.1)	11,694 (9.3)	13,943 (25.2)	
APR-ROM[b], n (%)				
Minor	101,690 (56.1)	88,599 (70.4)	13,091 (23.6)	<.001
Moderate	35,508 (19.6)	19,563 (15.5)	15,945 (28.8)	
Major	25,013 (13.8)	11,014 (8.7)	13,999 (25.3)	
Extreme	19,072 (10.5)	6,706 (5.3)	12,366 (22.3)	
CCI[c] by age group, mean (SD)				
18-64	1.8 (2.5)			<.001
65-74		1.3 (2.2)	2.8 (2.9)	
75-84			3.1 (2.9)	
≥85			3.1 (2.8)	
Hospital size, n (%)				
Small (<250 beds)	86,053 (47.5)	58,236 (46.3)	27,817 (50.2)	<.001
Medium (250-500 beds)	70,149 (38.7)	49,648 (39.4)	20,501 (37.0)	
Large (>500)	25,081 (13.8)	17,998 (14.3)	7,083 (12.8)	
Teaching status, n (%)				
Yes	94,616 (52.2)	67,790 (53.9)	26,826 (48.4)	<.001
No	86,667 (47.8)	58,092 (46.1)	28,575 (51.6)	
Payor status, n (%)				
Government	87,349 (48.2)	37,308 (29.6)	50,041 (90.3)	<.001
Commercial	83,906 (46.3)	78,850 (62.6)	5,056 (9.1)	
Self-pay	9,374 (5.2)	9,131 (7.3)	243 (.4)	
Other	564 (.3)	515 (.4)	49 (.1)	

[a]API-SOI, all payer-related severity of illness.
[b]API-ROM, all payer-related risk of mortality.
[c]CCI, Charlson Comorbidity Index.

and frequent presentation of OAs with intra-abdominal sepsis. While the increased HLOS in colorectal procedures has been reported to be due to post-operative complications such as ileus, anastomotic leak, sepsis, and wound infections,[14] additional factors influence HLOS in OA including increasing age and baseline comorbidities. Complications in OAs are exacerbated by preoperative time constraints in the EGS setting which preclude completion of a detailed workup and optimization of comorbidities, which lead to post-operative complications such as respiratory failure and need for reintubation, venous thromboembolism, and myocardial infarctions.[13] Factors that are associated with increased HLOS following exploratory laparotomy are more challenging to determine given that this procedural designation can reflect a myriad of disparate primary diagnoses or

Table 2. Prevalence of EGSP Among Patients Aged 18-64 vs ≥ 65 Years.

Procedure	Total n = 181,283	18-64 n = 125,882	≥65 n = 55,401
Cholecystectomy, n (%)	61,111 (33.7)	41,595 (33)	19,516 (35.2)
Lysis of adhesions, n (%)	59,746 (32.9)	41,752 (33.2)	17,994 (32.4)
Appendectomy, n (%)	31,111 (17.6)	27,219 (21.6)	3,892 (7)
Partial colectomy, n (%)	27,340 (15)	13,776 (10.9)	13,564 (24.5)
Small bowel resection, n (%)	15,888 (8.8)	8,820 (7)	7,068 (12.8)
Laparotomy, n (%)	12,763 (7)	8,655 (6.9)	4,108 (7.4)
Surgical management of PUD[a], n (%)	3,526 (1.9)	1,847 (1.5)	1,679 (3)

[a]PUD, Peptic ulcer disease.

Table 3. Median Hospital Charges in 2019 Dollars for each EGSP Among Patients Aged 18-64 vs ≥ 65 Years[a].

Procedure	18-64 n = 125,882	≥65 n = 55,401	Charge increases for ≥65 vs 18-64
Laparotomy	33,568	43,148	28.5%
Small bowel resection	33,152	37,659	13.6%
Partial colectomy	28,449	33,063	16.2%
Surgical management of PUD[b]	26,125	30,271	15.9%
Lysis of adhesions	16,030	27,480	71.4%
Cholecystectomy	13,836	19,822	43.3%
Appendectomy	9724	14,168	45.7%

[a]Median charges between 18-64 and ≥65 age groups are statistically significant (P<.001) for each EGS procedure.
[b]PUD, Peptic ulcer disease.

Table 4. Overall and EGSP-Specific Hospital Length of Stay Among Patients Aged 18-64 vs ≥ 65 Years.

	18-64	64-75	75-84	≥85
HLOS overall[a,b]	3 (2-6)	6 (3-11)	7 (4-13)	9 (5-14)
EGSP Specific[a,b]				
Laparotomy	8 (4-18)	11 (6-22)	12 (6-21)	11 (6-18)
Small bowel resection	8 (5-15)	10 (6-18)	11 (7-18)	11 (7-17)
Partial colectomy	8 (5-12)	8 (5-14)	10 (6-16)	11 (7-16)
Surgical Management of PUD[c]	7 (4-13)	8 (4-14)	9 (5-15)	8 (5-13)
Lysis of adhesions	3 (2-7)	7 (4-12)	8 (5-14)	10 (6-16)
Cholecystectomy	3 (2-5)	5 (3-8)	6 (3-9)	7 (4-10)
Appendectomy	2 (1-3)	3 (2-6)	(2-8)	5 (3-9)

[a]Median (IQR)
[b]Overall and EGSP-specific length of stay in 18-64 vs ≥65 years are statistically significant ($P < .001$).
[c]PUD, Peptic ulcer disease.

procedures with widely variable post-operative hospital courses and complications.

The greater increase in charges due to increased HLOS, over the last 10 years, for LOA, cholecystectomy, and appendectomy could possibly be accounted for by the combination of growth of the OA population and subsequent increased incidence of EGS disease and changes in practice in EGS to include a non-operative model for certain diagnoses.[8] This approach includes a longer non-operative period of time and utilization of nasogastric tube decompression for treatment of a small bowel obstruction rather than operative intervention with adhesiolysis in the OA population. Similarly, the use of antibiotics rather than surgical intervention in the management of acute cholecystitis and acute appendicitis in OAs due to concerns for increased perioperative morbidity and mortality. As a result, the potential failure of the non-operative approach and delayed surgical interventions could account for the increased HLOS in OAs compared to those <65 years where the non-operative approach may be utilized less frequently.

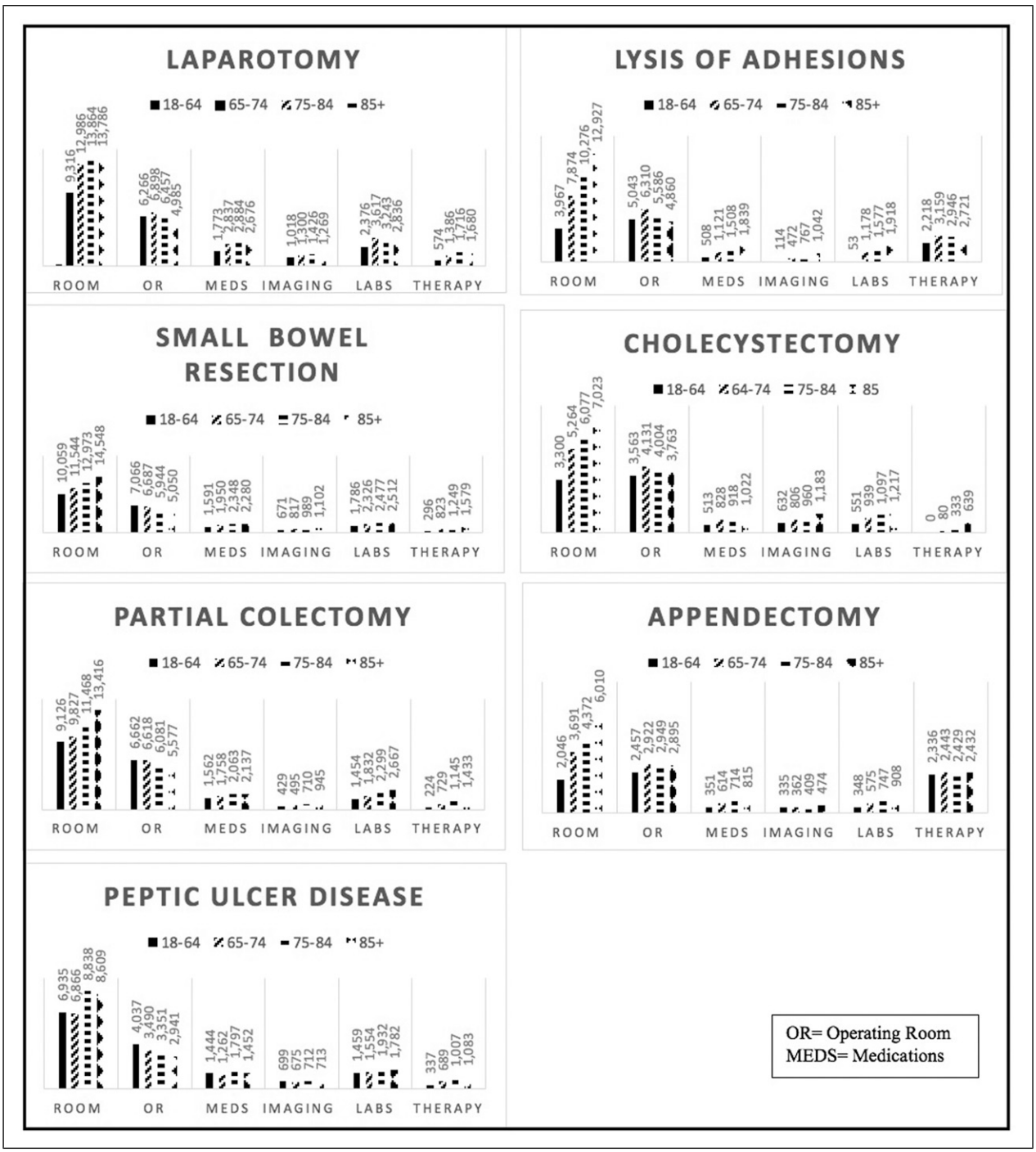

Figure 1. Annual median-specific hospital charges in 2019 dollars for EGSP performed in Ages 18-64 vs ≥ 65 years.

We acknowledge that there are several limitations to our study including its retrospective nature. Because we used an administrative claims database, there was missing information relevant for the patient, the hospital, and the EGSPs, the inability to determine timing of operative intervention from admission, the lack of information regarding physician and other provider fees, and the inability to characterize the variability in practice within the different institutions. On the other hand, one important strength to point out pertaining to the HSCRC database is that the HSCRC has established preset charges that are universal across all payor types including Medicare, Medicaid, and private insurance such that, in the state of Maryland, hospital charges do not vary as a function of health insurance coverage type.

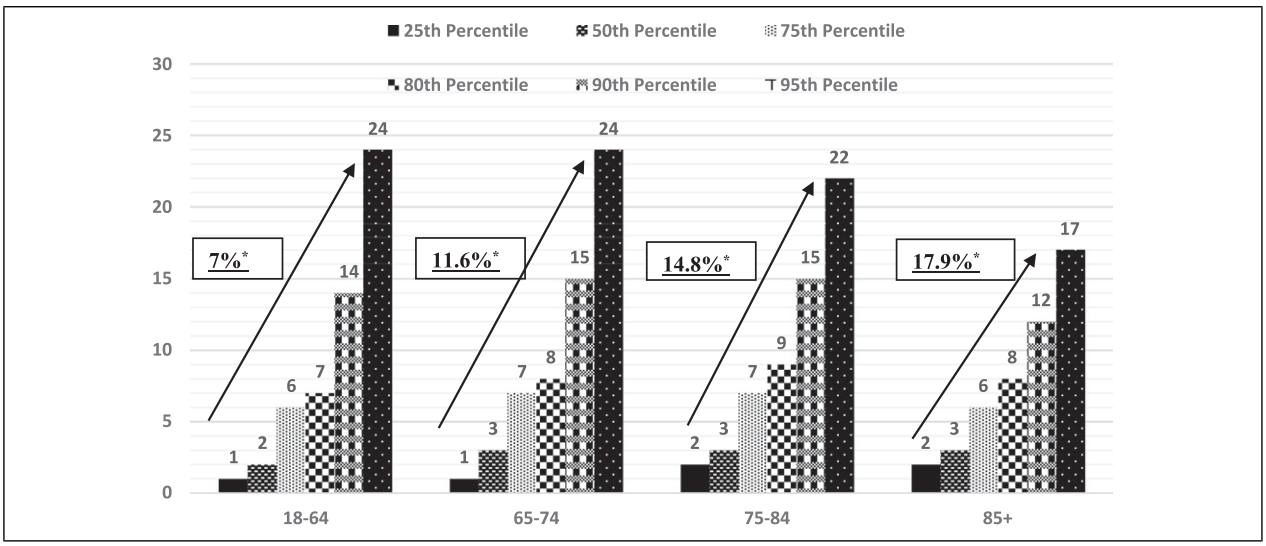

Figure 2. Intensive care unit length of stay among patients Aged 18-64 vs ≥ 65 years stratified by age. *Indicate increase in mortality with increased intensive care unit length of stay.

Table 5. Post-Operative Complications and Mortality Among Patients Aged 18-64 vs ≥ 65 Years.

	18-64 n = 125,882	≥65 n = 55,401	*P*-value
Post-operative complications, n (%)			
Pneumonia	1,227 (1)	1,332 (2.4)	<.001
Respiratory failure	2743 (2.2)	3016 (5.4)	
Urinary tract infection	4911 (3.9)	5429 (9.8)	
Acute kidney injury	6065 (4.8)	9218 (16.6)	
Sepsis	7779 (6.2)	8473 (15.3)	
Myocardial infarction	475 (0.4)	1187 (2.1)	
Venous throboembolism	1389 (1.1)	146 (2.6)	
At least 1 complication, n (%)	26,445 (21)	22,338 (40.3)	<.001
Mortality by age group, n (%)			
18-64	1,661 (1.3)		<.001
65-74		1,220 (4.2)	
75-84		1,229 (6.4)	
≥85		718 (9.7)	

Our findings indicate that as the US population continues to undergo a demographic transition and as the incidence of EGSPs among OAs continues to rise, there will be an associated increase in cost of care. In order to address this public health problem and to mitigate morbidity and mortality, future research endeavors should focus on directing resources to developing, analyzing, and modifying quality improvement initiatives for this population. The literature on prognostic factors for morbidity and mortality in OAs continues to lag behind and further research is required to identify and validate frailty indices that may reduce morbidity and mortality, decrease HLOS, and improve overall outcomes. Finally, high-volume centers should focus on the development of formal and multidisciplinary EGS services that tailor care to the OA population from time of admission to discharge as this model has been described in the OA trauma patient population, and recently in the EGS OA population in Canada,[15] which have shown reduced complications and HLOS.[16-20] Similarly, the American College of Surgeons has created the Geriatric Surgery Verification Program with the focus on systematically improving surgical care and outcomes for the aging adult population.[21]

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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References

1. *Indicator Definitions - Older Adults*. 2015. https://www.cdc.gov/cdi/definitions/older-adults.html. Accessed August 1, 2021
2. *65+ in the United States*. 2010. www.census.gov/library/publications/2014/demo/p23-212.html. Accessed August 1, 2021
3. Hall MJ, Schwartzman A, Zhang J, Liu X. Ambulatory surgery data from hospitals and ambulatory surgery centers: United States, 2010. *Natl Health Stat Report*. 2017;102:1-15.
4. Centers for Disease Control. National hospital discharge survey: number of all-listed procedures for discharges from short-stay hospitals, by procedure category and age: United States. 2010. www.cdc.gov/nchs/data/nhds/4procedures/2010pro4_numberprocedureage.pdf. www.cdc.gov/nchs/data/nhds/4procedures/2010pro4_numberprocedureage.pdf. Accessed August 1, 2021.
5. Scott JW, Olufajo OA, Brat GA, et al. Use of national burden to define operative emergency general surgery. *JAMA Surg*. 2016;151(6):e160480. doi:10.1001/jamasurg.2016.0480.
6. Mehta A, Efron DT, Canner JK, et al. Effect of surgeon and hospital volume on emergency general surgery outcomes. *J Am Coll Surg*. 2017;225(5):666-e2. doi:10.1016/j.jamcollsurg.2017.08.009.
7. Havens JM, Olufajo OA, Cooper ZR, Haider AH, Shah AA, Salim A. Defining rates and risk factors for readmissions following emergency general surgery. *JAMA Surg*. 2016;151(4):330-336. doi:10.1001/jamasurg.2015.4056.
8. Gale SC, Shafi S, Dombrovskiy VY, Arumugam D, Crystal JS. The public health burden of emergency general surgery in the United States: a 10-year analysis of the nationwide inpatient sample–2001 to 2010. *J Trauma Acute Care Surg*. 2014;77(2):202-208. doi:10.1097/TA.0000000000000362.
9. Ogola GO, Gale SC, Haider A, Shafi S. The financial burden of emergency general surgery: national estimates 2010 to 2060. *J Trauma Acute Care Surg*. 2015;79(3):444-448. doi:10.1097/TA.0000000000000787.
10. Shafi S, Aboutanos MB, Agarwal S, et al. Emergency general surgery: definition and estimated burden of disease. *J Trauma Acute Care Surg*. 2013;74(4):1092-1097. doi:10.1097/TA.0b013e31827e1bc7.
11. Mehta A, Dultz LA, Joseph B, et al. Emergency general surgery in geriatric patients: a statewide analysis of surgeon and hospital volume with outcomes. *J Trauma Acute Care Surg*. 2018;84(6):864-875. doi:10.1097/TA.0000000000001829.
12. McCormick PJ, Lin HM, Deiner SG, Levin MA. Validation of the all patient refined diagnosis related group (APR-DRG) risk of mortality and severity of illness modifiers as a measure of perioperative risk. *J Med Syst*. 2018;42(5):81. doi:10.1007/s10916-018-0936-3.
13. McGillicuddy EA, Schuster KM, Davis KA, Longo WE. Factors predicting morbidity and mortality in emergency colorectal procedures in elderly patients. *Arch Surg*. 2009;144(12):1157-1162. doi:10.1001/archsurg.2009.203.
14. Ahmed Ali U, Dunne T, Gurland B, Vogel JD, Kiran RP. Actual versus estimated length of stay after colorectal surgery: which factors influence a deviation?. *Am J Surg*. 2014;208(4):663-669. doi:10.1016/j.amjsurg.2013.06.004.
15. 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(4):e196021. doi:10.1001/jamasurg.2019.6021.
16. Mangram AJ, Shifflette VK, Mitchell CD, et al. The creation of a geriatric trauma unit "G-60". *Am Surg*. 2011;77(9):1144-1146. doi:10.1177/000313481107700925.
17. Mangram AJ, Mitchell CD, Shifflette VK, et al. Geriatric trauma service: a one-year experience. *J Trauma Acute Care Surg*. 2012;72(1):119-122. doi:10.1097/TA.0b013e318241f0ba.
18. Carpenter CR, Platts-Mills TF. Evolving prehospital, emergency department, and "inpatient" management models for geriatric emergencies. *Clin Geriatr Med*. 2013;29(1):31-47. doi:10.1016/j.cger.2012.09.003.
19. Grudzen C, Richardson LD, Baumlin KM, et al. Redesigned geriatric emergency care may have helped reduce admissions of older adults to intensive care units. *Health Aff*. 2015;34(5):788-795. doi:10.1377/hlthaff.2014.0790.
20. Boddaert J, Cohen-Bittan J, Khiami F, et al. Postoperative admission to a dedicated geriatric unit decreases mortality in elderly patients with hip fracture. *PloS One*. 2014;9(1):e83795. doi:10.1371/journal.pone.0083795.
21. *Introducing the ACS Geriatric Surgery Verification Program*. 2019. https://www.facs.org/quality-programs/geriatric-surgery. Accessed August 1, 2021