

Predictors of Emergency Visits Within 14 Days of Outpatient Endoscopy at A Safety-Net Hospital: A Case-Control Study

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ABSTRACT

AIMS: Gastrointestinal endoscopic procedures are commonly performed outpatient procedures associated with adverse events that may lead to emergency department visits. Establishing risk factor for post-endoscopy emergency department visits may guide quality improvement efforts.

MATERIALS AND METHODS: Matched case control study of

patients over the age of 18 presenting to the emergency department of a safety-net hospital within two weeks of any outpatient endoscopic procedure between July 1, 2013 and December 31, 2014. Controls were matched to cases by age, sex, procedure type, date, and day of week procedure was performed. Univariable and multivariable analysis were performed to identify predictors of emergency visits after endoscopy.

RESULTS: We identified 143 cases from a total of 6,601 outpatient procedures during the study period. 64 (44.8%) of the visits were attributed to the procedure yielding a visit rate of 0.97%. Compared to controls, cases were more likely to have MediCal (Medicaid) insurance (75.7% vs 59.2%, $p = 0.003$), prior ED visits (2.5 vs 0.5, $p < 0.001$), multiple primary care visits (4.9 vs 3.3, $p < 0.001$), trainee involvement (62.9% vs 44.4%, $p = 0.002$), and speak English (67.1% vs 54.9%, $p = 0.04$). On multivariable analysis of cases with visits attributable to the procedure, antiplatelet/anticoagulant use (OR 2.81, CI 1.07-7.34, $p = 0.04$), MediCal insurance (OR 2.55, CI 1.02-6.40, $p = 0.05$), multiple ED visits per year (OR 3.31, CI 2.22-4.94, $p < 0.001$), number of endoscopic interventions (OR 1.22, CI 1.06-1.40, $p = 0.006$), and trainee involvement (OR 2.55, CI 1.09-5.97, $p = 0.03$) were all risk factors for post-procedure visits.

CONCLUSION: In a safety-net system, medically complex patients, greater number of endoscopic interventions, and lower socioeconomic status may influence emergency department utilization after endoscopy. This information may inform future quality improvement efforts.

Key words: Adverse Events; Quality Improvement; Endoscopy; Acute Care Visits; Safety Net; Patient Safety

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INTRODUCTION

Nationwide, gastrointestinal endoscopic procedures are some of the most commonly performed procedures. In 2015 11.0 million

colonoscopies, 6.1 million upper endoscopies (EGD), 313,000 flexible sigmoidoscopies, 178,400 upper endoscopic ultrasound (EUS) examinations, and 169,500 endoscopic retrograde cholangiopancreatography (ERCP) procedures were performed across the U.S., with a total cost close to \$135.9 billion^[1]. These numbers underscore the overall burden of gastrointestinal disease in the United States and the incredible volume of endoscopic procedures that are being performed.

Given the widespread use of gastrointestinal endoscopic procedures, the safety, immediate adverse events during endoscopy, and the use of acute care services related to the procedure, are of paramount concern. Adverse events relating to EGD and colonoscopy are low (0.13%-0.5%)^[1], reflecting the overall safety of these procedures; at the same time, endoscopic biliary procedures, such as ERCP, have a much higher rate of adverse events (1.6%-15.7%)^[2]; however, mortality remains low (0.2%-0.5%). Most of these adverse events are immediate and anesthesia-related, yet there is a paucity of data on delayed adverse events which may cause patients to seek emergency care in the days after a procedure.

Assessing for delayed adverse events following outpatient gastrointestinal procedures is challenging due to the large number of procedures performed and lack of follow-up information often available. A number of studies have reported on delayed adverse events following individual endoscopic procedures using various metrics including unplanned hospital presentation^[3-5] or rates of cardiovascular events or GI bleeding following endoscopy^[6]. Yet, no prior studies have included all endoscopic procedures and there are no data regarding outcomes of these procedures in safety-net settings, which reflect a uniquely heterogeneous population and include different patient socioeconomic characteristics that may influence outcomes. Better understanding of this gap in the literature would allow us to better elucidate factors that may relate to patients who return to the ED post procedure and help to develop and steward quality improvement programs.

We assessed all outpatient endoscopic procedures performed at a large safety-net hospital in San Francisco, California over an 18-month period and identified patients who presented to the ED within 14 days of their procedure. Our objectives were to determine the frequency of patients returning to the ED post-endoscopy and to identify patient and procedural characteristics that correlated with an increased likelihood of an ED visit post-endoscopy.

MATERIALS AND METHODS

Ethics, consent and permissions

This study was approved by the Institutional Review Board (IRB) at the University of California, San Francisco (UCSF IRB number 16-19076). The requirement for individual Research HIPAA Authorization and informed consent was waived for all subjects for the following reasons (1) the research involves no more than minimal risk to the subjects; (2) the waiver will not adversely affect the rights and welfare of the subjects; (3) the research could not practicably be carried out without the waiver; and (4) whenever appropriate, the subjects will be provided with additional pertinent information after participation

Study Design and population

We performed a single-center matched case control study of factors associated with ED visits within 14 days of outpatient endoscopic procedures at the Zuckerberg San Francisco General Hospital (ZSFG). ZSFG is a safety-net institution (i.e. provides a

significant level of care to low income, uninsured, and vulnerable patient populations) affiliated with the University of California, San Francisco. Patients are ethnically diverse (20% African American, 20% Asian/Pacific Islander, 25% Caucasian, and 30% Hispanic/Latino), and many are immigrants with more than 20 different languages spoken by patients. Approximately 9% of outpatients at ZSFG lack insurance, 58% have MediCal (California's Medicaid program), 22% have Medicare, and 1% report commercial payers or other sources.

Cases

All patients over the age of 18 who underwent an outpatient endoscopic procedure at ZSFG between July 1, 2013 and December 31, 2014, and presented to the emergency department within 14 days were included in the study as cases (Figure 1). Endoscopic procedures included in the study were colonoscopy, EGD, flexible sigmoidoscopy (FS), and ERCP. EUS, small bowel enteroscopy, pH BRAVO testing, manometry, and capsule endoscopy were all excluded due to having zero or limited patients who had undergone these procedures and presented to the ED, thus precluding any meaningful comparisons. Patient demographic information, procedure information and data regarding the patient's visit to the emergency room was abstracted from the electronic medical record. Patients were excluded if the procedure was performed in the inpatient setting or if an immediate complication occurred requiring direct admission to the hospital.

Controls

The control group included patients over the age of 18 who underwent an outpatient endoscopic procedure during the study period, but did not present to the emergency room after 14 days. For each case, the respective procedure date in the endoscopy reporting software Provasion was searched for a matching control in a 1:1 fashion. Controls were matched to cases by procedure type, date, day of week, age within five years, and sex. After matching was performed, one control was found to have had an inpatient procedure and was subsequently excluded from the analysis.

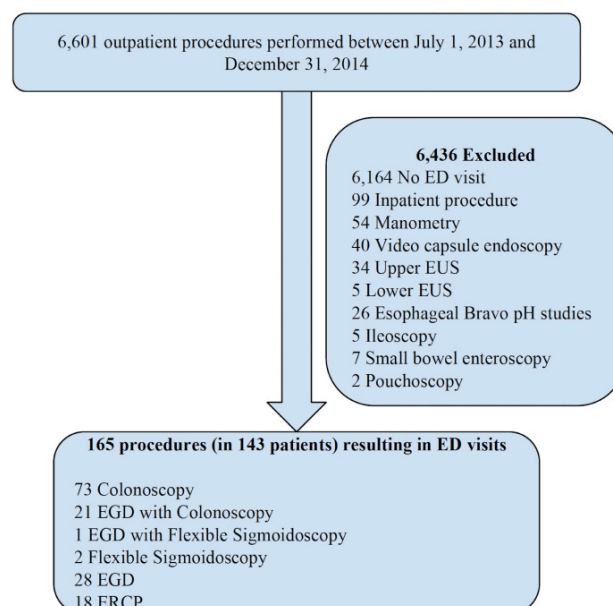


Figure 1 Flow diagram demonstrating the selection of cases who presented to the emergency department within two weeks of their procedure.

Data Collection and Abstraction

Two independent reviewers, AT and DS, reviewed the medical records, and findings were confirmed by AMK. Any disagreements were reviewed and adjudicated by LWD. Patient demographics, procedure related factors, and ED related factors, when applicable, were abstracted. Details of the procedure was obtained by reviewing the procedure report. Details of the ED visits were obtained by reviewing the ED note. In order to establish whether or not the ED presentation was related to the procedure, AMK, AT, and DS reviewed the ED note for the patients' chief complaints, vitals, labs, imaging, diagnosis, and disposition, and came to a final assessment using clinical judgement.

Outcome

The primary outcome examined was the presentation of patients to the ED within 14 days of an endoscopic procedure. The 14-day follow-up period was selected because most endoscopic procedural complications including post-polypectomy bleeding occur within 14 days^[7-9].

Statistical Analysis

Age, prior ED visits, prior PCP visits, interventions, and polyp size were all treated as continuous variables and described with the mean or median and standard deviations (SD). The remaining patient data was described as proportions. Differences between groups of patients were assessed using χ^2 and Student's *t*-test, as appropriate. To reduce risk of including confounders, univariable comparisons were only made for predictor variables with expected potential clinical relevance. Multivariable logistic analysis reported as odds ratios was performed using variables demonstrating univariable statistical significance or with expected clinical relevance. The statistical methods of this study were reviewed by Justin L Sewell MD, MPH, from Department of Gastroenterology and Hepatology, Zuckerberg San Francisco General Hospital. Stata/SE (version 14; StataCorp LP, College Station, TX, USA) statistical software was used for all analyses.

RESULTS

Patient related factors

Table 1 summarizes the baseline patient demographics of the 143 cases who presented to the ED within 14 days and 142 age-matched controls. The cases had a mean age at time of endoscopic procedure of 53.8 years with 45.5% of procedures performed on women. Our study population was ethnically diverse as shown in the table 1.

There were some notable differences between cases and controls. With regards to patient related factors, English-speakers constituted 67.1% of the cases and 54.9% of the controls ($p = 0.04$). Also, insurance coverage differed significantly between the cases and the controls, with 75.7% of the cases insured via MediCal as compared to 59.2% of controls ($p = 0.002$). There was a trend towards significance for cases having a higher ASA classification; specifically, there was a higher proportion of ASA class III patients in the cases (26.1% vs. 14.8%, $p = 0.06$). The cases had a significantly higher number of both total number of ED visits (2.5 vs 0.5 $p < 0.001$) and number of PCP visits (4.9 vs 3.3, $p < 0.001$) in the preceding 12 months compared to controls. Finally, most patients in both groups were not on any antiplatelet/anticoagulant agents (70.6% and 83.1% respectively, $p = 0.13$). The cases were less likely to have had their antiplatelet or anticoagulant agent held for the procedure (2.1% vs. 11.9%, $p = 0.004$).

Table 1 Demographic data and baseline patient characteristics of cases and controls.

	Cases (<i>n</i> = 143)	Controls (<i>n</i> = 142)
Age† (years), mean (SD)	53.8 (12.9)	53.9 (12.2)
Female†, <i>n</i> (%)	65 (45.5)	64 (45.1)
Race, <i>n</i> (%)		
White	28 (19.6)	17 (12.0)
Black	25 (17.5)	27 (19.1)
Hispanic	47 (32.9)	45 (31.6)
Native American	9 (6.3)	13 (9.2)
Asian	30 (21.0)	31 (21.8)
Other	4 (2.8)	9 (6.3)
Specific languages, <i>n</i> (%)		
English	96 (68.6)	78 (54.9)
Spanish	22 (15.7)	25 (17.6)
Chinese dialect	17 (12.1)	27 (19.0)
Other	5 (3.6)	12 (8.5)
English speaker, <i>n</i> (%)	96 (67.1)*	78 (54.9)
Insurance, <i>n</i> (%)		
MediCal	106 (75.7)*	84 (59.2)
Medicare	14 (10.0)	28 (19.7)
HSF	8 (5.7)	22 (15.5)
Other	8 (5.7)	8 (5.6)
ASA Class, <i>n</i> (%)		
1	11 (7.8)	14 (9.9)
2	94 (66.2)	107 (75.4)
3	37 (26.1)	21 (14.8)
ED visits year prior, mean (SD)	2.5 (2.6)*	0.5 (1.0)
PCP visits year prior, mean (SD)	4.9 (3.9)*	3.3 (3.0)
DSM IV diagnosis, <i>n</i> (%)	33 (23.1)	29 (20.4)
DSM IV diagnosis in ED visits attributable to the procedure, <i>n</i> (%)	11 (17.2)	

* $P < 0.05$ vs controls. †matched variable. SD: standard deviation; NA: not applicable; ASA: American Society of Anesthesiology Class; ED: Emergency department; PCP: Primary care provider; DSM: diagnosis statistical manual.

Procedure related factors

There were several differences observed between both study groups (Table 2). For example, significantly more endoscopic interventions were performed in the cases than in the control group (2.8 vs 2.1, $p = 0.02$). More cases underwent an endoscopic mucosal resection (EMR) as compared to the control group ($p = 0.001$). Lastly, cases were more likely to have had a trainee involved in the endoscopic procedure (62.9% vs. 44.4%, $p = 0.002$).

Emergency room factors

Of the 143 cases, the most common chief complaint after "Other" (54.6%) was abdominal pain (30.1%), followed by GI bleeding including bright red blood per rectum (8.4%) (Table 3). The most common diagnosis documented in the ED discharge for patients was "Other symptoms involving abdomen and pelvis" (18.3%) and hemorrhage of the gastrointestinal tract (4.9%) (See supplementary table 1). The majority of patients were discharged from the ED (60.1%), and it was determined that 64 (44.8%) of admissions from the ED were attributable to the procedure. Among patients presenting to the ED, 51 of those patients presented within 7 days of the procedure and 13 additional patients presented over the following 7 days. The overall ED visit rate was 2.16%, but when examining only patients with ED visits attributable to the procedure then the ED visit rate dramatically decreased to 0.97%.

Table 2 Comparisons of procedure related factors between cases and controls

	Cases (N=143)	Controls (N=142)
Procedure Performed†, n (%)		
Colonoscopy	73 (51.1)	73 (51.4)
EGD with Colonoscopy	21 (14.7)	22 (15.5)
EGD with Sigmoidoscopy	1 (0.7)	1 (0.7)
Flexible Sigmoidoscopy	2 (1.4)	2 (1.4)
EGD	28 (19.6)	26 (18.3)
ERCP	18 (12.6)	18 (12.7)
Indication, n (%)		
Diagnostic	111 (77.6)	108 (76.1)
Screening	3 (2.1)	9 (6.3)
Surveillance	23 (16.1)	23 (16.2)
Diagnostic and surveillance	5 (3.5)	2 (1.4)
Diagnostic and screening	1 (0.7)	0 (0.0)
Days from procedure to ED visit		
Median (range)	5.2 (0.0,15.3)	--
< 7 days, n (%)	84 (58.7)	--
>7 days, n (%)	59 (41.3)	--
Day of the week of procedure†		
Monday	12 (8.4)	13 (9.2)
Tuesday	48 (33.6)	49 (34.5)
Wednesday	2 (1.4)	2 (1.4)
Thursday	22 (15.4)	22 (15.5)
Friday	59 (41.3)	56 (39.4)
Time of day, n (%)		
Morning (< 12 pm)	103 (72.0)	107 (75.9)
Afternoon (12 pm-5 pm)	39 (27.3)	33 (23.4)
Evening (> 5 pm)	1 (0.7)	1 (0.7)
Any antiplatelet or anticoagulant use, n (%)	42 (29.4)*	24 (16.9)
Antiplatelet or Anticoagulation, n (%)		
None	101 (70.6)	118 (83.1)
Aspirin	26 (18.2)	18 (12.7)
Clopidogrel	2 (1.4)	1 (0.7)
Warfarin	7 (4.9)	2 (1.4)
NOAC	2 (1.4)	0 (0.0)
Aspirin and Clopidogrel	3 (2.1)	3 (2.1)
Aspirin and Warfarin	2 (1.4)	0 (0.0)
Antiplatelet or Anticoagulation held, n (%)		
Yes	25 (17.5)	22 (15.5)
No	17 (11.9)*	3 (2.1)
NA (none prescribed)	101 (70.6)	117 (82.4)
Sedation, n (%)		
Moderate sedation	109 (76.7)	111 (78.2)
Monitored anesthesia care	7 (4.9)	7 (4.9)
General anesthesia	23 (16.2)	20 (14.1)
None	3 (2.1)	4 (2.8)
Prep Quality, n (%)		
Good	81 (56.6)	96 (67.6)
Adequate	11 (7.7)	6 (4.2)
Poor	5 (3.5)	7 (4.9)
Interventions performed, mean (SD)	2.8 (2.9)*	2.1 (2.3)
Intervention performed, n (%)	128 (89.5)	115 (82.1)
Specific interventions, n (%)		
Cold forceps	97 (67.8)	89 (62.7)
Cold snare polypectomy	9 (6.3)	3 (2.1)
Hot snare	21 (14.7)	21 (14.8)

EMR	10 (7.0)*	0 (0.0)
Clipping	7 (4.9)	8 (5.6)
Banding	3 (2.1)	1 (0.7)
Dilation	7 (4.9)	3 (2.1)
Biliary stent placement	7 (4.9)	7 (4.9)
Biliary stent retrieval	7 (4.9)	6 (4.2)
Sphincterotomy	7 (4.9)	3 (2.1)
Balloon sweep	12 (8.4)	7 (4.9)
Brushing	5 (3.5)	3 (2.1)
Polyp size in mm, median (range)	5 (1-40)	4 (1-25)
Polyp size in mm, median (range) in ED visits attributed to procedure	5.5 (1-40)	
Trainee involvement, n (%)	90 (62.9)*	63 (44.4)

*P < 0.05 vs controls. †matched variable. SD: standard deviation; NA: not applicable; ED: Emergency department; EGD: esophagogastroduodenoscopy; ERCP: endoscopic retrograde cholangiopancreatography; NOAC: novel oral anticoagulant; EMR: endoscopic mucosal resection.

Risk factors for ED visits post endoscopy

On multivariable analysis (Table 4), the number of ED visits within the previous 12 months (OR 3.96, 95% CI 2.74-5.70) and number of endoscopic interventions (OR 1.17, CI 1.04-1.31) were both risk factors for ED visits post endoscopy. MediCal insurance, ASA classification, antiplatelet/anticoagulant use, and trainee involvement were not predictors of ED visits post endoscopy.

We performed a similar analysis on a subset of the cases whose ED visits were determined to be attributable to the procedure. Again, we observed that the number of ED visits per year (OR 3.31, CI 2.22-4.94, $p < 0.001$) and number of endoscopic interventions (OR 1.22, CI 1.06-1.40, $p = 0.006$) were associated with ED visits post endoscopy. Additionally, antiplatelet/anticoagulant use (OR 2.81, CI 1.07-7.34, $p = 0.04$), MediCal insurance (OR 2.55, CI 1.02-6.40, $p = 0.05$), and trainee involvement (OR 2.55, CI 1.09-5.97, $p = 0.03$) were all risk factors for post procedure ED visits that were attributable to the procedure.

DISCUSSION

With the widespread use of endoscopic procedures, understanding the safety of these procedures as well as the use of acute care service post-procedure are of great importance. To further evaluate these issues, we performed a single center matched case control study in order to determine the risk factors for ED visits after outpatient endoscopic procedures at a large integrated safety net hospital in San Francisco. Our overall ED visit rate post procedure was 2.16%, but when considering only ED visits attributable to the procedure the rate was 0.97%, on par with prior studies^[4, 10]. Furthermore, we found that patients who had an endoscopy and visited the ED afterwards were more likely to have had more frequent ED and PCP visits in the year prior. At the same time, when attributing the ED visit to the endoscopy itself additional risk factors became evident such as being on an anticoagulant/antiplatelet agent, English speaking, having MediCal insurance, EMR, and having a trainee involved in the procedure. This information adds to the sparse literature on this topic and can help to refine quality metrics relating to this issue as well as assist in developing performance improvement projects aimed at addressing this topic.

Some of our study findings are expected and others unexpected. First, antiplatelet/anticoagulant use as well as frequent ED and PCP visits are surrogates for increased patient complexity and burden of comorbid medical conditions, and thus unsurprisingly

Table 3 Characterization of emergency department (ED) presenting symptoms and other ED related factors. (Cases only, n=143).

ED Chief complain, n (%)	
Abdominal pain	43 (30.1)
BRBPR	12 (8.4)
Melena	0 (0.0)
Nausea and vomiting	6 (4.2)
Melena, Nausea, and vomiting	1 (0.7)
Abdominal pain, nausea, vomiting	1 (0.7)
Abdominal pain and melena	1 (0.7)
Other	78 (54.6)
ED visit attributed to procedure, n (%)	
Overall	64 (44.8)
< 7 days to ED visit, n (%)	51 (79.7)
> 7 days to ED visit, n (%)	13 (20.3)
ED Disposition, n (%)	
Discharge	86 (60.1)
Admission	57 (39.9)

ED: Emergency department BRBPR: bright red blood per rectum

were risk factors for ED visits post endoscopy. These results have also been echoed in previous studies^[10-12]. Second, continuation of anticoagulant/antiplatelet agents leading up to the procedure was also associated with a greater number of patients going to the ED post procedure, which stands to reason. Third, increasing ASA classification is also a marker of comorbidity and although ASA classification was not statistically significant, there were more patients with ASA 3 classifications in the cases than in the control group (26.1% vs 14.8%) likely explaining our results. Fourth, we found that patients who underwent EMR were more likely to be cases than controls. It is well known that EMR carries higher risk of bleeding, post polypectomy syndrome, and perforation, as compared to diagnostic colonoscopy^[13]. Finally, having MediCal, California's version of Medicaid insurance, was associated with increased ED visits. MediCal is a surrogate for low socioeconomic status and the later has been associated with worse health outcomes in prior studies of various disease states^[14-17]. All of these findings may help hospitals or endoscopy units to develop targeted quality improvement initiatives such as better risk stratification of patients prior to endoscopy as well as creating better communication and post

Table 4 Multivariable analyses of factors associated with post procedure ED visits.

	All cases compared with controls	Cases attributable to endoscopy compared with controls
	OR (95% CI)	OR (95% CI)
ASA class	0.96 (0.51-1.70)	0.46 (0.21-1.02)
Antiplatelet or anticoagulant drug use	1.76 (0.84-3.69)	2.81 (1.07-7.34)*
MediCal insurance	1.93 (0.97-3.83)	2.55 (1.02-6.40)*
Number of ED visits per year	3.96 (2.74-5.70)*	3.31 (2.22-4.94)*
Number of endoscopic interventions performed	1.17 (1.04-1.31)*	1.22 (1.06-1.40)*
Trainee involved	1.37 (0.72-2.60)	2.55 (1.09-5.97)*

*P < 0.05 vs controls. ED: Emergency department.

Supplemental Table 1 Most common post procedure ICD 9 (from endoscopy reports).

ED Cohort		Controls	
ICD 9 (n, %)	Description	ICD 9 (n, %)	Description
211.3 (34, 24.1%)	Benign neoplasm of colon	211.3 (39, 27.46%)	Benign neoplasm of colon
535.5 (11, 7.8%)	Gastroduodenitis	535.5 (11, 7.8%)	Gastroduodenitis
211.4 (6, 4.2%)	Benign neoplasm of rectum	455 (9, 6.3%)	Hemorrhoids
574.5 (6, 4.2%)	Calculus of the bile duct	569 (6, 4.2%)	Other disorder of intestine
239 (5, 3.5%)	Neoplasm of unspecified nature	537.9 (5, 3.5%)	Unspecified disorder of stomach and duodenum
455 (5, 3.5%)	Hemorrhoids	455.3 (4, 2.8%)	Hemorrhoidal skin tags
537.9 (5, 3.5%)	Unspecified disorder of stomach and duodenum	574.5 (4, 2.8%)	Calculus of the bile duct
569 (5, 3.5%)	Other disorder of intestine	751.69 (4, 2.8%)	Other anomalies of gallbladder, bile ducts, and liver
456.1 (3, 2.1%)	Esophageal varices without bleeding	211.4 (3, 2.1%)	Benign neoplasm of rectum
558.9 (3, 2.1%)	Unspecified noninfectious gastroenteritis and colitis	530.89 (2, 1.4%)	Other unspecified disease of esophagus
ED visit diagnosis ICD 9 (from ED report)			
ICD 9 (n, %)	Description		
789 (26, 18.3%)	Other symptom involving abdomen and pelvis		
578.9 (7, 4.9%)	Hemorrhage of gastrointestinal tract unspecified		
786.5 (5, 3.5%)	Chest pain		
578.1 (4, 2.8%)	Blood in stool		
998.11 (4, 2.8%)	Hemorrhage and hematoma of spleen		
784 (3, 2.1%)	Symptoms involving head and neck		
280 (2, 1.4%)	Iron deficiency anemia unspecified		
401.9 (2, 1.4%)	Unspecified essential hypertension		
411.1 (2, 1.4%)	Intermediate coronary syndrome		
553.1 (2, 1.4%)	Umbilical hernia without obstruction or gangrene		

endoscopy follow-up communication tools. Though some ED visits are unavoidable, most (60.1%) of patients presenting to the ED in our study were discharged home. Thus, this represents an opportunity for prevention of unnecessary ED visits in the form of improved communication with patients detailing return precautions, and improved access for patients to their providers on any new symptoms that arise after their procedures via phone calls or clinic visits.

An interesting study finding was that trainee involvement was associated with post procedure ED visits after endoscopy. A number of studies have not shown trainee involvement in procedural specialties to be associated with acute care visits or increased adverse events^[10,18,19], but others have found the opposite^[20,21], thus this remains an unanswered question. Possible explanations for our findings might include that fellow participation could have increased procedure time which may result in increased administration of sedation, use of air insufflation, and potentially suboptimal technique which could increase post endoscopy abdominal pain. This finding may also represent a difference in pre-procedure communication between attendings and trainees with trainees possibly not fully detailing or knowing how to communicate what patients should expect post endoscopy. These findings merit further investigation and such information could be helpful in developing educational curricula for gastroenterology fellowship programs.

Another interesting finding is that there were more English speakers who were cases than controls. In the context of gastrointestinal endoscopy, existing data is sparse on differences between English and non-English speakers in seeking acute care after endoscopy. Prior studies have suggested either no difference or increased ED visits in non-English speakers and limited English proficiency patients^[22,23]. To the best of our knowledge, English speakers have not previously been shown to have increased risk of ED visits as compared to non-English speakers in a primarily English speaking system. Perhaps this finding reflects a selection bias. Alternatively, English speakers may have an easier time navigating and utilizing the safety-net healthcare system of San Francisco and thus more likely to present to the ED for care.

This is the first study of its kind taking place at a safety-net hospital and also including all outpatient procedures performed by gastroenterologists. The vulnerable, underserved, underinsured patients of San Francisco represent a unique population from that of a tertiary care academic medical center population that has been represented in several previous studies. Being the safety net hospital for the city and county of San Francisco and being part of a dedicated integrated health plan, our patients are less likely to seek emergency care outside the ZSFG emergency room, increasing the reliability of our data. Our study evaluated all outpatient procedures performed in the endoscopy unit to determine if there are common characteristics that may be targets for quality improvement work. Unlike prior studies, all patient charts were reviewed manually to determine reliability of the procedure to the ED visit thereby increasing the accuracy of the data. Furthermore, we employed a much more robust time period for presenting to the ED (i.e. using a 14-day capture period as compared to 7 days as has been used in most studies) in order to capture delayed complications. All of these strengths of our study help to reinforce and validate our results.

There are a number of limitations to this study. First, the study is retrospective and there is the risk of selection bias and confounding for which we may not have been able to account. Second, though unlikely, given the structure of our safety net health system, it remains possible that some patients may have sought emergency care elsewhere and as a result we could have missed these patients in our analysis. Third, controls were matched 1:1 with case which may have

limited the overall power of the study. Fourth, although 10 cases underwent EMR, there were no controls who underwent EMR, again raising the possibility of selection bias. Lastly, the study occurred within a safety-net setting and may not be generalizable to other healthcare environments.

In summary, our study determined that the overall ED visit rate 14 days post procedure was 2.16% but when considering only ED visits attributable to the procedure the rate decreased to 0.97%. We highlight that a number of risk factors are associated with increasing ED visits post endoscopy and include prior ED visits, increasing number of endoscopic interventions especially EMR, MediCal insurance, antiplatelet/anticoagulant use, and trainee involvement. Our findings indicate that more medically complex patients and lower socioeconomic status predict ED visits after endoscopy and that this group of patients can be targeted for quality improvement efforts such as focusing on improved communication efforts and improved access to advice post procedure.

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REFERENCES

1. Levy I, Galnek IM. Complications of diagnostic colonoscopy, upper endoscopy, and enteroscopy. *Best Pract Res Clin Gastroenterol.* 2016; **30(5)**: 705-718. [DOI: 10.1016/j.bpg.2016.09.005]; [PMID: 27931631]
2. Mallery JS, Baron TH, Dornitz JA, Goldstein JL, Hirota WK, Jacobson BC, Leighton JA, Raddawi HM, Varg JJ 2nd, Waring JP, Fanelli RD, Wheeler-Harborough J, Eisen GM, Faigel DO. Complications of ERCP. *Gastrointestinal Endoscopy.* 2003; **57(6)**: 633-638. [DOI: 10.1053/ge.2003.v57.amge030576633]; [PMID: 12709688]
3. Leffler DA, Kheraj R, Garud S, Neeman N, Nathanson LA, Kelly CP, Sawhney M, Landon B, Doyle R, Rosenberg S, Aronson M. The incidence and cost of unexpected hospital use after scheduled outpatient endoscopy. *Arch Intern Med.* 2010; **170(19)**: 1752-1757. [DOI: 10.1001/archinternmed.2010.373]; [PMID: 20975024]
4. Ranasinghe I, Parzynski CS, Searfoss R, Montague J1, Lin Z, Allen J, Vender R, Bhat K, Ross JS, Bernheim S, Krumholz HM, Drye EE. Differences in colonoscopy quality among facilities: Development of a post-colonoscopy risk-standardized rate of unplanned hospital visits. *Gastroenterology.* 2016; **150(1)**: 103-113. [DOI: 10.1053/j.gastro.2015.09.009]; [PMID: 26404952]
5. Fox JP, Vashi AA, Ross JS, Gross CP. Hospital-based, acute care after ambulatory surgery center discharge. *Surgery.* 2014; **155(5)**: 743-753. [DOI: 10.1016/j.surg.2013.12.008]; [PMID: 24787100]
6. Day LW, Kwon A, Inadomi JM, Walter LC, Somsouk M. Adverse events in older patients undergoing colonoscopy: A systematic review and meta-analysis. *Gastrointestinal Endoscopy.* 2011; **74(4)**: 885-896. [DOI: 10.1016/j.gie.2011.06.023]; [PMID: 21951478]
7. Fisher DA, Maple JT, Ben-Menachem T, Cash BD, Decker GA, Early DS, Evans JA, Fanelli RD, Fukami N, Hwang JH, Jain R, Jue TL, Khan KM, Malpas PM, Sharaf RN, Shergill AK, Dornitz JA. Complications of colonoscopy. *Gastrointest Endosc.* 2011; **74(4)**: 745-752. [DOI: 10.1016/j.gie.2011.07.025]; [PMID: 21951473]
8. Sawhney MS, Salfiti N, Nelson DB, Lederle FA, Bond JH. Risk

- factors for severe delayed postpolypectomy bleeding. *Endoscopy*. 2008; **40**(2): 115-119. [DOI: 10.1055/s-2007-966959]; [PMID: 18253906]
9. Singaram C, Torbey CF, Jacoby RF. Delayed postpolypectomy bleeding. *Am J Gastroenterol*. 1995; **90**(1): 146-147; [PMID: 7801918]
 10. Grossberg LB, Vodonos A, Papamichael K, Novack V, Sawhney M, Leffler DA. Predictors of post-colonoscopy emergency department use. *Gastrointest Endosc*. 2018; **87**(2): 517-525.e6. [DOI: 10.1016/j.gie.2017.08.019]; [PMID: 28859952]
 11. Duseja R, Bardach NS, Lin GA, Yazdany J, Dean ML, Clay TH, Boscardin WJ, Dudley RA. Revisit rates and associated costs after an emergency department encounter: A multistate analysis. *Ann Intern Med*. 2015; **162**(11): 750-756. [DOI: 10.7326/M14-1616]; [PMID: 26030633]
 12. Widmer AJ, Basu R, Hochhalter AK. The association between office-based provider visits and emergency department utilization among medicaid beneficiaries. *J Community Health*. 2015; **40**(3): 549-554. [DOI: 10.1007/s10900-014-9970-3]; [PMID: 25466431]
 13. Reumkens A, Rondagh EJ, Bakker CM, Winkens B, Masclee AA, Sanduleanu. Post-Colonoscopy Complications: A Systematic Review, Time Trends, and Meta-Analysis of Population-Based Studies. *Am J Gastroenterol*. 2016 Aug; **111**(8): 1092-101. [DOI: 10.1038/ajg.2016.234]; [PMID: 27296945]
 14. Sewell JL, Velayos FS. Systematic review: The role of race and socioeconomic factors on IBD healthcare delivery and effectiveness. *Inflamm Bowel Dis*. 2013; **19**(3): 627-643. [DOI: 10.1002/ibd.22986]; [PMID: 22623078]
 15. Hawkins NM, Jhund PS, McMurray JJV, Capewell S. Heart failure and socioeconomic status: Accumulating evidence of inequality. *Eur J Heart Fail*. 2012; **14**(2): 138-146. [DOI: 10.1093/eurjhf/hfr168]; [PMID: 22253454]
 16. Marshall IJ, Wang Y, Crichton S, McKeivitt C, Rudd AG, Wolfe CDA. The effects of socioeconomic status on stroke risk and outcomes. *Lancet Neurol*. 2015; **14**(12): 1206-1218. [DOI: 10.1016/S1474-4422(15)00200-8]; [PMID: 26581971]
 17. Gershon AS, Hwee J, Victor JC, Wilton AS, To T. Trends in socioeconomic status-related differences in mortality among people with chronic obstructive pulmonary disease. *Ann Am Thorac Soc*. 2014; **11**(8): 1195-1202. [DOI: 10.1513/AnnalsATS.201403-094OC]; [PMID: 25166428]
 18. Frost JW, Kurup A, Shetty S, Fisher N. Does the presence of a trainee compromise success of biliary cannulation at ERCP? *Endosc Int Open*. 2017; **5**(7): E559-E562. [DOI: 10.1055/s-0043-105579]; [PMID: 28670611]
 19. Kaufmann TJ, Huston J, Mandrekar JN, Schleck CD, Thielen KR, Kallmes DF. Complications of diagnostic cerebral angiography: Evaluation of 19,826 consecutive patients. *Radiology*. 2007; **243**(3): 812-819. [DOI: 10.1148/radiol.2433060536]; [PMID: 17517935]
 20. Aisen CM, James M, Chung DE. The impact of teaching on fundamental general urologic procedures: Do residents help or hurt? *Urology*. 2018. [DOI: 10.1016/j.urology.2018.05.044]; [PMID: 30092301]
 21. Nguyen S, Ferland N, Beaudoin S, Martel S, Simon M, Laberge F, Lampron N, Fortin M, Delage A. Influence of trainee involvement on procedural characteristics for linear endobronchial ultrasound. *Thorac Cancer*. 2017; **8**(5): 517-522. [DOI: 10.1111/1759-7714.12481]; [PMID: 28731576]
 22. Rawal S, Srighanthan J, Vasantharopan A, Hu H, Tomlinson G, Cheung AM. Association between limited english proficiency and revisits and readmissions after hospitalization for patients with acute and chronic conditions in toronto, ontario, canada. *JAMA*. 2019; **322**(16): 1605-1607. [DOI: 10.1001/jama.2019.13066]; [PMID: 31638666]
 23. Inagaki E, Farber A, Kalish J, Siracuse JJ, Zhu C, Rybin DV, Doros G, Eslami MH. Role of language discordance in complication and readmission rate after infrainguinal bypass. *Journal of Vascular Surgery*. 2017; **66**(5): 1473-1478. [DOI: 10.1016/j.jvs.2017.03.453]; [PMID: 28625669]