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Impact of the SARS-CoV-2 pandemic on turnover time and revenue in the endoscopy unit: single-center experience*

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ABSTRACT

Background and study aims The SARS-CoV-2 pandemic heavily impacted the New York metro area causing most institutions to either reduce case volume or fully close remaining open units incorporated specific guidelines for procedures lockdown potentially leading to a greater turnover time. We analyzed the quantitative and financial impact of this lost time on our tertiary care center's endoscopy unit.

Patients and methods This single-center, retrospective study included demographics, procedure details and turnover times (TOT) from all endoscopic procedures between December 1, 2019 to June 30, 2020. Cases were categorized as pre-COVID-19 group from December 1, 2019 to March 15, 2020 and during COVID-19 (lockdown) group from March 16, 2020 to June 30, 2020. The financial impact was assessed using national averages for reimbursement of outpatient endoscopic procedures provided by Center for Medicare and Medicaid Services.

Results A total of 3622 procedures were performed during the study period: 2297 in the pre-COVID-19 period, 1325 in the COVID-19 period, representing a 42.32 % decrease. In the COVID-19 lockdown group, there was a significant increase in TOT in both the general endoscopy cases (18.11 minutes, $P = 0.000$) and advanced endoscopy cases (17.7 minutes, $P = 0.000$). The 42.3 % decrease in volume equated to at least $1.6 million USD in lost revenue during the lockdown.

Conclusions COVID-19 pandemic led to an increase in TOT with overall reduced procedure volume and a negative effect on revenue. Providing continued endoscopic management during a pandemic avoids delays in reopening the endoscopy unit and hampers the post-pandemic surge of delayed cases and its financial impact.

Introduction

SARS-CoV-2 disease has strongly impacted the New York metropolitan area, with the peak of the pandemic in the region occurring between March and May 2020 [1]. Many regional private practices and institutions had either significantly reduced case volume or fully closed their endoscopy units. During the surge of the COVID-19 epidemic, people were strongly encouraged to avoid hospitals and only emergency procedures were performed.

Indeed, the virus is predominantly spread by respiratory droplets, but fecal excretion has been reported [2]; upper and lower endoscopies became a focus for infection control. Gastrointestinal societies and the World Health Organization (WHO) released statements to maintain safety for healthcare personnel and patients in endoscopy units [3–6]. These guidelines includ-

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ed the strong recommendation to only perform urgent or emergent cases, defined as one or more of the following: 1) upper and lower gastrointestinal bleeding leading to symptoms; 2) dysphagia impacting oral intake; 3) cholangitis or impending cholangitis; 4) symptomatic pancreaticobiliary disease, i. e. necrotizing pancreatitis; 5) palliation of gastrointestinal obstruction; 6) patients with a time-sensitive diagnosis, such as premalignant or malignancy; 7) cases in which endoscopic procedures would urgently change management such as in IBD; and 8) other cases reviewed and deemed to be exceptional [4, 6].

Hospital factors such as increased need for enhanced personal protective equipment, reduced staff and room capacity, need for protective pathways ensuring linear flow of patients through units, and enhanced cleaning coupled with environmental factors such as accessories and device delivery issues and COVID-19 testing caused a substantial reduction in services. As a result of these changes made during the pandemic, we hypothesized that the turnover time (TOT) between patients was also affected.

TOT, which was defined as the time the patient is transported out of the room to the time the next patient is transported into the room, is a mainstay focus in our study. The TOT is crucial to every endoscopy unit, as optimization of this time has shown to improve endoscopist performance measures as well as endoscopy efficiency [7]. The demand for endoscopy services is high; improving general TOT may be an important potential mechanism to meet this high demand. Improving an endoscopy unit's efficiency could have major benefits in its cost effectiveness. As we learned more about COVID-19, endoscopy units started reopening or increasing their capacity; however, many of the changes implemented during the pandemic remain in effect in endoscopy units.

We aimed to measure the impact of COVID-19 on the endoscopy unit at our tertiary care center in the New York metropolitan area (New Brunswick, New Jersey, United States) and the financial implications related to it.

Patients and methods

Data were retrieved from our endoscopy quality activities (QA/QC) database. The database was established to assess and improve the quality of the program to ensure established educational, clinical service standards are met or best evidentiary practices attained. We reviewed inpatient and/or outpatient endoscopic procedures during the lockdown period of March 16, 2020 to June 30, 2020. Patients who underwent inpatient and/or outpatient endoscopic procedures during the proceeding months were used as a comparative baseline, from December 1, 2019 to March 15, 2020. Demographics, quantity of procedures, procedure types, and TOT were obtained.

TOT was defined as the time the patient is transported out of the room to the time the next patient is transported into the room. This did not include time needed to intubate the patient nor the procedure time. A two-sample *t*-test was conducted to compare TOT. Interventional endoscopic cases were reviewed as a subset, which included but were not limited to mucosal and submucosal dissection, transoral fundoplication, and endoscopic ultrasound. The financial impact on endoscopic procedures was assessed using national averages for reimbursement for outpatient endoscopic procedures provided by Center for Medicare and Medicaid Services (CMS) [8–12]. In regards to analyzing the financial impact, our data included outpatient and inpatient procedures.

During the lockdown period, only emergent/urgent procedures were performed. There were two socially distanced preoperative and postoperative bays and up to two endoscopy rooms utilized. All endotracheal intubations were done with a Hepa filter in place to limit the spread of the virus in the procedure area. There were at least two endoscopists (one interventionalist) always present. There was no more than one fellow per case. Nursing staff was reduced to no more than two per case. Total nurses and technicians per day was about 13. The number of anesthesiologists remained unchanged. There was no shortage of personal protective equipment (PPE) such as N95 masks or powered air purifying respirators (PAPRs). After each procedure, an extensive room-cleaning protocol was implemented and all horizontal and high-touch surfaces, such as procedure tables, countertops, chairs, patient care equipment, and anesthesia equipment, were thoroughly wiped

Results

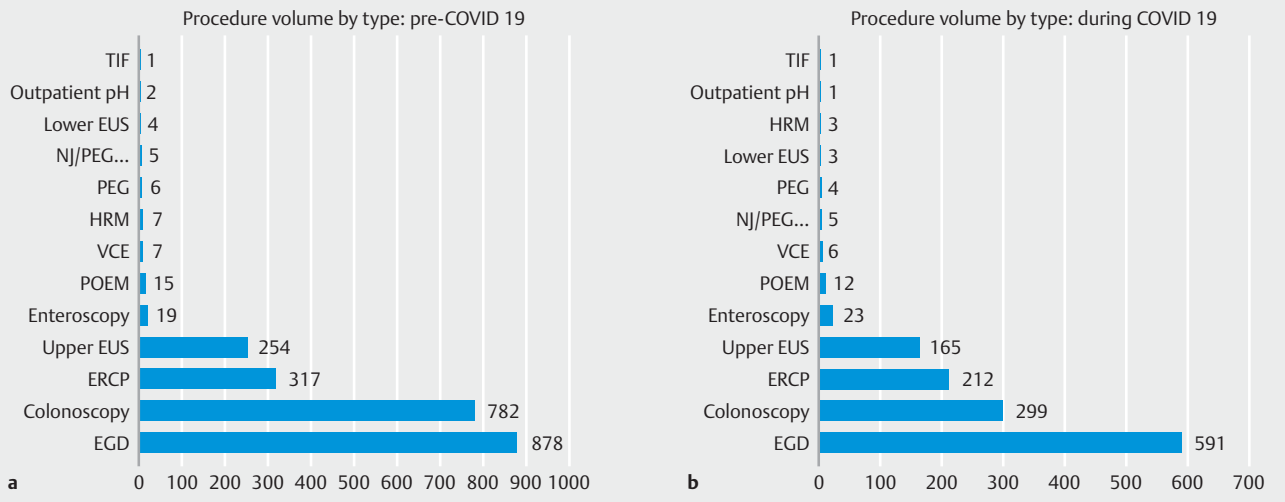
A total of 3622 procedures were performed during the study period: 2297 during the pre-COVID-19 period and 1325 during the COVID-19 lockdown, representing a 42.32 % decrease. The quantity of both general and interventional endoscopic procedures decreased (▶ **Fig. 1a**, ▶ **Fig. 1b**). There were 1139 (49 %) and 735 (55 %) male patients in the pre-COVID-19 and COVID-19 lockdown groups, respectively, with a mean age of 59 years. The mean TOT from pre-COVID-19 to during COVID-19 increased by 45 % from 40.2 minutes to 58.3 minutes (▶ **Table 1**). In the COVID-19 lockdown group, there was a significant increase in TOT in both the general endoscopy cases (18.11 minutes, $P = 0.000$) and advanced endoscopy cases (17.7 minutes, $P = 0.000$) (▶ **Table 1**). Furthermore, during the COVID19 lockdown period, the time between a general case and an interventional case had a statistically significant increase (9.79 minutes, $P = 0.012$) (▶ **Table 1**).

The decrease in nursing staff and extensive room cleaning process was responsible of the prolonged TOT. The number of cases performed per day steadily increased 2 months into the pandemic (▶ **Fig. 2**). Of eight endoscopists, five became COVID-19 positive during the lockdown, but none required hospitalization.

The 42.3 % decrease in volume equated to at least $ 1.6 million USD in lost revenue during the lockdown. This represented $ 960,000 USD from general endoscopy cases and $ 963,000 USD from interventional cases (▶ **Table 2**, ▶ **Table 3**).

Discussion

As healthcare systems became flooded with high volumes of patients with COVID-19 during the pandemic, medical centers had to further improve efficiency while maintaining high-qual-



▶ **Fig. 1** **a** Endoscopy procedure volume by type: period before COVID-19. **b** Endoscopy procedure volume by type: period during COVID-19.

▶ **Table 1** Endoscopy unit patient demographics and case productivity.

	Pre-COVID-19	COVID-19 lockdown
Average age (years)	58	60
Sex (male)	1139 (49 %)	735 (55 %)
Number of procedures (n)	2297	1325
Number of advanced procedures (n)	678	481
Average turnover times (minutes)	Average (SD)	Average (SD)
▪ Composite	40.2 (23.5)	58.3 (33.4)
▪ General	36.7 (23.2)	54.8 (33.4)
▪ Advanced	47 (22.4)	64.6 (32.2)

SD, standard deviation.

ity care. Many regional private practices and institutions had either significantly reduced case volume or fully closed their endoscopy units [13]. During the peak of the pandemic, our institution was one of the most heavily affected facilities in our region. Yet, our endoscopy unit remained functional throughout the pandemic, providing emergent patient care when medical access became restricted. However, the decrease in nursing staff and implementation of an extensive room cleaning protocol after each endoscopy dramatically affected TOT.

Our analysis revealed that TOT increased 1.5 times in the COVID-19 lockdown group, and case volume decreased by 42 %. Although this decrease reflected only cases deemed emergent or urgent, it was higher than we expected because neighboring facilities were shut down and referred their patients to our center because we are a tertiary referring center in the area. No infections occurred in our unit after hospital-wide infection control measures were put in place. In a recent study from Italy, the global number of procedures in tertiary centers decreased from 19,876 in March 2019 to 7701 (61.2 % decrease rate) in March 2020. The number of esophagogastroduodenoscopies decreased from 8967 to 3143 (64.9 %) and rectosigmoidocolonoscopies decreased from 9563 to 3795 (60.3 %). The reduction was slightly less pronounced for pancreaticobiliary endoscopy procedures, with endoscopic ultrasound decreasing from 732 to 407 (44.4 %) and endoscopic retrograde cholangiopancreatography from 614 to 356 (42 %) [14], similar to our data.

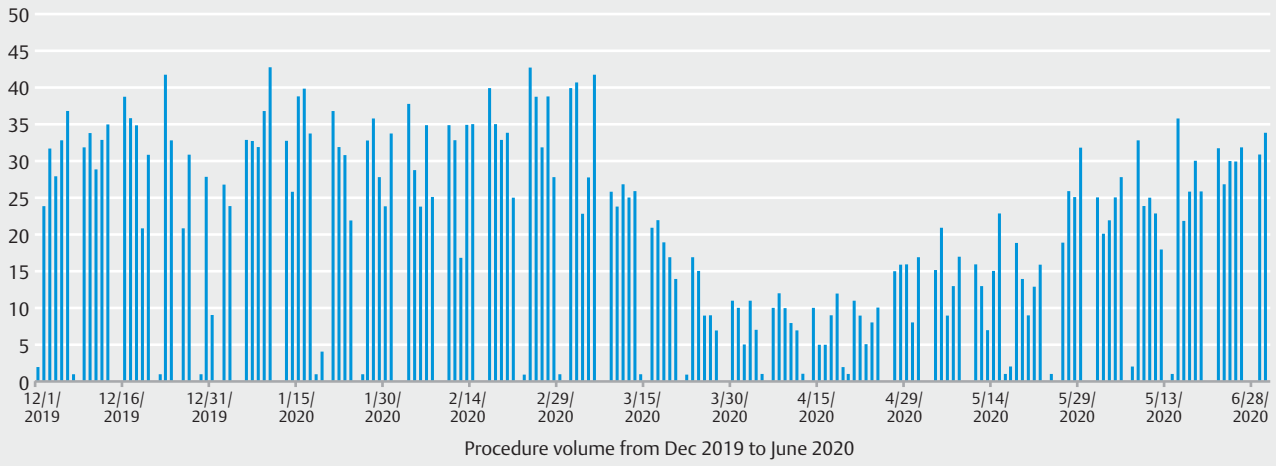
In analyzing the financial impact of the lockdown period on our endoscopy unit, the preceding 3 months were used for comparison due to our center's steadily increasing volume. Outpatient CMS reimbursement estimates were used, but the authors acknowledge the amount of reimbursement varies per practice and each endoscopy can entail a wide array of endoscopic interventions. Financially, we estimated at least $ 1.6 million USD in reduced total revenue for all endoscopic procedures compared to the preceding months.

Remaining open throughout the pandemic allowed our facility to reduce the financial impact compared to being completely shut down.

▶ **Table 2** Components of total procedures performed and average outpatient reimbursement by CMS (excluding interventions, including sphincterotomy and stent placement).

Procedure type	Pre-COVID-19	COVID-19 lockdown	Cost (USD)	Total (pre)	Total (lockdown)
EGD	878	591	762	669,036	450,342
Colonoscopy	782	299	980	766,360	293,020
Upper EUS	254	165	1483	376,682	244,695
Lower EUS	4	3	980	3,920	2,940
ERCP	317	212	2825	895,525	598,900
VCE	7	6	786	5,502	4,716
Enteroscopy	19	23	1483	28,177	34,109
PEG	6	4	1483	8,898	5,932
Outpatient pH	2	1	485	970	485
HRM	7	3	485	3,395	1,455
POEM	15	12	2500	37,500	30,000
NJ/PEG exchange	5	5	231	1,155	1,155
TIF	1	1	3613	3,613	3,613
Total				2,800,733	1,671,362

CMS, Center for Medicare and Medicaid Services; EGD, esophagogastroduodenoscopy; EUS, endoscopic ultrasound; ERCP, endoscopic retrograde cholangiopancreatography; VCE, video capsule endoscopy; PEG, percutaneous endoscopic gastrostomy; HRM, high-resolution manometry; TIF, transoral incisionless fundoplication. POEM; per oral endoscopic myotomy.



▶ **Fig. 2** Endoscopy procedure volume from December 2019 through June 2020.

We observed local facilities that shut down during the pandemic had delays reopening and met a lot of obstacles in revising their infection control processes. In addition, some healthcare providers chose not to return to work because of fear of getting infected. By adapting infection control measures based on the evolving infection control recommendations, our center avoided not only delays in reopening the endoscopy unit but the post-pandemic surge of delayed cases and its resultant financial impact. Due to the adaptive infection control measures, after the lockdown period, our endoscopy unit rapidly returned to being fully operational.

Our study had a few limitations. The optimal workflow processes could not be reported, as recommendations continued to be modified throughout the study period. The financial impact was significant but we could not account for all accessories and devices utilized, such as biliary stents, biopsy forceps, injection needles wires, and luminal stent deployment). Our facility fees may be different from those in other centers. However, we feel it is essential to report our experience as a heavily im-

▶ **Table 3** Components of all interventional endoscopic procedures and average outpatient reimbursement by CMS.

Procedure type	Pre-lockdown	Lockdown	Cost	Total (pre-lockdown)	Total (lockdown)
EGD	46	45	762	35,052	34,290
Colon	11	13	980	10,780	12,740
Upper EUS	254	165	1483	376,682	244,695
Lower EUS	4	3	980	3,920	2,940
ERCP	317	212	2825	895,525	598,900
TIF	1	1	3613	3,613	3,613
POEM	15	12	2500	37,500	30,000
Enteroscopy	19	23	1483	28,177	34,109
NJ/PEG Exchange	5	5	231	1,155	1,155
Outpatient pH	2	1	485	970	485
EndoFLIP	4	1	485	1,940	485

pacted center that remained open throughout the COVID-19 epidemic.

Finally, by adapting infection control measures based on continued infection control recommendations during the COVID-19 pandemic, our center prevented not only delays in reopening the endoscopy unit but the post pandemic surge in delayed cases and its resultant financial impact.

Conclusions

In conclusion, the COVID-19 pandemic led to an overall reduced procedure volume and an increase in TOT with a negative effect on revenue. As we enter the second year of the COVID-19 pandemic, these data underscore the need to maintain a functioning endoscopy unit while adopting infection control measures.

Competing interests

Dr. Tyberg is a consultant for Endogastric Solutions. Dr. Gaidhane is a consultant for Interscope Med. Dr. Kahaleh receives grant support from Boston Scientific, MaunaKea, Apollo Endosurgery, Cook Endoscopy, ASPIRE Bariatrics, NinePoint Medical, Merit Medical, Olympus, and Interscope Med and is a consultant for Boston Scientific, Concordia Laboratories Inc., Abbvie, and Mauna Kea Tech.

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