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Readmission after emergency general surgery

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ABSTRACT

Background: Readmission rates are an important metric because they enable an evaluation of care and affect Medicare funding. This study evaluates factors contributing to readmission after emergency general surgery.
Methods: The Virginia Health Information database was used to identify patients who had undergone the most common emergency general surgery procedures from 1/2011-6/2016. Analyses were performed for 30 and 90-day readmission.
Results: 121,223 records met initial inclusion criteria and 54,372 remained after exclusions. In 30 days there were 5050 readmissions and 7896 readmissions in 90 days. Factors significant in contributing to 30-day readmission were length of stay, discharge location, and several comorbidities. For 90-day readmission the same factors were significant with the addition of urgent vs emergency admission and insurance status as well as additional comorbidities. Discharge to rehab, SNF, or with home healthcare had particularly high rates of 90 day readmission.
Conclusions: We identified factors that contribute to readmission after emergency general surgery providing targets for future interventions. Improved follow up for patients discharged with rehab or home health needs is our next step.

Introduction

Emergency general surgery (EGS) is an important component of acute care surgery. Annually, there are over 2.3 million patients admitted with an EGS diagnosis, which is greater than the 1.7 million patients diagnosed with diabetes.[1] The seven most common procedures in emergency general surgery were determined by Scott et al. to be partial colectomy, small bowel resection, cholecystectomy, operative management of peptic ulcer disease, lysis of peritoneal adhesions, appendectomy and laparotomy.[2]

The readmission rate is an important metric for a variety of reasons. The most salient reason for the emphasis on readmission rates has been the fact that the Centers for Medicare and Medicaid Services (CMS) Readmissions Reduction Program, put into effect by the Affordable Care Act, dictates a reduction in fees paid for Medicare patients when readmission rates exceed an acceptable level.[3] Readmission was targeted by the Affordable Care Act because hospital payments for readmissions make up nearly 20% of the 100 billion dollars paid to hospitals annually by Medicare.[4] Most importantly, patients are negatively impacted by readmission. Readmission is correlated with a decrease in patient satisfaction.[5]

Uninsured and underinsured patients are a vulnerable population and the primary focus of this study was to see if insurance status effected readmission rates after emergency general surgery in hospitals in Virginia. We additionally sought to identify other factors affecting readmission in this population. In contrast to other studies evaluating readmission over the initial 30 days after discharge we also included 90 day readmissions to better elucidate patient outcomes.

Materials and methods

The Virginia Health Information (VHI) database was used to identify patients who had undergone the seven most common emergency general surgery procedures in the state of Virginia, from January 2011–June 2016. This database includes all patients admitted in the state of Virginia and compiles demographic, administrative and clinical information using diagnosis codes.

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Readmissions in this database are tracked regardless of hospital utilized as long as the patient remains in the state. Procedures were identified by ICD 9 codes or use of a conversion to equivalent ICD 10 codes. Conversion was accomplished utilizing the ICD-9-PCS General Equivalency Mapping maintained by the Center for Medicare Services and the CDC.[6] Records were excluded if there were insufficient data about insurance or readmission status, if patients were already readmitted or had been transferred, and if patients were <16 years of age, were admitted electively, were admitted for trauma, or were military, research, jail, foreign or hospice patients. Demographic, admission, discharge and readmission data were compiled. Comorbidity information was also collected for patients during the time period for which it was recorded in the database which was from Oct 2015–June 2016.

The following variables were analyzed: age, sex, race, admission type (emergency, urgent, or elective), length of stay, patient discharge status, pre-operative length of stay, post-operative length of stay, payer insurance type, 30-day readmission, 90-day readmission, and 29 comorbidities, based on predefined VHI variables. These comorbidities included congestive heart failure, valvular disease, pulmonary circulation disease, peripheral vascular disease, hypertension (combined uncomplicated and complicated), paralysis, other neurological disorders, chronic pulmonary disease, diabetes without chronic complications, diabetes with chronic complications, hypothyroidism, renal failure, liver disease, peptic ulcer disease with bleeding, acquired immune deficiency syndrome (AIDS), lymphoma, metastatic cancer, solid tumor without metastasis, rheumatoid arthritis/collagen vascular disease, coagulopathy, obesity, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, deficiency anemias, alcohol abuse, drug abuse, psychoses, and depression. Descriptive statistics for the demographic characteristics and presence of comorbidities were stratified by 30-day readmission and 90-day readmission status for this cohort between January 2011 and June 2016. Bivariate analysis included simple logistic regression. Variables that were significantly associated with the outcome (i.e. either 30-day readmission or 90-day readmission) in the bivariate analysis were included in the multivariable analyses, using multiple logistic regression. A list of the variables associated with the outcomes in the bivariate analyses, and therefore subsequently entered into the multivariable models for assessment, are provided in the supplemental table (Appendix A). A forward selection process (with selection entry of 0.05) was utilized to determine which variables remained significant in the final models. Analyses were performed in SAS 9.4 (SAS Institute, Cary, NC).

Results

There were 121,223 records that met initial inclusion criteria. After exclusions, seen in Fig. 1, there were 54,372 subjects. The average age was approximately 54 years and the median length of stay was 4 days. There were 22,548 (41%) male patients and 31,822 (59%) female patients. The majority of patients were white (37,581, 71%) with 10,660 (20%) black and the remainder of races each representing 3% or less of the study population. There were 44,894 (83%) emergency admissions and 9363 (17%) urgent admissions. Most patients were discharged to either home (43,760, 80%), home with home health assistance (5,859, 11%), or a skilled nursing facility (SNF) (3,846, 6%). Other discharge locations each represented less than a percent of the population. There were 24,004 (44%) with private insurance or workers' compensation or government insurance, 18,972 (35%) with Medicare, 3729 (7%) with Medicaid or another form of government assistance, and 7667 (14%) self-pay. In

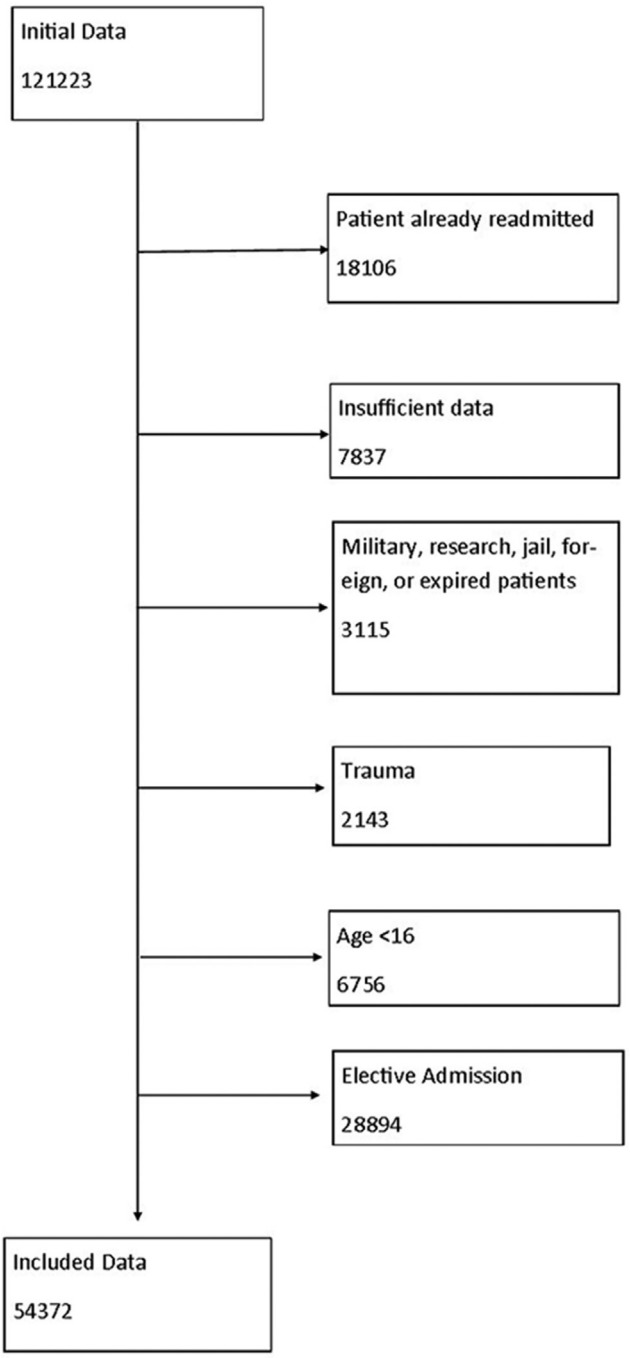

Fig. 1. Flowchart of exclusions.

30 days there were 5050 (9.2%) readmissions and in 90 days this increased to 7896 (14.5%). The most common surgical procedures were cholecystectomies (44%), appendectomies (17%), and lysis of adhesions (15%). The descriptive statistics can be seen in Table 1.

In the initial multivariate analysis of 30 day readmissions the only admission factor that was significant was length of stay. When extended to 90 days Medicaid vs private insurance, Medicare vs private insurance, length of stay and urgent vs emergency admission were significant. Odds ratios and p values for the admission factors can be seen in Table 2.

The multivariate analysis showed that when compared to

Table 1
Demographic and disease characteristics of the study sample.

Characteristic	Study Population N = 54,372 frequency (%)
Age in Years (mean, SD)	54 (18.4)
Length of Stay (median, range)	4 (0–384)
Gender	
Male	22548 (41)
Female	31822 (59)
Race	
White	37581 (71)
Black	10660 (20)
Hispanic	1678 (3)
Black Hispanic	17 (0)
Asian	1363 (3)
American Indian	50 (0)
Other	1378 (3)
Admission Type	
Emergency	44894 (83)
Urgent	9363 (17)
Patient Discharge Status	
Home	43760 (80)
Home with HH	5859 (11)
SNF	3846 (7)
AMA	96 (0)
Hospice	133 (0)
LTAC	126 (0)
Psych	27 (0)
Swing Bed	38 (0)
Int Med Care	197 (0)
Payer Type	
Medicare	18972 (35)
Medicaid/Govt Assistance	3729 (7)
Private Insurance/Workers Comp/Govt Insurance	24004 (44)
Self-Pay	7667 (14)

Notes. SD = standard deviation; HH = home health care; SNF = Skilled Nursing Facility; LTAC = Long Term Acute Care.

discharge home, discharge with home health, to rehab, to intermediate medical care (facility with more physician care than SNF but less than an acute hospital), and to SNF were significantly associated with 30 day readmission. These same factors as well as discharge to psych were significantly associated with 90 day readmission. Odds ratios and p values for the discharge factors can be seen in Table 3.

Comorbidity information was available for 6204 patients (11%). The multivariate analyses for 30 and 90 day showed congestive heart failure, liver disease, metastatic cancer, rheumatoid arthritis/collagen vascular disease, coagulopathy, weight loss, deficiency anemias, renal failure, and valvular disease to be significantly associated with readmission. Additionally, the multivariate analysis showed solid tumor without metastasis to be significantly associated with 90 day readmission. The odds ratios and p values for comorbidities can be seen in Table 4.

Table 4
Comorbidities.

Parameter	30 day		90 day	
	OR	Pr > ChiSq	OR	Pr > ChiSq
Congestive Heart Failure	1.45	0.021	1.39	0.021
Liver Disease	1.48	0.011	1.51	0.002
Metastatic Cancer	1.91	0.004	1.99	0.001
Rheumatoid Arthritis/Collagen Vas	1.91	0.006	1.91	0.002
Coagulopathy	1.92	<.001	1.47	0.008
Weight Loss	1.56	0.007	1.46	0.010
Deficiency Anemias	1.43	0.005	1.40	0.003
Solid Tumor without Metastasis			1.60	0.038
Renal Failure	1.40	0.025	1.37	0.016
Valvular Disease	1.61	0.024	1.61	0.011

Discussion

This study has identified several factors that contribute to readmission after emergency general surgery. Inclusion of both 30-day and 90-day readmission enables assessment of late patient morbidity that is otherwise missed by assessing only for 30-day readmission. Thirty-six percent of patients readmitted within 90 days of discharge were readmitted after the initial 30-day period.

Both Medicare and Medicaid were associated with higher

Table 2
Admission information.

Parameter	30 day		90 day	
	OR	Pr > ChiSq	OR	Pr > ChiSq
Medicaid/Government Assistance vs Private Insurance/Worker's Compensation/Government Insurance			1.63	0.001
Medicare vs Private Insurance/Worker's Compensation/Government Insurance			1.26	0.016
Self Pay/Charity vs Private Insurance/Worker's Compensation/Government Insurance			1.19	0.208
Length of Stay	1.02	<0.001	1.02	<0.001
Urgent vs Emergency			1.250	0.0321

Table 3
Discharge status.

Parameter	30 day		90 day	
	OR	Pr > ChiSq	OR	Pr > ChiSq
Discharge to Home	1	–	1	–
Discharged to Federal Facility	0.82	0.853	0.64	0.666
Discharged to Home Under Care of Organized Home Health Service	1.75	<.001	2.46	<.001
Discharged to Hospice	<0.001	0.972	0.87	0.863
Discharged to Int Medical Care*	3.00	0.020	2.90	0.015
Discharged to Rehab	2.84	0.037	9.83	<.001
Discharged to Skilled Nursing Facility	1.70	0.001	2.03	<.001
Left Against Medical Advice	3.67	0.052	2.37	0.198
Transferred to Long Term Acute Care Hospital	0.44	0.324	1.52	0.436
Transferred to Psychiatric Facility	3.13	0.314	13.24	0.005

*Int Medical Care = facility with more physician care than SNF but less than an acute hospital.

likelihood of readmission compared to private insurance. Self-pay also had a higher odds ratio but was not statistically significant on multivariate analysis. Insurance status has been found to be a factor for readmission in other studies of surgery patients.[7,8] Better insurance may lead to better follow-up care thereby decreasing the need for readmission to the hospital. Alternatively, insurance may just be a marker for socioeconomic status and more in-depth analysis of patient financial status would help to tease this out. Unfortunately, this would be difficult to assess without a more detailed database.

Age, race and gender all were not significantly associated with readmission in this multivariate analysis. The lack of association with age is consistent with other studies,[7,8] which is likely related to the separate assessment of comorbidities typically associated with older patients. There is increasing literature supporting the idea that age as a number is less important than other factors contributing to frailty.[9–11] In contrast to our findings, other studies have found race to be a significant factor with regard to readmission.[7,12] This is partly related to the specific healthcare facilities utilized by patients of different race.[12] It is unclear why the racial discrepancy was not seen in our study, although it may be that the differences were associated with other factors such as insurance status or comorbidities and so race was not an independent predictor of readmission. Our findings that gender was not associated with readmission matched those of Havens et al. but was not consistent with the significant difference that McIntyre et al. found. The study by McIntyre did not look at as many comorbidities which may have accounted for the difference in findings.

Discharge to rehabilitation facility, SNF, and with home health assistance all had high rates of readmission. The odds ratio of 90-day readmission after discharge to rehab was particularly high. It is unclear at what point in time those patients were discharged from their rehabilitation facilities. Perhaps their later readmissions were a factor of spending their first 30 days after hospital discharge in the rehabilitation facility. Then, once discharged from there to home, they were unable to be cared for at home and were readmitted. Similarly, patients discharged to SNF and with home healthcare may have exceeded their ability to care for themselves once they were home without further home health services. The care received both at facilities and in home also varies depending on the agency involved and while there are some factors such as higher staffing ratios associated with improved outcomes this is largely an ill-defined area.[13] It is also likely that patients discharged to rehab, SNF and with home health were all more affected by their initial surgeries making them more vulnerable to readmission. Our identification of this increase in delayed (>30 day) readmission in SNF, rehab, and home health patients provides a new target for improving patient care. Further prospective study of the care such patients receive after discharge and how this affects their readmission is warranted to improve their post hospital discharge plans.

This study was limited by being a retrospective database study. However, the study did allow the inclusion of a large number of patients and identifies several factors that were associated with readmission. The comorbidity variables were not collected before October 2015, therefore comorbidities and their association may be underestimated. Odds ratios were provided for all bivariate and multivariable outcomes. Since readmission is not a rare outcome, the results must be interpreted as odds ratios and cannot sufficiently approximate risk ratios. An additional limitation of this study is the lack of available mortality information after discharge. Patients that died during their index hospital stay were excluded but after discharge patient records were not attached to mortality data. Therefore the rate of negative outcomes combining mortality and readmission is likely higher than readmission alone. A prospective study of patients would enable better assessment of the impact mortality has on overall patient outcomes.

Conclusions

Our analysis identified several factors associated with 30 and 90-day readmission. We found type of insurance, length of stay, discharge to other than home, and several comorbidities were significant factors for readmission. By identifying these factors, interventions and prospective studies can be directed toward those patients with the greatest odds for readmission. One area of future intervention to focus on is to see if improved follow up beyond the initial 30 days for patient discharged to rehab, SNF and with home health can decrease their 90 day readmission rates. A program including follow-up phone calls and additional office visits is being developed.

Disclaimer

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Author contributions

KMK: Study design, data interpretation, writing.
JJC: data interpretation, critical revision.
LDB: data interpretation, critical revision.
DDH: Data analysis, data interpretation, critical revision.
RCB: Study design, data interpretation, critical revision.

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Declaration of competing interest

There are no conflicts of interest for any authors for this study.

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Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amjsurg.2020.01.010.

Appendix A. Variables significant in the bivariate analyses

30-Day Readmission	90-Day Readmission
Age in Years	Age in Years
Length of Stay	Length of Stay
Sex	Sex
Race	Race
Admission Type	Admission Type
Patient Discharge Status	Patient Discharge Status
Payer	Payer
Congestive Heart Failure	Congestive Heart Failure
Valvular Disease	Valvular Disease
–	Peripheral Vascular Disease
Hypertension (Combined Uncomplicated and Complicated)	Hypertension (Combined Uncomplicated and Complicated)
Paralysis	Paralysis
Other Neurological Disorders	Other Neurological Disorders
Chronic Pulmonary Disease	Chronic Pulmonary Disease
–	Diabetes with Chronic Complications
Renal Failure	Renal Failure
Liver Disease	Liver Disease
Peptic Ulcer Disease with Bleeding	Peptic Ulcer Disease with Bleeding
Metastatic Cancer	Metastatic Cancer
Solid Tumor without Metastasis	Solid Tumor without Metastasis
Rheumatoid Arthritis/Collagen Vascular Disease	Rheumatoid Arthritis/Collagen Vascular Disease
Coagulopathy	Coagulopathy
Weight Loss	Weight Loss
Fluid and Electrolyte Disorders	Fluid and Electrolyte Disorders
Deficiency Anemias	Deficiency Anemias
–	Alcohol Abuse

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