

Impact of COVID-19 on gastroenterology fellowship training: a multicenter analysis of endoscopy volumes



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submitted 16.4.2021

accepted after revision 19.5.2021

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Endosc Int Open 2021; 09: E1572–E1578

DOI 10.1055/a-1526-1419

ISSN 2364-3722

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ABSTRACT

Background and study aims The COVID-19 pandemic has had a profound impact on gastroenterology training programs. We aimed to objectively evaluate procedural training volume and impact of COVID-19 on gastroenterology fellowship programs in the United States.

Methods This was a retrospective, multicenter study. Procedure volume data on upper and lower endoscopies performed by gastroenterology fellows was abstracted directly from the electronic medical record. The study period was

stratified into 2 time periods: Study Period 1, SP1 (03/15/2020 to 06/30/2020) and Study Period 2, SP2 (07/01/2020 to 12/15/2020). Procedure volumes during SP1 and SP2 were compared to Historic Period 1 (HP1) (03/15/2019 to 06/30/2019) and Historic Period 2 (HP2) (07/01/2019 to 12/15/2019) as historical reference.

Results Data from 23 gastroenterology fellowship programs (total procedures = 127,958) with a median of 284 fellows (range 273–289; representing 17.8% of all trainees in the United States) were collected. Compared to HP1, fellows performed 53.6% less procedures in SP1 (total volume: 28,808 vs 13,378; mean 105.52 ± 71.94 vs 47.61 ± 41.43 per fellow; $P < 0.0001$). This reduction was significant across all three training years and for both lower and upper endoscopies ($P < 0.0001$). However, the reduction in volume was more pronounced for lower endoscopy compared to upper endoscopy [59.03% (95% CI: 58.2–59.86) vs 48.75% (95% CI: 47.96–49.54); $P < 0.0001$]. The procedure volume in SP2 returned to near baseline of HP2 (total volume: 42,497 vs 43,275; mean 147.05 ± 96.36 vs 150.78 ± 99.67 ; $P = 0.65$).

Conclusions Although there was a significant reduction in fellows' endoscopy volume in the initial stages of the pandemic, adaptive mechanisms have resulted in a return of procedure volume to near baseline without ongoing impact on endoscopy training.

Introduction

The coronavirus disease (COVID-19) outbreak, first identified in December 2019, has become a global pandemic, resulting in approximately 92 million cases and 1.9 million deaths worldwide [1]. The United States has been one of the most severely affected nations, recording over 23 million cases and 380,000 deaths – becoming the epicenter of the SARS-CoV-2 (2019-nCoV) infection. Along with this devastating impact to patients and immense burden on healthcare systems, the COVID-19 pandemic has caused an unprecedented disruption in medical education and physician training [2,3]. Multiple healthcare centers, both university and community programs, have reduced the volume of elective visits, procedures, and even redeployed trainees to other critical services to meet the demands of the COVID-19 pandemic.

While these extraordinary times have impacted all facets of medical education and training, training in surgical and procedural specialties such as gastroenterology which require residents and fellows to achieve procedural competencies, have been uniquely affected. Changes to fellowship rotations, inpatient consult services, outpatient clinics, and reduction in endoscopy hours (or in some cases, complete closure of units) have aimed to reduce elective cases, promote a culture of safety, but also limited clinical exposure for gastroenterology fellows [4–7]. In response to COVID-19, the Accreditation Council for

Graduate Medical Education (ACGME) made a statement that “The visits/Case Logs of a program’s graduates who were on duty during this pandemic (particularly those in their ultimate or penultimate years) will be judiciously evaluated in light of the impact of the pandemic on that program” [8]. Yet, despite this acknowledgement by the ACGME, some studies have shown a correlation between procedural volumes and acquisition of skills and patient related outcomes [9–12].

Large-scale assessment of COVID-19 and its impact on gastroenterology fellowship training is currently limited to survey results and opinion pieces [4–6,13]. One single-center study during the COVID-19 pandemic did demonstrate an overall 50% reduction in the number of inpatient upper endoscopies performed among trainee providers [14]. Other subjective studies with self-reported data have shown that 93.8% of a cohort of 770 trainees worldwide reported a reduction in their monthly procedure volumes, with colonoscopies reduced more than other procedures [15]. A survey of 177 gastroenterology fellows, all within the United States, demonstrated that COVID-19 impacted all aspects of training, including endoscopy, outpatient clinics, inpatient consults, and educational activities [13]. While these data were critical to evaluate the impact of COVID-19 on gastroenterology fellowship training, the vast majority of published literature reports outcomes or survey responses early on in the pandemic, and does not allow for objective measurements to evaluate changes in procedural volume,

or assess fellowship programs' ability to respond to the current pandemic.

Given that the pandemic has been ongoing for the last 10 months, serious concerns have been raised about its impact on trainees as it encompasses roughly 25% of the 3-year fellowship training period; however, objective data are lacking. The aim of this study was to audit gastroenterology fellowship programs across the United States to objectively evaluate the impact of COVID-19 on fellows' endoscopy volume prior to implementing strategies to address these perceived issues in fellowship training.

Methods

This was a multicenter, retrospective study of ACGME-accredited gastroenterology fellowship training programs across the United States, which aimed to investigate the volume of endoscopic procedures performed by fellow trainees. Participating programs extracted deidentified aggregate procedural data from their electronic medical records (EMR) or electronic endoscopy reporting system (EERS) (eg. ProVation MD, ProVation Medical, Inc, Minneapolis, Minnesota, United States; MD-Reports Infinite Software Solutions, Inc., Staten Island, New York, United States; and EndoWorks Olympus America, Inc Center Valley, Pennsylvania, United States) including the number of endoscopic procedures performed during the pre-specified time periods. These procedures were performed by gastroenterology fellows under the direct supervision of attending physicians. The study period was stratified into two time periods to adjust for the transition to the new academic year on July 1, 2020 (i.e. March 15, 2020 to June 30, 2020 (Study Period 1, SP1) and July 1, 2020 to December 15, 2020 (Study Period 2, SP2). A comparison was performed with the same time period in the year prior, which served a historical cohort for reference or comparison purposes (i.e. March 15, 2019 to June 30, 2019 (Historic Period 1, HP1) and July 1, 2019 to December 15, 2019 (Historic Period 2, HP2).

Endoscopic procedures were divided into upper gastrointestinal endoscopy (esophagogastroduodenoscopy and push enteroscopy) and lower gastrointestinal endoscopy (flexible sigmoidoscopy and colonoscopy). Other endoscopic procedures including antegrade or retrograde balloon (device)-assisted enteroscopy, endoscopic ultrasound, and endoscopic retrograde cholangiopancreatography were excluded as most of these are performed by advanced endoscopy trainees at most participating institutions and may lead to a lack of generalizability. Data were strictly extracted from the EMR and/or EERS to avoid subjective and reporting biases. Detailed data harvesting instructions were provided to all participating sites along with access to point of contact from the primary investigators to resolve any issues or concerns with data collection. Data were not considered from trainee self-reported logs and centers that could not provide direct data were excluded. Programs were encouraged to include data from all their training sites; however, if regulatory or logistic barriers prevented the inclusion of all training sites, data from primary training sites were considered.

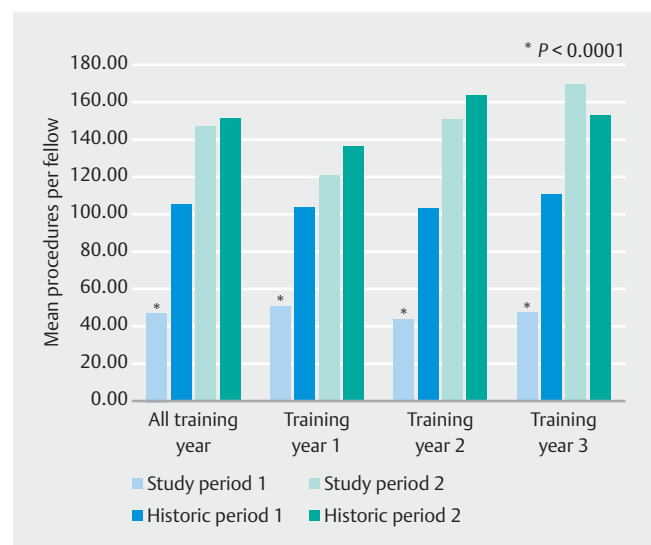
Statistical analysis was performed by using Student's *t*-test for comparing means and standard deviations for continuous variables. Percentage change in endoscopy volumes with 95% confidence intervals were calculated and compared for statistical significance among different time periods. $P \leq 0.05$ was considered statistically significant. The study received a waiver from institutional review board at University of New Mexico given the collection of deidentified aggregate data.

Results

Data were collected from 23 gastroenterology fellowship programs with a total of 127,958 procedures performed by the fellows. Program sizes ranged from two to eight fellows per year. Given that data collection spanned different academic periods, there was minor variation in the number of fellows between the study time periods. There were a median of 284 fellows (range 273–289) in each time period.

Comparing SP1 (3/15/2020 to 6/30/ 2020) to HP1 (3/15/2019 to 6/30/ 2019)

The total number of procedures performed by fellows were markedly reduced by 53.6% (95% CI: 52.98–54.14) from 28,808 in HP1 to 13,378 in SP1. There was significant reduction in mean total volume (105.52 ± 71.94 vs 47.61 ± 41.43 ; $P < 0.0001$), mean upper endoscopies (56.15 ± 38.67 vs 27.95 ± 24.26 ; $P < 0.0001$), and mean lower endoscopies (49.38 ± 38.38 vs 19.65 ± 20.06 $P < 0.0001$) per fellow between HP1 and SP1, respectively (► Fig. 1, ► Table 1, ► Table 2). The reduction in volume was more pronounced for lower endoscopy compared to upper endoscopy (59.03% [95% CI: 58.2–59.86] vs 48.75% [95% CI: 47.96–49.54]; $P < 0.0001$).



► Fig. 1 Comparison of procedures performed by gastroenterology trainees between the study and historic periods at the 23 participating programs.

► **Table 1** Summary of upper endoscopies performed by gastroenterology trainees at the 23 participating programs.

	Study period 1	Historic period 1	% reduction	P value	Study period 2	Historic period 2	% reduction	P value
Training year 1								
Number of fellows (n)	93	95			96	94		
No. of procedures	3038	5964	49.06 (47.79–50.33)		7399	7997	7.48 (6.92–8.08)	
Mean procedures	32.67±25.75	62.78±35.65		<0.0001	77.07±50.16	85.07±54.17		0.2921
Training year 2								
Number of fellows (n)	95	93			94	98		
No. of procedures	2390	4879	51.01 (49.61–52.41)		7214	7983	9.63 (9.0–10.3)	
Mean procedures	25.16±20.23	52.46±37.77		<0.0001	76.74±50.91	81.46±56.22		0.5433
Training year 3								
Number of fellows (n)	93	85			99	95		
No. of procedures	2427	4485	45.89 (44.44–47.35)		8062	7182	Increase 12.25 (11.51–13.04)	
Mean procedures	26.1±26.01	52.76±42.2		<0.0001	81.43±52.43	75.6±54.86		0.4501
All training years								
Number of fellows (n)	281	273			289	287		
No. of procedures	7855	15328	48.75 (47.96–49.54)		22675	23162	2.10 (1.92–2.29)	
Mean procedures	27.95±24.26	56.15±38.67		<0.0001	78.46±51.06	80.7±55.05		0.6128

Comparing SP2 (7/1/2020 to 12/15/2020) to HP2 (7/1/2019 to 12/15/2019)

The total number of procedures performed by fellows were marginally reduced by 1.8% (95% CI: 1.68–1.93) from 43,275 in HP2 to 42,497 in SP2. There was no difference in mean total volume (150.78±99.67 vs 147.05±96.36; $P=0.6481$), mean upper endoscopies (80.70±55.05 vs 78.46±51.46; $P=0.6128$), and mean lower endoscopies (70.08±53.63 vs 68.59±54.16; $P=0.7402$) per fellow between HP2 and SP2, respectively (► **Fig. 1**, ► **Table 1**, ► **Table 2**). The reduction in volume was more pronounced for upper endoscopy compared to lower endoscopy (2.10% [95% CI: 1.92–2.29] vs 1.45% [95% CI: 1.29–1.62]; $P<0.05$).

Subgroup analysis

Subgroup analysis between different training years showed significant reduction in total procedure volume, upper endoscopies, and lower endoscopies across all three training years during SP1 compared to HP1 ($P<0.0001$) (► **Table 1**, ► **Table 2**). Fellows in training year 1 had the least reduction in lower endoscopies and fellows in training year 3 had significantly less reduction in upper endoscopy volume, compared to fellows in other training years ($P<0.05$) (► **Table 1**, ► **Table 2**).

There was no significant difference across all three training years for total procedure volume, upper endoscopies, and low-

er endoscopies between SP2 and HP2 ($P>0.05$) (► **Table 1**, ► **Table 2**). Although not significant, fellows in training year 3 were found to have an increase in total procedure volume, upper endoscopies, and lower endoscopies, compared to a reduction in these volumes for fellows in training years 1 and 2.

Discussion

Since March 2020, gastroenterology practices across the country have faced immense challenges due to the COVID-19 pandemic as institutions adapt to regulations on elective and semi-elective procedures from local and state governments, implement new standard operating procedures, and design infection control protocols. In addition, there has been a diversion of resources and manpower including physicians, nurses, and patient care technicians toward critical care areas. In a national survey of 177 gastroenterology trainees, 29.4% reported being redeployed to non-gastroenterology services during the pandemic [13]. Trainees in this survey felt the pandemic impacted multiple domains of their educational experience, including endoscopy. A majority (64.3%) of the trainees believed that the pandemic would impact their endoscopic skills at the end of their training. Their concern regarding achieving competence in endoscopic skills was also echoed by international trainees [15]. While didactic training has managed to easily evolve onto multiple online platforms providing on-demand and interactive webinars, as well as structured social media education pro-

► **Table 2** Summary of lower endoscopies performed by gastroenterology trainees at the 23 participating programs.

	Study period 1	Historic period 1	% reduction	P value	Study period 2	Historic period 2	% reduction	P value
Training year 1								
Number of fellows (n)	93	95			96	94		
No. of procedures	1722	3892	55.76 (54.19–57.31)		4187	4794	12.66 (11.75–13.63)	
Mean procedures	18.52 ± 15.39	40.97 ± 28.52		<0.0001	43.61 ± 30.16	51 ± 30.92		0.0970
Training year 2								
Number of fellows (n)	95	93			94	98		
No. of procedures	1820	4723	61.47 (60.07–62.85)		6922	8020	13.69 (12.96–14.46)	
Mean procedures	19.16 ± 20.86	50.78 ± 40.4		<0.0001	73.64 ± 54.76	81.84 ± 61.02		0.3290
Training year 3								
Number of fellows (n)	93	85			99	95		
No. of procedures	1981	4865	59.28 (57.89–60.65)		8713	7299	Increase 19.37 (18.48–20.29)	
Mean procedures	21.3 ± 23.21	57.24 ± 43.89		<0.0001	88.01 ± 62.26	76.83 ± 58.38		0.1990
All training years								
Number of fellows (n)	281	273			289	287		
No. of procedures	5523	13480	59.03 (58.2–59.86)		19822	20113	1.45 (1.29–1.62)	
Mean procedures	19.65 ± 20.06	49.38 ± 38.38		<0.0001	68.59 ± 54.16	70.08 ± 53.63		0.7402

grams, no substitute has yet been implemented for procedural volume, expertise, and training.

This current multi-institution study is the first attempt to objectively evaluate the impact of COVID-19 on endoscopic procedures and gastroenterology fellowship training in the United States. Furthermore, this study provides historical data to compare the initial, and more current impact to evaluate programs' ability to adapt training to the current pandemic. Based on the results of this multicenter study, there was a significant reduction in procedure volume during the initial stages of the COVID-19 pandemic, with the number of upper endoscopies and colonoscopies reduced by 48.75% and 59.03%, respectively. Reassuringly, however, adaptive mechanisms (including relative ease of pre-procedural COVID-19 testing and availability of adequate personal protective equipment) have transformed the structure of current training with an increase in total number of endoscopic procedures, approaching a number similar to our 2019 historical cohort.

Procedure volume is a critical component of gastroenterology fellowship and training. Studies have suggested minimum thresholds ranging between 250 and 500 colonoscopies and around 250 upper endoscopies to achieve competence [10, 12, 16–19]. The 2017 American Society of Gastroenterological Endoscopy (ASGE) guidelines, which is the standard for ACGME-accredited gastroenterology fellowship programs, recommend that trainees perform a minimum of 130 upper endoscopies

and 275 colonoscopies prior to assessment for competency [20]. Although these thresholds do not guarantee competence and ASGE places emphasis on shifting from a volume-based approach to assess competency towards more well-defined performance metrics, reduction in endoscopy volume is important as studies have demonstrated improved metrics such as cecal intubation rate, adenoma detection rate and polyp detection rate with higher volumes [11, 12, 21]. Based upon the results of this study, gastroenterology fellows appear to achieve these recommendations, even despite the COVID-19 pandemic. However, given that the pandemic has already impacted 10 months of a 36-month training program and is expected to continue for the foreseeable future, valid concerns have been raised [22]. Keswani et al proposed a phased approach to re-starting training with implementation of newer educational models including an increase in online and simulated training [4]. As such, future investment by fellows, program leadership, and industry, into simulation training models may be required to supplement more traditional approaches. However, while these models may assist in training, though are unlikely to be a complete substitute for real-world procedures on live patients.

Ultimately, the results of this study suggest that although the pandemic is ongoing, procedure volume was effectively decreased for only a short period of time during the initial response and that adaptive measures have resulted in a return to near-normal volume and should likely not impact quality of

endoscopy training for gastroenterology fellows. It is also imperative to note that although endoscopic volumes are important, competence cannot be based solely on procedure numbers and other factors including quality of training in those procedures need to be taken into account. This is, however, beyond the scope of this study.

Although there was no significant change in the total procedure volume, we found a shift of procedures towards third-year fellows during SP2. There was a decrease of 9.42% and 11.67% in the number of procedures performed by fellows in training years 1 and 2, respectively, in SP2 compared to HP2. During the same time, a non-significant increase of 15.84% was seen in procedures performed by fellows in training year 3. We speculate that this may be due to a variety of subjective factors, including efforts to protect fellows in training years 1 and 2 by senior third-year fellows, faculty preferences to involve third-year trainees given experience and efficiency to avoid longer aerosol generating procedures, or a drive from senior trainees to get more experience prior to venturing out into practice. Even though we noticed this interesting trend, these differences were not significant when compared to HP2 for individual training year, and it should not impact the fellows in training years 1 and 2 in the long run as they have approximately 30 and 18 months of training ahead of them, respectively.

It is important to acknowledge this study is not without limitations. First, given the retrospective nature of the study, it is possible unmeasured confounders (i. e., specific fellow interest or other external non-COVID-19 factors) may have impacted the number of procedures during the predetermined time periods. In addition, given the heterogeneous nature of reporting institutions and main outcomes of the manuscript, specific data regarding possible fellow-specific outcomes, such as sex or race/ethnicity inequities, were not evaluated. Given that we had 23 centers participating in the study with different EMRs, we could not obtain additional data in a reliable way regarding the setting (inpatient vs. outpatient), indication, and urgency of the performed procedures. However, earlier during the pandemic, we audited the trends in upper gastrointestinal bleeding at the primary study site and found no trend in the absolute number of inpatients with hemodynamically unstable gastroenterology bleeding, esophagogastroduodenoscopies (EGDs) performed in the Intensive Care Unit or the number of inpatients undergoing EGD for variceal bleeding [14]. Further, this study was limited in its ability to evaluate specific measures taken by programs during the COVID-19 pandemic; however, it provides a barometer of objective evidence to demonstrate trends that are likely reflected across the country. Furthermore, for a few programs, data from all training sites could not be included for logistical reasons. However, given a typically consistent rotation schedule across the years, we do not expect this to be a major confounding factor.

Despite these limitations, this study possesses several strengths. Most importantly, this study included data from 23 training programs across the United States, reflecting approximately 11.3% of a total of 203 programs, encompassing 17.8% of an estimated 1,598 active trainees [23]. Furthermore, this study uniformly assessed the EMR or EERS reporting data, pro-

viding an accurate objective measure of procedure volume instead of subjective data collected from anonymous surveys. Finally, this study had a unique ability to objectively measure procedure volume at two distinct time points during the COVID-19 pandemic – an early response during SP1, as well as an adaptive response during SP2.

Conclusions

In conclusion, there was a significant reduction in procedure volume among gastroenterology fellowship trainees during the initial stages of the COVID-19 pandemic. However, adaptive mechanisms have resulted in a return of procedure volume to baseline without ongoing impact on endoscopy training.

Competing interests

The authors declare that they have no conflict of interest.

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