Title: Effect of using personal protective equipment during the COVID-19 pandemic on the quality indicators of screening colonoscopies.

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Abbreviations:

ADR: Adenoma detection rate
CIR: Cecal intubation rate
CIT: Cecal intubation time
COVID-19: Coronavirus Disease 2019
CRC: Colorectal Cancer
PPE: Personal protective equipment
SWT: Scope withdrawal time

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Abstract:

**Background and Aims:** Coronavirus Disease 2019 (COVID-19) has affected many facets of the practice of medicine including screening colonoscopries. Our study looks to observe if there has been an effect on the quality of colonoscopies, as indicated by quality measures such as cecal intubation rate (CIR), cecal intubation time (CIT), scope withdrawal time (SWT) and adenoma detection rate (ADR) with the adoption of standard COVID-19 precautions.

**Methods:** We conducted a retrospective chart review to analyze the effects of the COVID-19 pandemic on screening colonoscopies. The study utilized data on CIR, CIT, SWT and ADR from outpatient, non-emergent procedures conducted at 3 endoscopy suites of St Luke’s University Health Network. All inpatient and emergent procedures were excluded. Data was obtained by performing chart review on EPIC electronic health record.

**Results:** Our study demonstrated that the total number of screening colonoscopies was decreased between 2019 to 2020 (318 in 2019 vs 157 in 2020, p= 0.005). CIT (320±105 seconds in 2019 vs 392±107 seconds in 2020, p=0.001) and SWT (706±232 seconds in 2019 vs 830±241 seconds in 2020, p=0.001) were increased while CIR (98.2% in 2019 vs 96.6% in 2020, p=0.04) was decreased between 2019 and 2020 likely due to PPE introduction. ADR was similar between the two groups (38.23 (12.50-66.66) in 2019 vs 38.18(16.66-66.00) in 2020, p=0.8).

**Conclusion:** Our study showed that quality indices for screening colonoscopies like cecal intubation rate, cecal intubation time and scope withdrawal time were negatively impacted during the initial COVID time period compared to pre-COVID time. The study also displayed that though there was a significant decline in both screening and diagnostic colonoscopies during
pandemic, adenoma detection rates were comparable. Thus, the efficiency of the procedures was affected by the use of PPE but it did not affect the colonoscopy’s clinical benefit.

**Keywords**: Colonoscopy; COVID-19; adenoma; cecal intubation; personal protective equipment
Introduction:

SARS-COV-2 or Coronavirus Disease 2019 (COVID-19) has affected many facets of the practice of medicine. It has resulted in an alarming amount of hospitalizations. Since January 21 2020, a total of 27.8 million cases have been diagnosed, in addition to 488,000 deaths in the United States alone.¹ This number is likely much higher given a large majority of cases go unreported. Due to the massive spread of the pandemic, personal protective equipment (PPE) has become a part of daily routine for healthcare workers. A majority of standard PPE worn today include gown, gloves, N95 mask and face shield or some form of eye protection. It has been shown by numerous studies to decrease the rate of new infections as much as 5% over a relatively short period of time, particularly among healthcare workers.² Another study conducted in Wuhan, China looked at transmission rates among healthcare workers who strictly adhered to PPE protocols found that those with direct contact with COVID-19 patients had no symptoms and all tested negative after their shifts.³ Strict adherence to wearing PPE has been enforced in most hospitals and is also important in the procedural setting as well.

Various medical procedures had been affected by the onset of the global pandemic. Initially, outpatient procedures were being cancelled in order to minimize transmission. However, emergent surgeries and procedures would continue and as COVID -19 became more predominant in medicine, elective procedures would also return a few months later. One of the procedures that has been closely followed is endoscopy. Colonoscopy screenings have been a cornerstone for colorectal cancer (CRC) detection. A meta-analysis has shown a reduced risk of death due to CRC by up to 60% due to the introduction of screening colonoscopies.⁴ Delayed diagnosis in cancer screening during the pandemic was a concern but some studies have shown that there is no effect on cancer detection rates over a 10 month period.⁵ This observation,
however, was likely temporal and if the suspension of elective surgeries were extended, there
would likely be an effect.

Endoscopic procedures are considered aerosol-generating procedures which means there
is a risk of transmission of viruses due to aerosolization when the scope is inserted and removed.
This has been well studied for upper GI procedures including esophagogastroduodenoscopy,
small bowel enteroscopy, endoscopic ultrasound (EUS), endoscopic retrograde
cholangiopancreatography (ERCP), and esophageal manometry. The risk of aerosolization
during lower GI procedures has been less well studied and has shown to be low.

Soon after the COVID-19 pandemic, the American Gastroenterological Association
(AGA) issued recommendations for GI endoscopy personnel. For all GI procedures the AGA
recommends the use of N95 (or N99, or PAPR) and recommends against the use of surgical
masks only, regardless of COVID-19 status. The decision to extend the recommendation to
lower gastrointestinal procedures is based on evidence of possible aerosolization during
colonoscopy especially during the insertion and removal of instruments through the biopsy
channel and the uncertain risks associated with evidence of the presence of the viral RNA in
fecal channels. Our study looks to observe if there has been an effect on the quality of
colonoscopies, as indicated by quality measures such as cecal intubation rate (CIR), cecal
intubation time (CIT), scope withdrawal time (SWT) and adenoma detection rate (ADR) with the
adoption of standard COVID-19 precautions.

Methods:

We conducted a retrospective chart review to analyze the effects of the COVID-19
pandemic on GI endoscopy procedures. Our aim was to study the consequences of the pandemic
on the quantity and quality of procedures. We hypothesized that the pandemic caused a significant decrease in the number of screening colonoscopies and other outpatient endoscopies. We also hypothesized that PPE use would lead to a significant decrease in quality indicators by decreasing CIR (the percentage of times that the endoscopist was able to reach the cecum), increasing CIT (the time it takes for the endoscopist to begin the colonoscopy to the time the scope can be pushed through to the cecum), increasing SWT (the times it takes to withdraw the scope from the cecum to the end of the procedure) and possibly decreasing ADR (the proportion of screening colonoscopy examinations performed by an endoscopist that detect one or more adenomas).

The comparison was made during the first peak around the time when the AGA issued recommendations for GI endoscopy personnel. We compared the number of procedures performed, type of procedures, CIR, CIT, SWT and ADR between mid-May to mid-June (05/16-06/14) of 2019 to the same time period in 2020 (05/18-06/16). The comparison was done for outpatient, non-emergent procedures conducted at 3 endoscopy suites at St Luke’s University Health Network. The procedures included were esophago-gastro duodenoscopy (EGD), EGD with single balloon, EGD with double balloon, EGD with percutaneous endoscopic gastrostomy tube insertion, endoscopic retrograde cholangiopancreatography (ERCP), endoscopic ultrasound (EUS), screening and diagnostic colonoscopies. All inpatient and emergent procedures were excluded. Data was obtained by performing a chart review on EPIC electronic health record.

**Results:**

SPSS version 26 was used to analyze the data. There were a total of 1609 patients who underwent procedures during the period of mid-May to mid-June 2019 (Pre-COVID) and 1198
patients during the one-month period of mid-May to mid-June 2020 (COVID). The median age of patients undergoing endoscopy procedures was 59 in 2019 and 61 in 2020. 62% of the patients were males in 2019 as compared to 58% in 2020. Number and type of procedures were compared between pre COVID and COVID time. Missing values were not analyzed in the data. No Bonferroni correction was applied for multiple comparisons. P-values equal to or less than 0.05 were considered statistically significant.

There was a significant decline in the number of all procedures from a total of 1609 to 1198 in 2020 as compared with 2019 with 1024(63.7%) colonoscopies in 2019 to 637 (53.7%) (p=0.001) in 2020. (Table 1)

Further classification was done for the colonoscopies to see the difference in the screening and diagnostic colonoscopies between the two years (Table 2). The number of screening colonoscopies were almost half in 2020 compared to 2019, from 972 in pre-COVID to 648 during COVID (p= 0.005).

Independent sample t-tests were done to compare CIT and SWT between pre-COVID and COVID periods (Table 3). The mean cecal intubation time in COVID (392±107 seconds) was significantly higher than that of Pre-COVID group ((320±105), p=0.001). Similarly scope withdrawal time in COVID (830±241 seconds) was significantly higher than Pre-COVID group ((706±232), p=0.001) whereas CIR was significantly lower in COVID (96.60%) compared to Pre- COVID time ((98.20%), p=0.04) (Table 4).

Since the data for adenoma detection rates was not normally distributed, we conducted non-parametric Mann Whitney tests to compare the rates during these two periods (Table 5). It was seen that the median rate of detection during 2019 was 38.23% (12.50-66.66) and during
2020 it was 38.18% (16.66-66.00). The adenoma detection rates between these two periods were not statistically different.

**Discussion:**

The impact of the global COVID-19 pandemic permeates every facet of medicine, including endoscopic procedures. While in the beginning, patients were encouraged to forgo elective screening colonoscopies for the sake of decreasing the transmission of the virus, these procedures were slowly reintroduced over the span of a few months. Colonoscopies have been shown to play a vital role in preventing colorectal cancer (CRC). Many studies have been conducted on the matter, one of which showed that screening colonoscopies can reduce mortality of CRC in the range of 60 to 70%. CRC screening guidelines have been implemented based on multiple organizations such as the American Cancer Society (ACS) and United States Preventive Task Force (USTPF).

CRC screening during the pandemic overall decreased during the “lockdown period” in early 2020 due to a fear of exacerbating the spread. Modes of transmission have been studied which include aerosolization of the virus during the procedure as well as fecal contact spread. Studies however have shown that screening colonoscopies are both safe and efficacious when performed using proper PPE and decontamination protocols for the endoscopic room after every procedure during the pandemic. As screening and diagnostic colonoscopies became reintroduced, new protocols have been placed to ensure the safety of practitioners and patients during the pandemic. This includes the donning of PPE, which may influence the efficiency and accuracy of the test.
Modes of transmission during endoscopy have been studied which include aerosolization of the virus during the procedure as well as fecal contact spread. As screening and clinical colonoscopies became reintroduced, new protocols including the use of PPE have been placed to ensure the safety of practitioners and patients during the pandemic. The retrospective study we performed aimed to observe if there was a difference between the quality of colonoscopies prior to COVID-19 and those performed during the pandemic.

Our study demonstrated that CIT and SWT were increased while CIR was decreased between 2019 and 2020 likely due to PPE introduction. Before the pandemic, many factors have been shown to affect cecal intubation rates and cecal intubation time. CIR is an important quality measure that gastroenterologists are evaluated on. One study showed that age of patient >60, constipation, poor preparation and two person colonoscopies were all independent risk factors for elevated cecal intubation rates. 9 Another study looked at 10,000 colonoscopies done over a 2 year period and found the female gender was also an independent risk factor and that there was now difference in CIR between clinical and screening colonoscopies.10 The efficiency of the procedures may be affected due to the standard precautions taken to ensure low transmission of the virus. COVID-19 precautions include thorough cleaning of the room, donning of PPE (which includes N95 mask, gown, gloves, face shield) for all staff during the procedures, and repeating this for every colonoscopy. This time likely translates to increased procedure time. There have been few studies on this subject but one similar one showed no difference in overall procedure time (including cecal intubation rate) between pre and post COVID-19 colonoscopy standards.11 This was the opposite of our findings, however, this study had a low power (256) compared to our study which may have skewed their results. Our study demonstrated that CIR was decreased from 2019 to 2020 (p=0.04). Overall, PPE appears to have a negative impact on CIR and CIT but
continues to be necessary during the pandemic to maintain the safety of the practitioners and patients.

SWT was also prolonged during colonoscopies done during the pandemic with PPE. SWT is an important measure of the efficacy of a colonoscopy. It acts as a “second pass” to detect lesions in the colon not visible on entry. Interestingly, longer SWT are associated with an elevated polyp detection rate, particularly when the time is > 6 minutes. One study showed that a SWT of 10 minutes was shown to have a higher detection of overall polyps but no difference in detection of adenomatous polyps. Longer SWT allow for practitioners to be more diligent in the visualization of the entire colon to the end of the procedure. Our study found that colonoscopies performed during COVID-19 had prolonged SWT without improving ADR.

Another major aspect of our study focused on the comparison between ADR in colonoscopies prior to the implementation PPE to those performed after the pandemic began. ADR is distinguished from polyp detection rates (PDR) in that the former is a subset of the latter. Some studies have attempted to provide a conversion factor between PDR to ADR. ADR has been observed to be a valuable marker for cancer related mortality. One study that reviewed over 300,000 colonoscopies found that ADR was inversely related to risk of developing interval advanced stage and fatal colorectal cancer. In another prospective cohort study, increased ADR was associated with a decrease in cancer related mortality. It may have been theorized that the additional equipment used during the procedure might obscure a practitioner's ability to see additional adenomas and thus affect ADR. Surprisingly there was no difference between both groups in our results. Teh et al as discussed prior conducted a similar study which showed no difference in ADR between pre and post COVID-19 precaution colonoscopies. This is reassuring as PPE may not interfere with the clear benefits of colonoscopies.
COVID-19 has profoundly permeated every element of medicine over the past year. It has affected how hospitalists and specialists practice their specific brand of medicine. Colonoscopies are one of the procedures affected by the pandemic. It is vital in the prevention of CRC and the use of PPE minimizes transmission during the procedure. Our retrospective study conveyed there was an elevated CIR and SWT, which may affect the efficiency of the procedure. However, adenoma detection rates were similar, indicating that the use of PPE does not affect a colonoscopy’s efficacy. With the advent of COVID vaccines, these precautions may change in the near future. Nonetheless, it is an interesting view of how procedural precautions during a pandemic can evolve over time.

Conclusion

Our study showed that quality indices for screening colonoscopies like cecal intubation rate, cecal intubation time and scope withdrawal time were negatively impacted during the initial COVID time period compared to pre-COVID time. The study also displayed that though there was a significant decline in both screening and diagnostic colonoscopies during pandemic, adenoma detection rates were comparable. Thus, the efficiency of the procedures was affected by the use of PPE but it did not affect the colonoscopy’s clinical benefit.
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## Tables:

**Table 1:** A crosstab between type of gastrointestinal procedures and Pre-COVID/COVID time period

| Type of Procedure | Pre-COVID 2019 N=1609 | COVID 2020 N=1190 |
|-------------------|-----------------------|-------------------|
| Colonoscopy       | 1024 (63.6%)          | 637 (53.7%)       |
| EGD               | 503 (31.3%)           | 421 (35.4%)       |
| Other             | 82 (5.1%)             | 132 (11.1%)       |

p-value < 0.001 (Chi Square test)
Table 2: A crosstab between Diagnostic/Screening colonoscopies and Pre-COVID/COVID Time.

| Type of Colonoscopy | Pre-COVID 2019 (N=1024) | COVID 2020 (N=637) |
|---------------------|-------------------------|---------------------|
| Diagnostic          | 706 (68.9%)             | 480 (75.4%)         |
| Screening           | 318 (31.1%)             | 157 (24.6%)         |

p-value=0.005 (Chi-Square test)
Table 3: A comparison of cecal intubation times and scope withdrawal times in screening colonoscopies between Pre-COVID-19 (2019) and COVID-19 (2020) time periods.

| Quality Indices of Colonoscopy | Pre-COVID 2019 n=972 Mean/SD (sec) | COVID 2020 n=648 Mean/SD (sec) | p-value* |
|-------------------------------|-----------------------------------|--------------------------------|----------|
| Cecal Intubation Time (seconds) | 320/105                           | 392/107                         | <0.001   |
| Scope Withdrawal Time (seconds) | 706/232                           | 830/241                         | <0.001   |

*Independent Sample t-test
Table 4: A comparison of cecal intubation rates in screening colonoscopies between Pre-COVID and COVID time

| Cecal intubation Rates | Pre-COVID 2019 | COVID 2020 | P-Value* |
|------------------------|---------------|------------|----------|
| Colonoscopies with successful intubation N/Percent | 972/98.20% | 648/96.60% | 0.004 |

*Pearson chi square test
Table 5: A comparison of adenoma detection rates between the Pre-COVID-19 (2019) and COVID-19 (2020) time periods.

|               | Pre-COVID | COVID  | P-Value* |
|---------------|-----------|--------|----------|
| 2019 N=23     | Median    | Median | 0.8      |
|               | (min-max) | (min-max) |          |
| 38.23%        | 38.18 %   | 0.8    |
| (12.50-66.66) | (16.66-60.00) |        |

*Mann Whitney test
