

# Complication rates of trainee- versus attending-performed upper gastrointestinal endoscopy

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## Abstract

**Background** Although esophagogastroduodenoscopy (EGD) is usually the first procedure trainees learn, it is not known whether the involvement of a trainee affects the procedure's complication rate, a key quality and safety indicator. The purpose of this study was to determine whether the complication rate of fellow-performed upper endoscopy differs from that of attending gastroenterologists, and whether that difference varies with the level of training.

**Methods** Emergency room visits within 14 days of an outpatient EGD deemed to be probably or definitely related to the EGD were categorized as complications. Complication rates were calculated for attending- and trainee-performed gastrointestinal endoscopies, the latter stratified by level of training.

**Results** Forty-five attendings and 43 fellows performed 21,899 EGDs during the study period. There were 43 complications (1.96 per 1000 EGDs). Procedures performed by any fellow were more likely to have a complication than those performed by an attending (odds ratio [OR] 2.3, 95% confidence interval [CI] 1.17-4.6). This difference was driven by a higher rate of complications among fellows who had completed general gastroenterology training and were in advanced training (OR 3.8, 95%CI 1.76-8.04); all of these complications involved trainees in interventional endoscopy. Fellows in any year of general gastroenterology training were not more likely to cause complications than attendings.

**Conclusions** The rate of complications from EGDs performed by fellows in their general gastroenterology training does not differ from that of attending endoscopists. The complication rate of advanced trainees exceeded that of attendings, but this is likely to be attributable to the higher-risk interventions undertaken by fellows in interventional endoscopy.

**Keywords** Endoscopy, esophagogastroduodenoscopy, trainee, education, complications, quality, safety

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## Introduction

Landmark reports from the Institute of Medicine released in 2000 and 2001 marked the start of an increased focus on quality throughout medicine and its subspecialties [1,2]. In gastroenterology, this quality focus led to the development of

quality measures and indicators for a variety of endoscopic procedures. Because of its widespread use for colorectal cancer screening, colonoscopy has been the highlight of these efforts. Quality measures such as adenoma detection rate, shown to be independently associated with interval colorectal cancer after screening colonoscopy, have gained broad acceptance and are used nationally to assess the quality of screening colonoscopy [3,4].

Although performed nearly as often as colonoscopy, esophagogastroduodenoscopy (EGD) has few quality indicators that have entered widespread use [5]. The American Society for Gastrointestinal Endoscopy and the American College of Gastroenterology jointly proposed 23 quality indicators for EGD, consisting mostly of process measures [6]. The two outcome measures focus on procedural complications: the first on immediate adverse events and the second on delayed adverse events occurring within 14 days, emphasizing the importance of quality metrics centered on procedural safety.

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Thus far, the safety of an endoscopy performed in the hands of a trainee has not been widely studied. Trainees do not appear to increase the perforation rates of colonoscopy, a crude measure of safety, but there is a dearth of data regarding the safety of upper endoscopy performed by trainees, even though this is typically the first endoscopic procedure taught to gastroenterology fellows [7,8]. Therefore, we sought to determine whether the rate of complications of fellow-performed upper endoscopies differs from those performed by attending gastroenterologists without a trainee and whether that difference varies with level of training.

## Materials and methods

Complications of all EGDs performed at a tertiary academic center were identified prospectively from January 1, 2014, through June 30, 2016, using a previously implemented automated system based on patient medical record number that identifies patient visits to the emergency department within 14 days of an endoscopic procedure [9]. The 14-day window was selected based on data suggesting that clinically significant complications related to the procedure occur infrequently outside this time period, and is in line with a proposed upper endoscopy quality indicator [6,10]. When an emergency department visit within 14 days of an EGD was identified, the endoscopist was queried via email to determine whether the visit was related to the procedure. If the endoscopist deemed the visit definitely or probably related to the procedure, this was entered prospectively into a local database; these procedures were categorized as having complications for the purposes of this study. Audits on these visits are performed by a quality specialist to determine if any visits were categorized incorrectly as unrelated. For the purposes of this study, the charts of patients with complications were reviewed to characterize those complications.

## Inclusion and exclusion criteria

All upper endoscopies performed or supervised by the faculty of the Division of Gastroenterology at Beth Israel Deaconess Medical Center were included. The study was approved by the Center's Institutional Review Board. Procedures performed at off-site (non-hospital) locations were not included, as fellows do not participate in procedures at these locations. All inpatient procedures, endoscopic retrograde cholangiopancreatography and endoscopic ultrasound procedures were excluded from the study, as were all balloon enteroscopies and lower endoscopies.

## Outcomes

The primary outcome was the complication rate of EGDs performed with trainees compared to those performed without trainees. Complications were defined as any reported adverse event associated with an upper endoscopy that the endoscopist

deemed definitely or probably related to the procedure, as previously described. Complication rates were calculated for attending-performed endoscopies and for trainee-performed endoscopies, the latter stratified by the postgraduate year (PGY) of the fellow on the date of the procedure. Fellows were also divided into those in their 4<sup>th</sup> through 6<sup>th</sup> postgraduate years (general gastroenterology training) and those completing more advanced training (PGY 7-8). The total number of endoscopies performed by each physician was determined via automated procedural volume tracking through the gCare electronic endoscopic record (version 3.6.4.21, gMed, Weston, FL).

## Statistical analysis

Odds ratios (OR) with 95% confidence intervals (CI) were calculated to compare the rate of complications of procedures performed by fellows with those performed by attending physicians, the former stratified by level of training.

## Results

In total, 21,899 EGDs were performed during the study period by a total of 45 attending gastroenterologists and 43 fellows. Fifty-six percent of these procedures were performed with fellows. There were 43 complications, for an overall complication rate of 1.96 per 1000 EGDs. Fifty-three percent of patients experiencing complications were over the age of 65. Nearly half (47%) were on single or dual antiplatelet therapy and 16% were being treated with anticoagulants. Cardiac disease (47%), liver disease (37%), and cancer (40%) were common among patients who had complications (Table 1). Nearly all (93%) patients with complications were sedated for their EGDs with anesthesia care monitored by an anesthesiologist.

Compared to procedures performed by attendings, procedures performed by fellows of any PGY were significantly more likely to have a complication (OR 2.3, 95%CI 1.17-4.6). When stratified by PGY, advanced fellows (those in PGYs 7-8) had significantly higher rates of complications compared with attendings (OR 3.8, 95%CI 1.76-8.04), but EGDs performed by gastroenterology fellows during their routine fellowship years (i.e. PGY4s, PGY5s or PGY6s) were not significantly more likely to have a complication (Table 2 A,B). Of the 3452 EGDs performed by fellows who had completed their general gastroenterology fellowship but who continued supervised training for further specialization (in PGYs 7 or greater), 86% were performed by fellows in interventional/therapeutic endoscopy; no EGDs performed by other types of advanced fellows, for example fellows in motility or transplant hepatology, had complications.

When complications occurred, most were serious, requiring hospitalization in 77% (n=33) of cases. The most common complication was bleeding, which occurred in 15 (35%) patients. Pain in the absence of any other complication occurred in 10 (23%), infection in 9 (21%); the majority were due to

periprocedural aspiration), cardiovascular complications in 4 (9%, including pulmonary edema, pulmonary embolism, stroke, supraventricular tachycardia), duodenal perforation

**Table 1** Characteristics of patients with EGD complications

Characteristic	Number (rate %)
Male	34 (79)
Age	
25-39	3 (7)
40-54	12 (28)
55-69	15 (35)
70-84	10 (23)
85 and over	3 (7)
Antiplatelet agent use	
Aspirin	17 (40)
Clopidogrel	1 (2)
Aspirin and clopidogrel	2 (5)
Nonsteroidal anti-inflammatory drug use	3 (7)
Anticoagulant use	7 (16)
Monitored anesthesia care used for EGD	40 (93)
Cardiac disease	20 (47)
Hypertension	22 (51)
Pulmonary disease	10 (23)
Liver disease	16 (37)
Cancer	17 (40)

EGD, esophagogastroduodenoscopy

**Table 2 (A)** Comparison of trainee and attending complication rates (all fellows, fellows in general gastroenterology training, fellows in advanced gastroenterology training)

Variable	All fellows	PGY4-6	PGY7 or greater
Number of EGDs	12198	8202	3996
Number of complications	32	15	17
Complications per 1000	2.62	1.8	4.25
OR for complication (vs. attending)	2.3	1.6	3.8
95%CI for OR	1.17-4.6	0.74-3.52	1.76-8.04

**Table 2 (B)** Comparison of trainee and attending complication rates (fellows in general gastroenterology training by postgraduate year)

Variable	PGY4	PGY5	PGY6
Number of EGDs	3632	2018	2552
Number of complications	3	6	6
Complications per 1000	0.83	2.97	2.35
OR for complication (vs. attending)	0.7	2.6	2.1
95%CI for OR	0.2-2.61	0.97-7.11	0.77-5.62

EGD, esophagogastroduodenoscopy; PGY, postgraduate year; OR, odds ratio; CI, confidence interval

in 1 (2%), and other types of complication in the remaining 4 (9%) (Table 3). Nearly three-quarters of complications were associated with a therapeutic intervention being performed during the endoscopy (n=32, 74%). The most common interventions with complications were esophageal stenting (n=8), variceal banding (n=7), argon plasma coagulation (n=3), and endoscopic mucosal resection (n=3) (Table 4). There was one EGD-related death during the study period. This patient died of tumor bleeding associated with an esophageal stent.

## Discussion

Trainees in gastroenterology must perform procedures to gain expertise in endoscopy. The safety of their involvement is critical to allow them the opportunity to learn endoscopy

**Table 3** Type and frequency of complications of EGD

Type of complication	Number (rate %)
Bleeding	
Following variceal banding	5 (12)
Following endoscopic mucosal resection	3 (7)
Other	9 (21)
Pain (in absence of other complication)	10 (23)
Infection	
Pulmonary	7 (16)
Other	2 (5)
Cardiovascular	4 (9)
Duodenal perforation	1 (2)
Others	4 (9)

EGD, esophagogastroduodenoscopy

**Table 4** Types of interventions performed during EGDs with complications and distribution of interventions by training level

Type of intervention	PGY4-6	PGY7 or greater	Attending	Total
Esophageal stent		8		8
Variceal banding	3		4	7
APC (AVM or GAVE)	3			3
EMR		3		3
Cryoablation		1	1	2
Esophageal dilation	1		1	2
NJT placement	2			2
Radiofrequency ablation		2		2
Banding nodular GAVE		1		1
Food disimpaction			1	1
PEG		1		1

APC, argon plasma coagulation; AVM, arteriovenous malformation; EGD, esophagogastroduodenoscopy; GAVE, gastric antral vascular ectasia; EMR, endoscopic mucosal resection; NJT, nasojejunal tube; PEG, percutaneous endoscopic gastrostomy

without causing the patient harm. In this study, we sought to determine whether upper endoscopy in the hands of a trainee was as safe as in the hands of an attending endoscopist by comparing the complication rates of procedures performed with fellows to those performed by attending endoscopists alone. Consistent with current quality metrics, complications were defined as emergency department visits within 14 days of the procedure that the endoscopist deemed to be definitely or probably related to the procedure. We found that trainees in their routine gastroenterology fellowship do not increase the risk of complications compared with attending gastroenterologists, whereas therapeutic/interventional endoscopy fellows have a higher rate of complications compared with attending endoscopists; however, this difference appears to be related to the higher-risk interventions they undertake. Complications were more frequent after EGDs that included a therapeutic intervention than after diagnostic EGDs.

Reported complication rates of EGD vary widely, from 1 in 200 to 1 in 10,000, a range that can probably be explained by differences in reporting and definitions of complications [11]. The rate of complications in this study, defined by emergency department utilization for a reason related or probably related to the procedure, was about 2 in 1000 and falls within this range. Although higher rates of emergency department utilization following upper endoscopy have been reported, the rate we describe was adjudicated by the performing endoscopist, and therefore would be expected to be lower than unadjudicated rates, which would include visits that occurred for reasons entirely unrelated to the endoscopy [12].

In our study, the majority of complications were severe enough to require hospitalization (77%), indicating that the overall complication rate of 1.96 per 1000 EGDs is weighted to more severe complications not adequately managed in the emergency department. Examining fellows of all postgraduate years together, including advanced fellows in their seventh or greater year of training, we found that procedures involving fellows were more likely to have a complication than those performed by attendings alone (OR 2.3, 95%CI 1.17-4.6). However, because we also found that fellows in their routine gastroenterology fellowship years (PGYs 4-6) do not have significantly higher rates of complications than attendings, this difference seems to be driven by a higher rate of complications among advanced fellows training in interventional endoscopy, rather than by an increased rate of complications among less experienced fellows.

As would be expected, most complications were associated with an endoscopic intervention (74%). For example, the intervention most commonly associated with a complication was esophageal stenting (n=8, 19% of complications). All of these procedures were performed by fellows training in interventional endoscopy, suggesting that the higher rate of complications of advanced fellows is related to their participation in higher risk procedures, rather than signaling that a lack of experience is linked to higher complication rates.

The finding that the involvement of an inexperienced fellow did not increase the rate of complications is consistent with the literature regarding colonoscopy, which suggests that fellows

do not show higher perforation rates [7,8]. In fact, studies have shown that fellow involvement may actually enhance the quality of colonoscopy through improvement in adenoma detection rate, a key colonoscopy quality metric [13-15].

Nonetheless, it is well established that there is a learning curve for endoscopic procedures that extends from general procedures, such as upper endoscopy and colonoscopy, to more advanced procedures, such as retrograde cholangiopancreatography and radiofrequency ablation of Barrett's esophagus [16-23]. Because of this, it remains plausible that less experienced trainees might increase complication rates, and this could be especially true for EGD because fellows typically begin learning upper endoscopy before attempting colonoscopy. However, our findings highlight that a lower level of experience does not appear to increase rates of adverse events from upper endoscopy and should lend comfort to trainees in endoscopy, their supervisors and their patients.

Our study has a number of strengths, but also limitations. To our knowledge, this is the first report comparing rates of complications of upper endoscopy performed by trainees and performed by attending endoscopists. We utilized a large sample, analyzing nearly 22,000 endoscopies, and we stratified analysis by postgraduate year, allowing analysis of the most junior and the most senior fellows separately. However, it is possible the study was underpowered to find a difference between the complication rates of general gastroenterology fellows and attendings. Despite this, given the sample sizes we analyzed and the low overall rate of complications, any undetected difference would be expected to be small, especially in absolute terms. Although these rates probably differed between diagnostic and interventional endoscopies, our data lacked the granularity to calculate separate rates of complications for the two categories. Among the study's strengths is that all emergency department evaluations and hospitalizations were adjudicated by the endoscopist who performed the procedure. This has the advantage of utilizing the individual with the most knowledge about the patient and the procedure to adjudicate relatedness. Although this process was audited, the differing perspectives of each endoscopist could lead to over- or under-reporting of true complications. Finally, our study was conducted in a single center, potentially limiting its generalizability.

In summary, we report that the rate of complications from upper endoscopy performed by fellows in their general gastroenterology training does not differ from that of upper gastrointestinal endoscopy performed by attending endoscopists. This finding persisted even for the least experienced trainees in their first year of gastroenterology training. We observed the rate of complications of advanced fellows to be higher than that of attendings, but this difference is likely driven by the higher-risk interventions these fellows perform rather than indicating that a lack of experience may be linked to higher complication rates. Further multicenter studies are needed to validate these findings in other settings.

## Summary Box

### What is already known:

- The complication rate of endoscopic procedures, including esophagogastroduodenoscopy (EGD), is a key quality and safety measure
- Trainees appear to have no effect on the safety of colonoscopy and improve at least one measure of quality, the adenoma detection rate
- However, the safety of trainees performing EGD is unknown, and this is typically the endoscopic procedure taught first

### What the new findings are:

- The rate of complications from upper endoscopy performed by fellows in their general gastroenterology training was not different than that of attending endoscopists
- This rate also did not differ when only fellows in their first year of training were examined
- However, the rate of complications for advanced fellows (who had already completed general gastroenterology training) was higher than that of attendings, and this drove the overall higher complication rate among fellow-performed endoscopies when fellows of all experience levels were evaluated together

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