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# Patient Perspective on Safety of Elective Gastrointestinal Endoscopy During the COVID-19 Pandemic

Vikas Taneja, MD,<sup>1</sup> Mohammed El-Dallal, MD,<sup>2,3</sup> Mohammad Bilal,<sup>2</sup> Sarah N. Flier, MD,<sup>2</sup> Sunil G. Sheth, MD,<sup>2</sup> Sarah K. Ballou, MD,<sup>2</sup> Tyler M. Berzin, MD,<sup>2</sup> Douglas K. Pleskow, MD,<sup>2</sup> Joseph D. Feuerstein, MD,<sup>2,†</sup> and Mandeep S. Sawhney, MD, MS<sup>2,†</sup>

<sup>1</sup>Section of Hospital Medicine, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts; <sup>2</sup>Division of Gastroenterology, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Massachusetts; and <sup>3</sup>Division of Hospital Medicine, Cambridge Health Alliance, Cambridge, Massachusetts

## Abstract

**BACKGROUND AND AIMS:** Patients' perception regarding the risks of COVID-19 infection with gastrointestinal (GI) and the preventive measures taken in GI endoscopy units to mitigate infection risk remains unclear. We aimed to assess patients' perception regarding risks of COVID-19 with GI endoscopy and the changes in the endoscopy unit as a result of the ongoing pandemic.

**METHODS:** Outpatients undergoing GI endoscopy at our institution were categorized into those scheduled to undergo GI endoscopy (preprocedure) and those who had recently undergone GI endoscopy during the pandemic (postprocedure). Two separate but similar survey instruments were designed. Patients were asked to respond on a 5-point Likert scale. Responses were stratified as "low," "neutral," and "high" for analysis.

**RESULTS:** A total of 150 and 355 respondents completed the preprocedure and postprocedure surveys, with a combined response rate of 82.5%. Non-white ethnicity was associated with reporting a "high" level of concern for endoscopy related COVID-19 exposure in both the preprocedure (OR 4.09, 95% CI 1.54-10.82) and postprocedure cohorts (OR 2.11, 95% CI 1.04-4.29). 42% of patients in the preprocedure cohort and 11.8% in the postprocedure cohort reported their level of concern for COVID exposure as "high." Among the postprocedure cohort, 88% of the patients were likely to undergo repeat endoscopy during the pandemic if recommended.

**CONCLUSION:** Patients are willing to undergo GI endoscopy during the COVID-19 pandemic. Non-white and older patients, and those undergoing screening examinations were more concerned with the GI endoscopy related COVID-19 transmission risk.

**Keywords:** Endoscopy; COVID-19; Patient satisfaction; Gastrointestinal endoscopy; Patient perspective.

## Introduction

The coronavirus disease (COVID-19) pandemic has caused significant changes in medical practices worldwide. On March 18, 2020, the Centers for Medicare and Medicaid (CMS) announced that all elective procedures should be deferred to reduce the spread of infection.<sup>1</sup> Following that, all major gastroenterological organizations in the United States and experts also suggested that elective gastrointestinal (GI) endoscopy procedures be deferred.<sup>2-5</sup> This led to a significant reduction in GI endoscopy services throughout the country.<sup>6</sup> However, as COVID-19 cases reduced, several GI endoscopy units resumed services.

Nevertheless, to meet the challenges presented by the COVID-19 pandemic, numerous operational changes have been implemented in GI endoscopy units.

A central goal for GI endoscopy units has been to introduce measures to mitigate the spread of infection while continuing to provide high-quality care to patients needing GI endoscopy. Moreover, upper GI endoscopic procedures have been considered aerosol generating so there may be additional risk to the involved staff during the procedure itself.<sup>7</sup> These risks must be balanced against the reality that GI endoscopic procedures can be critical and sometimes lifesaving for certain patients, for

Abbreviations: COVID-19, Coronavirus Disease 2019; GI, gastrointestinal; IQR, interquartile range; PPE, personal protective equipment

† Contributed equally.

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## What You Need to Know

### Background

Elective gastrointestinal endoscopy procedures have now been resumed across the country, however the patients' perception of the risk of COVID-19 exposure from these procedures remains unclear.

### Findings

A majority of patients consider elective gastrointestinal endoscopy a low-risk procedure for potential COVID-19 exposure. Most of the patients agree with the importance of preventive measures and are willing to follow the changes in the gastrointestinal endoscopy unit workflow that have resulted due to the ongoing pandemic. Patients who are older, non-White and those who are undergoing the procedure for screening are more likely to be more concerned with the risk of exposure.

### Implications for patient care

Patients undergoing gastrointestinal endoscopy require continued counseling regarding the low transmission of COVID-19 during GI endoscopy, the importance of preprocedure testing and the preventive measures instituted by GI endoscopy units (appropriate use of PPE and waiting in the car instead of the waiting room). The inconvenience resulting from the preventive measures does not impact patient satisfaction.

instance those with GI bleeding, acute exacerbations of inflammatory bowel disease, or patients being evaluated for GI cancers.

Multiple gastroenterology societies have released guidelines regarding the reopening of GI endoscopy and clinics.<sup>8-10</sup> Accordingly, different measures have been adopted by local institutions to provide a safe environment while continuing care for patients. However, there is limited knowledge regarding how the patients' perception to changes in GI endoscopy units and workflow in response to the COVID-19 pandemic.

In this study, we aimed to evaluate the patients' perception regarding changes to the GI endoscopy workflow in response to the COVID-19 pandemic. We also assessed patients' perception in regard to the risk of COVID-19 infection during GI endoscopy.

## Methods

### Study Population

Two patient cohorts were identified for this prospective study of patients undergoing outpatient GI endoscopy at Beth Israel Deaconess Medical Center, Boston, MA. These cohorts included patients who were scheduled for GI endoscopic procedures in the near future

(preprocedure group) and patients who had already undergone GI endoscopic procedures (postprocedure group). The preprocedure cohort comprised of patients who were scheduled to undergo any GI endoscopy procedure from August 1st 2020 to November 30th 2020, while the postprocedure cohort comprised of patients who underwent a GI endoscopic procedure from June 15th to July 15th, 2020. Participants were excluded if they refused to participate in the study. Non-English speaking patients filled the survey with the help of an interpreter or family member who spoke English when available.

### Survey Instruments and Outcomes

Two separate survey instruments (preprocedure and postprocedure questionnaires) were designed for each of the cohorts iteratively by authors MS, MB, JF, SB, TB, and SF. Standard formatted 5-point Likert scoring questionnaires were used to assess survey items. The outcomes of interest were (i) the level of concern for COVID-19 exposure (referred to as level of concern for the purpose of this manuscript) before and after undergoing GI endoscopy, and its association with clinical and sociodemographic factors, (ii) evaluation of patients' perception of the various measures taken to reduce potential COVID-19 exposure during GI endoscopy, and (iii) the patient satisfaction and the willingness to undergo another GI endoscopic procedure during the pandemic. Likert scales were organized for questions assessing the level of concern and the importance of measures, with responses 1 and 2 representing "low" value, response 3 being "Neutral" and responses 4 and 5 representing "high" value. Since the primary outcome of the study was to ascertain patients' concern for COVID-19 exposure associated with endoscopy, both the questionnaires consisted of the same question (and response options) to assess the level of concern. It was decided a priori to combine the data for this question for analyzing the level of concern and associated predictors. Furthermore, both the cohorts were interviewed in the same time frame to limit any effect of change in perception with time.

### Data Collection

From 15th June 2020 to 15th July 2020, patients in the preprocedure cohort were contacted by phone with a questionnaire consisting of 15 questions (preprocedure questionnaire) [appendix]. During the same time period (15th June 2020 to 15th July 2020), patients in the postprocedure cohort were invited to fill the postprocedure questionnaire [appendix] after they had fully recovered from GI endoscopic procedure and met standard discharge criteria. Information regarding patient demographics and procedural details was also collected.

### Perception Toward the Preventive Measures

Patient perspectives toward the measures instituted to mitigate the risk of COVID-19 transmission during endoscopy were assessed across 2 domains: (a) patients'

perceived importance of the various preventive measures and, (b) patients' willingness to follow them. On a 5-point Likert scale, with 1 being "not important at all" to 5 being "Extremely important," the respondents were asked about the level of importance of the following measures: (i) endoscopy staff wearing personal protective equipment (PPE) all the time, (ii) preprocedure testing for all patients, (iii) waiting in the car instead of in the waiting room, (iv) having companion(s) wait in the car instead of in the waiting room for the duration of the procedure, and (v) having a waiting room with seating at least 6 feet apart. Patients were also asked about the measures, among the above mentioned, that they deemed as absolutely essential in order to schedule the procedure. Similarly, the respondents were asked about their willingness to wait in the car instead of in the waiting room and, to have the companion(s) wait in the car instead of in the waiting room for the duration of the procedure. We also assessed patients' favorability toward undergoing preprocedure testing and to consent verbally instead of using a pen and paper.

### Statistical Analysis

Descriptive analyses were conducted to describe both the patient samples with respect to demographics, and the type and indication of procedures. Frequencies and percentages were reported for categorical outcomes and medians, and interquartile ranges (IQR) were reported for continuous outcomes. Wilcoxon signed-rank test was conducted to compare the level of concern related to endoscopy with other settings such as visiting a supermarket and a physician's office. Mann-Whitney *U* test was used to compare the level of concern and the perceived importance of preventive measures among the pre and postprocedure cohorts. Multivariable analysis was performed using ordinal logistic regression. The outcome variable analyzed was the questionnaire item assessing patients' level of concern. The independent variables included age, gender, race-ethnicity, level of education (categorized as "High school or less" and "College or higher") and indication ("Screening" or "symptom-based"). In order to increase sample size for a regression model, we a priori decided to combine data from the pre- and postprocedure cohorts for those questions that were identical in the 2 survey instruments. All preprocedure patients were included in the analysis, regardless of cancellation or rescheduling. Limited data on patient perception of the safety of endoscopy during the pandemic precluded sample size calculation, instead we specified time period over which survey would be conducted. Significance for all statistical methods was defined as  $P < 0.05$ . All analyses were performed using the statistical software SAS, version 9.4 (SAS Institute Inc, Cary, NC). This study was reviewed by the Institutional Review Board at Beth Israel Deaconess Medical center, Boston, MA and deemed to be exempt.

## Results

### Patient Characteristics

A total of 612 patients were invited to participate in the survey and 505 (150 preprocedure and 355 postprocedure) of those patients agreed to participate with a response rate of 82.5%. The details of nonrespondents are provided in the supplement. The baseline characteristics of the 2 cohorts are described in Table 1. The median age in the preprocedure cohort was 66.5 years (IQR 57-73 years) and for the postprocedure cohort was 59 years (IQR 48-68 years), respectively. Both the cohorts had similar gender distribution (50.7% and 52.7% females) and a majority of the patients were Caucasian (82% and 84.1%) and had college-level education (74% and 79.7%).

### Level of Concern for Endoscopy Related COVID-19 Exposure

In the preprocedure cohort, 41.3% of the patients reported their Level of concern for endoscopy related COVID-19 exposure as "low," 16.6% of the patients rated this as "neutral" and 42% of the patients reported this as "high" (Figure 1.a)

In the postprocedure cohort, 79.1% of the patients reported their level of concern as "low," 9.7% of the patients reported this as "neutral" and 11.2% of the patients reported this as "high."

Overall, across both cohorts, 67.7% of respondents reported their level of concern for potential COVID-19 exposure during GI endoscopy as "low," 11.8% as neutral and 20.4% reported this as "high." In comparison, a significantly higher proportion of patients rated the level of concern on visiting the supermarket (30.8%,  $P < 0.01$ ) and visiting a doctors' office (22.7%,  $P = 0.01$ ) as "high."

As compared to the preprocedure cohort, patients in the postprocedure cohort appeared less concerned with infection risk as the number of patients reporting a "low" level of concern was higher ( $37.7\% \pm 4.57\%$ ,  $P < 0.01$ ) and the number of patients reporting a "high" level of concern was lower ( $30.8\% \pm 4.35\%$ ,  $P < 0.01$ ) (Figure 1.b).

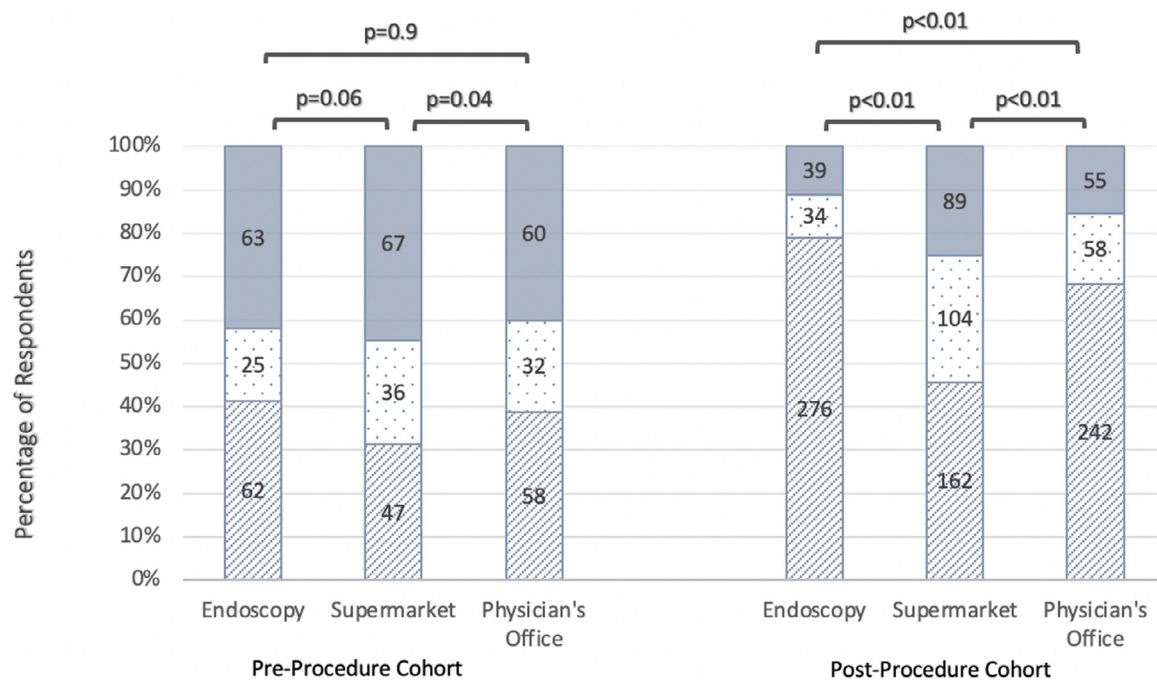
### Perception Toward the Preventive Changes Being Instituted in the Endoscopy Practice

Patients' perception toward the importance and willingness to follow the preventive measures such as i) preprocedure COVID-19 testing of all patients, ii) routine COVID-19 testing of all staff, iii) staff to wear PPE at all times, iv) waiting in the car instead of in the waiting room prior to the procedure, and v) having companion(s) wait in the car for the duration of the procedure is reported in Figures 2 and 3.

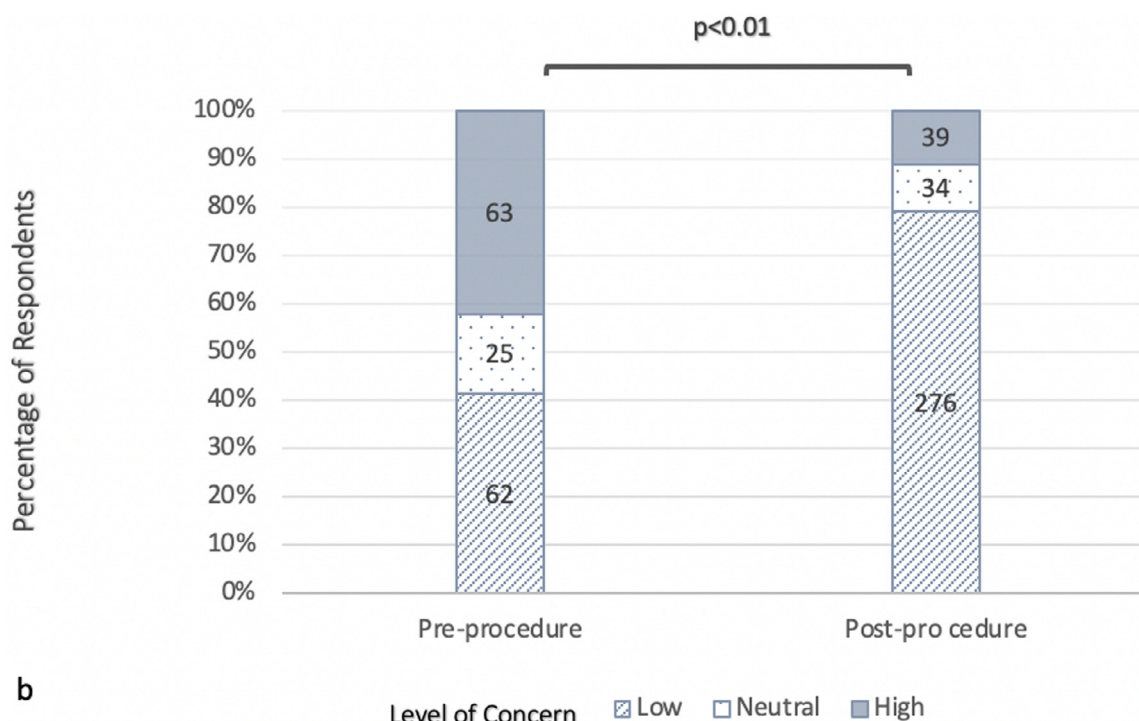
Among the preprocedure cohort, the measures rated as absolutely essential were "endoscopy staff to wear PPE at all times" by 79.3%, "waiting room with seating at least 6 feet apart" by 52% and "testing all patients and endoscopy staff" by 26% of the patients.

**Table 1.** Baseline Characteristics of the Study Population (\*Reported as Median, IQR, Interquartile Range. <sup>a</sup>Includes Pouchoscopy, Single Balloon Enteroscopy, Sigmoidoscopy, Radio Frequency Ablation, Cryoablation. <sup>b</sup>Includes GI Bleed, Peptic Ulcer Disease, Malignancy)

| Variable                                      | Preprocedure cohort N = 150 (%) | Postprocedure cohort N = 355 (%) |
|-----------------------------------------------|---------------------------------|----------------------------------|
| Age* (IQR)                                    | 66.5y (57y-73y)                 | 59 y (48y-68y)                   |
| Sex                                           |                                 |                                  |
| Male                                          | 74 (49.3)                       | 168 (47.3)                       |
| Female                                        | 76 (50.7)                       | 187 (52.7)                       |
| Race                                          |                                 |                                  |
| White                                         | 116 (82)                        | 276 (84.1)                       |
| Non-White                                     | 25 (17)                         | 52 (15.9)                        |
| Education level                               |                                 |                                  |
| High School or less                           | 23 (17)                         | 63 (20.3)                        |
| College or more                               | 111 (74)                        | 248 (79.7)                       |
| Procedure                                     |                                 |                                  |
| Colo                                          | 88 (58.6)                       | 143 (40.3)                       |
| EGD                                           | 22 (14.7)                       | 134 (37.7)                       |
| EUS                                           | 12 (8.0)                        | 18 (5.1)                         |
| Other <sup>a</sup>                            | 28 (18.6)                       | 60 (16.9)                        |
| COVID positive                                | 2 (1)                           | -                                |
| COVID diagnosis among family or close friends | 8 (5.3)                         | -                                |
| Comorbidities* (IQR)                          | 1 (0-2)                         | -                                |
| Indication                                    |                                 |                                  |
| Screening                                     | 46 (31)                         | 49 (13.8)                        |
| IBD                                           | 24 (16)                         | 17 (4.8)                         |
| Polyp or Dysplasia                            | 44 (29)                         | 91 (25.6)                        |
| Other <sup>b</sup>                            | 36 (24)                         | 198 (55.8)                       |



**Figure 1.a.** Patients' level of concern for COVID transmission from visiting a supermarket, a physician's office and from endoscopy.



**Figure 1.b.** Comparison of level of concern among the preprocedure and postprocedure cohorts. (Assessed on a 5-point Likert scale, with 1 being extremely low and 5 being extremely high. Values of 1 or 2 were assigned low level of concern, a value of 3 was assigned neutral level of concern and values of 4 or 5 were assigned “high” level of concern.)

### Preprocedure Testing for COVID-19

Among the preprocedure cohort, while 75.3% of the patients rated preprocedure COVID-19 screening as important, 52% of the patients responded “no” when asked if they should undergo preprocedure testing for COVID-19 if they were asymptomatic. Upon assessing the association of burden of preprocedure screening for COVID-19 and the willingness to undergo the screening, 34% of the respondents who did not agree with preprocedure testing for COVID-19 reported the associated Level of inconvenience as “high” (4 or 5 on the scale) as compared to 11% of those who agreed with the testing indicating that the burden of testing was associated with the willingness to undergo preprocedure testing ( $P < 0.01$ ). 60% of the respondents favored consenting verbally instead of using “pen and paper.”

### Associated Clinicodemographic Characteristics

Among the preprocedure cohort, non-White ethnicity (OR 3.7, 95% CI 1.3-10.3) and screening-based indication as compared to symptom-based indication (OR 2.3, 95% CI 1.05-5.1) were associated with reporting a “high” level of concern on univariate analysis (Table 2). In the final ordinal regression model (Table 3), non-White ethnicity remained significantly associated with expressing a “high” level of concern (OR 4.1, 95% CI 1.5-10.8).

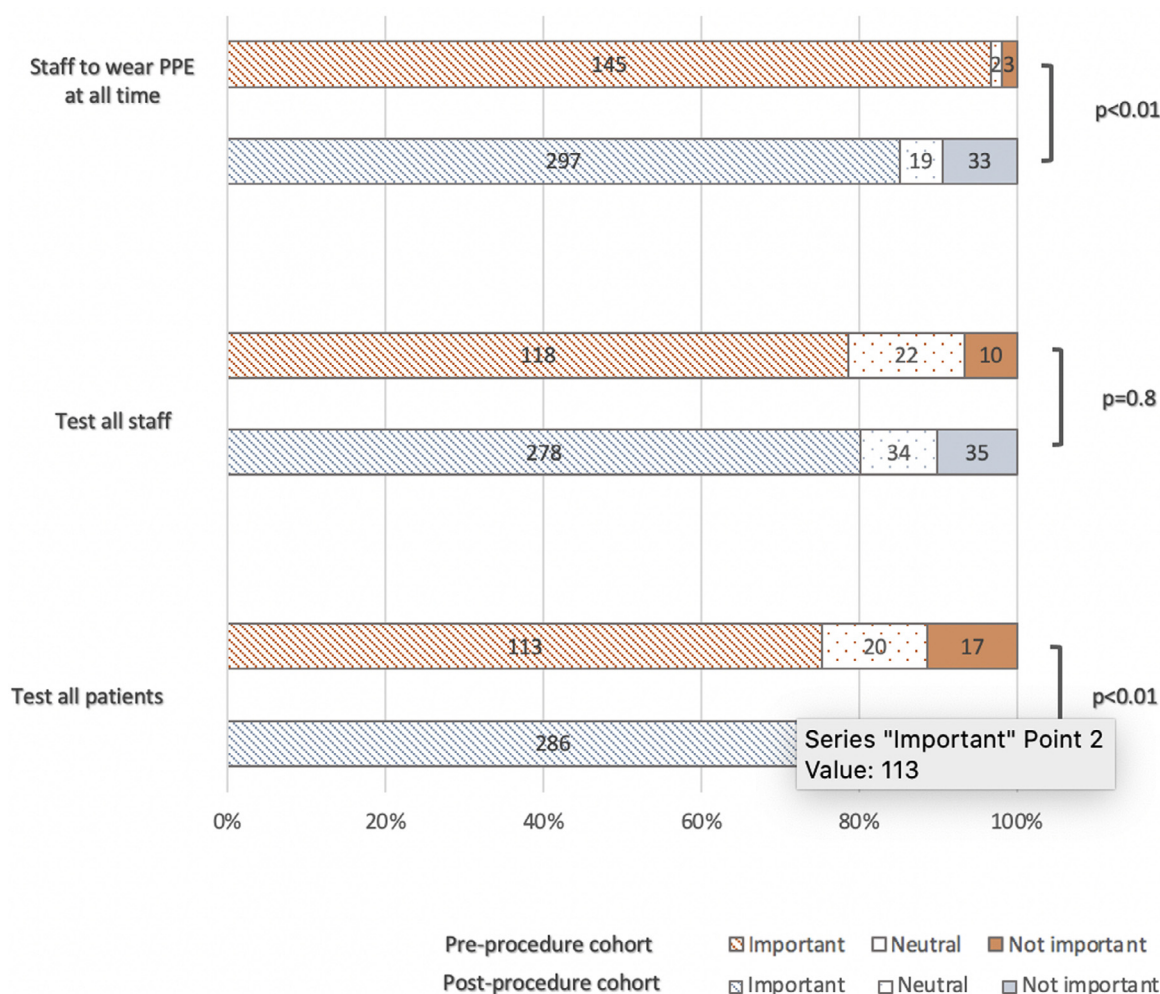
Among the postprocedure cohort, non-White ethnicity as compared to white ethnicity (OR 2.3, 95% CI 1.02-5.5) was significantly associated with expressing a “high” level

of concern on univariate analysis (Table 2). Non-White ethnicity also remained significantly associated with “high” level of concern in the adjusted model (OR 2.1, 95% CI 1.04-4.3) (Table 3).

On pooled analysis of the combined cohorts, higher age (OR 1.02, 95% CI 1.01- 1.04), non-White ethnicity (OR 2.7, 95% CI 1.6-4.8) and screening-based indication as compared to symptom-based indication (OR 2.4, 95% CI 1.4-4.0) were associated with reporting a “high” level of concern in the univariate model (Table 3). A similar pattern was noted in the final ordinal regression model, wherein higher age (OR 1.02, 95% CI 1.01- 1.04), non-White ethnicity (OR 2.5, 95% CI 1.5-4.3) and screening-based indication as compared to symptom-based indication (OR 1.7, 95% CI 1.1-2.9) were associated with reporting a “high” level of concern after adjusting for other variables.

### Patient Experience and Perception Regarding Changes in GI Endoscopy Unit Due to COVID-19 Pandemic

Patient experience was assessed in the postprocedure cohort and was noted to be overall positive. 98% of the participants had a favorable view of the measures taken to minimize COVID-19 exposure, with 92% and 6% reporting these as excellent and as good, respectively. 1% of the respondents each reported the measures as fair or poor. Similarly, satisfaction with the visit was reported as excellent or good by 99% and poor by 1% of the participants respectively. 88% of the respondents indicated that



**Figure 2.** Patients' self-reported level of importance toward various preventive measures before and after the procedure on a Likert scale of 1-5, with 1 being not important at all and 5 being extremely important (numbers in bars represent number of respondents). Values of 1 or 2 were assigned "low" level of concern, a value of 3 was assigned neutral level and values of 4 or 5 were assigned "high" level of concern. Bars in brown represent preprocedure cohort and bars in gray represent postprocedure cohort. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

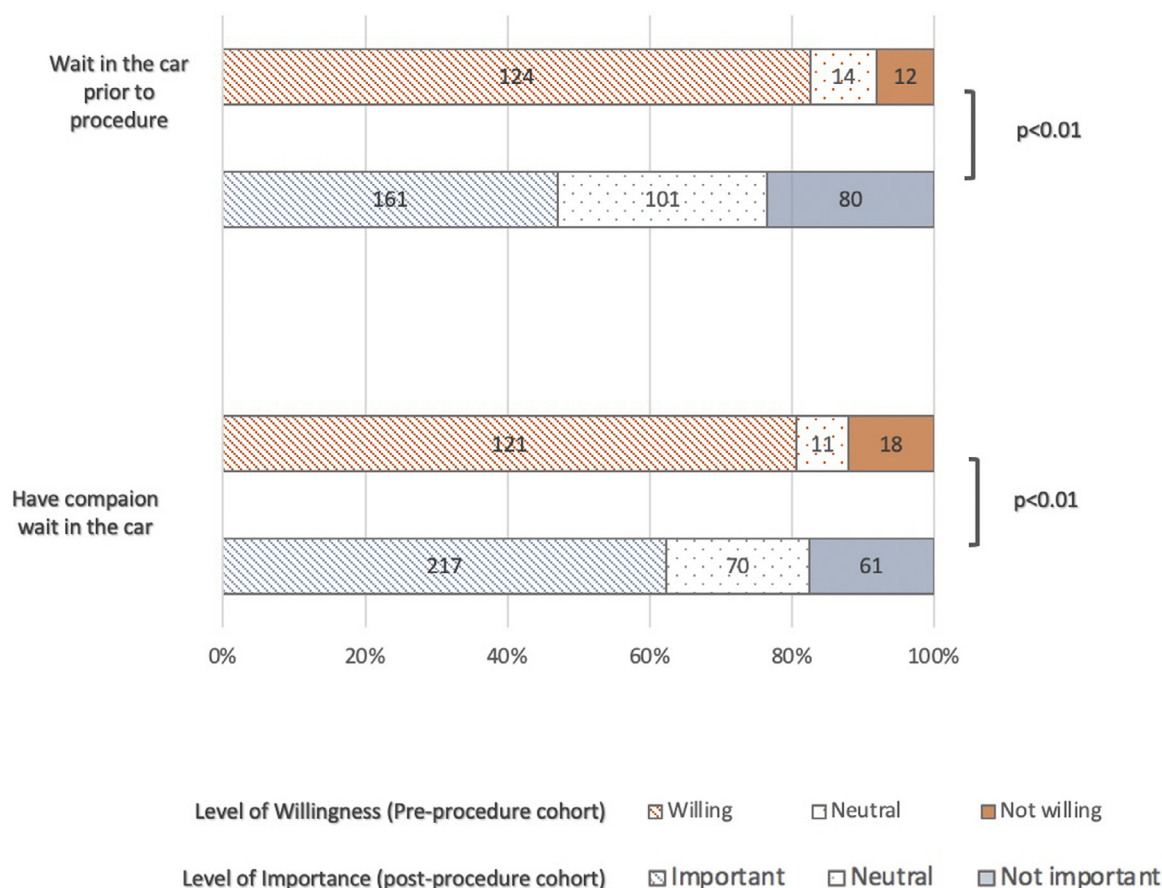
they were either extremely likely (72%) or likely (16%) to undergo another procedure during the COVID-19 pandemic if recommended, with 5% reporting extremely unlikely (3%) or unlikely (2%) to this survey item.

## Discussion

In this study, we found that a majority of patients reported their level of concern for acquiring COVID-19 during routine GI endoscopy as low, with a comparable risk perception as visiting a doctor's office or going to the supermarket. As compared to the preprocedure cohort, the patients' self-reported concern for endoscopy related COVID-19 exposure was significantly lower in the postprocedure cohort. Furthermore, our study identified non-White ethnicity along with higher age and screening indication (as compared to symptom-based indication) as factors associated with a perception of higher risk of endoscopy related COVID-19 exposure. This cohort of

patients might benefit from additional education, particularly in light of evidence that COVID-19 transmission is very rare during endoscopy.<sup>11</sup> Among the preventive measures, while preprocedure COVID-19 screening was considered important by a majority of the patients, about half the respondents did not favor undergoing screening themselves if they were asymptomatic, partly due to the associated inconvenience. The overall patient satisfaction with the endoscopy experience was high and a majority of the patients were willing to undergo a GI procedure again if recommended during the pandemic.

Our study finding of a reduction in the patients' perceived endoscopy related COVID-19 exposure risk after undergoing the procedure is noteworthy given that our preprocedure cohort's risk perception was similar to an earlier study.<sup>12</sup> The postprocedure improvement in the safety perception of endoscopy is also supported by the patients' high overall favorability of the preventive measures noted in this cohort. Interestingly, a majority of



**Figure 3.** Comparison between patient's willingness to follow preventive measures and their self-reported importance of these measures. The bars in brown represent the number of patients that were willing to follow the above-mentioned preventive measures among the preprocedure cohort. The bars in gray represent the number of patients' self-reported importance of the above-mentioned measures among the postprocedure cohort. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

patients had a relatively lower concern of COVID-19 transmission in the GI endoscopy unit compared to going to the clinic or the supermarket. It is likely that some of this is due to the controlled environment in the GI endoscopy unit, which could explain the patients' willingness to follow the preventive measures even if some of those were not convenient or important to the patients.

A significant majority of the patients were willing to follow the preventive measures such as waiting in the car prior to the procedure and having their companion(s) wait in the car for the duration of the procedure. While 80% of all respondents agreed that screening all patients for COVID-19 was important, only 48% favored undergoing the screening themselves if asymptomatic. This relatively lower favorability toward preprocedure screening

**Table 2.** Univariate Odds Ratio of Clinical and Sociodemographic Factors Associated With Expressing a "High" Level of Concern for Endoscopy Related COVID Transmission (Upper Endoscopy Procedures Included EGD, EUS, and ERCP, Lower Endoscopy Procedures Included Colonoscopy, Pouchoscopy, Sigmoidoscopy)

| Characteristics            | Preprocedure cohort |            | Postprocedure cohort |           |
|----------------------------|---------------------|------------|----------------------|-----------|
|                            | Estimate            | 95% CI     | Estimate             | 95% CI    |
| Upper vs lower             | 1.11                | 0.46-2.66  | 1.28                 | 0.63-2.59 |
| College vs no-college      | 0.88                | 0.31-2.44  | 0.68                 | 0.29-1.69 |
| Males vs females           | 0.51                | 0.25-1.03  | 0.72                 | 0.36-1.41 |
| Age                        | 1.01                | 0.98-1.03  | 1.01                 | 0.99-1.03 |
| Non-White vs White         | 3.79                | 1.38-10.38 | 2.38                 | 1.02-5.54 |
| Screening vs symptom based | 2.32                | 1.05-5.14  | 1.17                 | 0.46-2.99 |
| Comorbidities              | 1.146               | 0.89-1.46  | -                    | -         |

**Table 3.** Multivariate Odds Ratios for Characteristics Associated With Self-Reported "High" Level of Concern for Endoscopy Related COVID Transmission for Preprocedure, Postprocedure, and Combined Cohorts (Ordinal Regression Model Adjusted for Age, Gender, Race-Ethnicity, Level of Education, and Indication Category)

| Characteristics            | Preprocedure cohort |            | Postprocedure cohort |           | Combined cohort |           |
|----------------------------|---------------------|------------|----------------------|-----------|-----------------|-----------|
|                            | Estimate            | 95% CI     | Estimate             | 95% CI    | Estimate        | 0.59-1.69 |
| College vs no-college      | 0.86                | 0.34-2.13  | 1.15                 | 0.57-2.3  | 1.01            | 0.47-1.06 |
| Males vs females           | 0.69                | 0.35-1.35  | 0.71                 | 0.40-1.26 | 0.70            | 1.01-1.04 |
| Age                        | 1.02                | 0.99-1.05  | 1.00                 | 0.98-1.02 | 1.02            | 1.49-4.27 |
| Non-White vs White         | 4.09                | 1.54-10.82 | 2.11                 | 1.04-4.29 | 2.52            | 1.09-2.90 |
| Screening vs symptom based | 1.75                | 0.84-3.66  | 0.96                 | 0.43-2.15 | 1.78            | 0.59-1.69 |

was partly due to the burden of testing, but about 66% of the respondents who were not willing to undergo the testing rated the testing burden as "low" suggesting other barriers. Furthermore, a few participants deemed measures such as themselves and companion(s) waiting in the car as unimportant suggesting that there is continued need for patient education regarding the importance of mitigating measures.

The finding of higher concern with increasing age and in patients undergoing screening procedures is also noteworthy. Postponement of scheduled procedures due to a perceived COVID-19 exposure risk among this group of patients might lead to a subsequent increase in the volume of GI endoscopic procedures as the pandemic settles. An estimated 45% of the colonoscopies are performed for screening<sup>13</sup> and this downstream increase in volume could potentially have implications for wait times even after accounting for the planned catch-up interventions,<sup>14</sup> as recently reported in a simulation-based analysis of elective surgeries.<sup>15</sup> There is emerging evidence of colorectal cancers being detected at a later stage during the pandemic due to delay in seeking care<sup>16</sup> and, addressing the COVID-19 exposure concern with patients that might consider screening procedures as being low priority would remain critical for the duration of the pandemic. The relatively higher concern among non-Whites in our study is disconcerting and is consistent with prior evidence on racial and ethnic disparities in seeking healthcare before<sup>17</sup> and during the pandemic.<sup>18</sup> In the postprocedure survey, a majority of the patients rated the preventive measures as good or excellent and reported a high level of satisfaction despite the inconvenience associated with those measures. It was also reassuring to find that a significant majority were likely to undergo another GI endoscopic procedure during the pandemic if needed.

A major strength of our study is the inclusion of distinct preprocedure and postprocedure cohorts to compare patient perspectives on the overall safety of endoscopy and the specific preventive measures before and after undergoing the procedure. As patients continue to weigh the short-term risk of potential COVID-19 exposure during the procedure vs the long-term consequences of delaying the procedure, our study underscores the significance

of shared decision making. One of the limitations of using surveys for healthcare research is its limited appropriateness in a low literacy audience.<sup>19</sup> Our study population had a fairly high level of literacy, and thus the likelihood of inadvertent erroneous responses resulting from misunderstanding of survey questions remains low.

Our study has some limitations warranting further discussion. First, while each survey question was analyzed separately for both the cohorts, we combined data from the 2 surveys to improve precision of our regression model used to determine factors associated with elevated risk of concern for endoscopy related COVID-19 infection. While this may have introduced heterogeneity into the model, it is unlikely to have biased our results as data was only combined for those questions that were similar on both surveys. Furthermore, the level of concern for endoscopy related COVID-19 exposure was consistently associated with similar clinicodemographic factors (age, race-ethnicity, and procedure indication) in preprocedure and postprocedure cohorts and the final regression model. Second, our study was conducted during a time of lower incidence of COVID-19 cases in Massachusetts, and patient perceptions may change with changing incidence. During the time period of our study, the daily new COVID-19 cases in the state of Massachusetts during that time frame remained steady and ranged from 3.2 per 100,000 to 4.2 per 100,000.<sup>20</sup> With the initiation of vaccination, we predict a return to a lower incidence of COVID-19 infections, making our findings applicable long term. However, the cross-sectional nature of our study did not allow as to ascertain any change in the patients' attitudes during the evolution of the pandemic. In addition, we did not collect data on procedure cancellations or deferrals due to an expressed concern for COVID-19 exposure. The collection of such data was not prioritized since an association between patients' level of concern for COVID-19 and avoidance of medical care has been previously reported.<sup>21</sup> Finally, due to the relatively low number of patients in the non-White race-ethnicity, we were unable to stratify our analysis by individual race/ethnicities.

In conclusion, our study demonstrates that patients are willing to undergo GI endoscopy during the COVID-19 pandemic. Patients' perceived concern regarding

potential exposure to COVID-19 during GI endoscopy is lower than at the supermarket or at a physicians' office. Among both the cohorts, this concern is significantly lower in the postprocedure cohort as compared to the preprocedure cohort. Older, non-White patients and those that are undergoing screening procedures are more concerned with the endoscopy related COVID-19 transmission risk and might benefit from continued educational efforts. While COVID-19 pandemic has forced the GI endoscopy suites to make several changes to the workflow, patient satisfaction with the endoscopy experience remains high.

## Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.tige.2021.05.001.

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## Correspondence

Address correspondence to: Mandeep S. Sawhney, Division of Gastroenterology, Beth Israel Deaconess Medical Center, Harvard Medical School, 330 Brookline Avenue, Rabb-Rose 101, Boston, Massachusetts 02215. e-mail: [msawhney@bidmc.harvard.edu](mailto:msawhney@bidmc.harvard.edu)

**Authors' Contributions**

Study concept and design: Mohammad Bilal, Sarah N. Flier, Sunil G. Sheth, Sarah K. Ballou, Tyler M. Berzin, Douglas K. Pleskow, Joseph D. Feuerstein, Mandeep S. Sawhney.

Analysis and interpretation of the data: Vikas Taneja, Mohammed El-Dallal, Mohammad Bilal, Joseph D. Feuerstein, Mandeep S. Sawhney.

Drafting of the manuscript: Vikas Taneja, Mohammed El-Dallal, Mohammad Bilal.

Critical revision of the manuscript for important intellectual content: Mohammad Bilal, Joseph D. Feuerstein, Mandeep S. Sawhney.

Study supervision: Joseph D. Feuerstein, Mandeep S. Sawhney.

Each author has approved the final draft of this manuscript.

**Conflicts of Interest**

Tyler Berzin: Consultant for Boston Scientific, Medtronic and Fuji.

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