

Original Article

The Effect of Covid-19 Pandemic on Current and Future Endoscopic Personal Protective Equipment Practices: A National Survey of 77 Endoscopists

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Abstract

Introduction: The COVID-19 pandemic has raised awareness about the importance of personal protective equipment (PPE). We aimed to study and compare PPE practices among Canadian endoscopists before and after the COVID-19 pandemic.

Methods: A 74-item questionnaire was emailed from June 2020 to September 2020 to practicing endoscopists in Canada. Survey questions collected basic demographics and differences between PPE practices pre- and post-COVID-19. PPE practices were categorized into four endoscopic procedure types including upper or lower endoscopy and diagnostic or interventional. Outcomes for specific procedures were reported as rates, with ranges shown when evaluating all procedure types together.

Results: A total of 77 respondents completed the survey with the majority of respondents aged 40 to 49 (44%) and identifying as Gastroenterologists (70%). Gender was evenly split (49% females versus 51% males). In the pre-pandemic era, the majority of endoscopists wore gowns (91 to 94%) and all endoscopists wore gloves (100%). However, the majority of endoscopists did not wear surgical masks (21 to 31%), face shields (13 to 34%), eye protection (13 to 21%), hair protection (11 to 13%), or N95 respirators (2 to 3%). In the post-pandemic era, more surgeons plan on wearing face shields (33 to 47%, $P = 0.001$ to 0.045), goggles (38.5 to 58.7%, $P < 0.001$), hair protection (33 to 36%, $P = 0.011$ to 0.024), and a trend suggests more surgeons will wear surgical masks (51 to 61%, $P = 0.163$ to 0.333). More endoscopists also plan on wearing N95 respirators during lower endoscopy (6 to 7%, $P < 0.005$).

Conclusion: The COVID-19 pandemic has changed the attitudes of many endoscopists regarding future PPE use in routine endoscopy. Ongoing studies are needed to inform new post-pandemic PPE consensus guidelines.

Introduction

Gastrointestinal endoscopy is frequently used for both diagnostic investigation and therapeutic interventions. The

use of endoscopy can expose endoscopists and other health care workers to bodily fluids, which may lead to spread of infectious pathogens (1,2). Therefore, workplace safety

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guidelines and institutional protocols for use of personal protective equipment (PPE) within endoscopy suites are established to prevent the transmission of pathogens (3). However, previous studies have demonstrated variable and suboptimal compliance to PPE use in health care workers due to several barriers, including cost, access, education, and tolerability (4,5).

With the rise of the 2019 SARS-CoV-2 pandemic (COVID-19), institutional protocols have been reinforced and PPE practices scrutinized. Many institutions and associations have provided updated endoscopic PPE guidelines to protect health care providers and patients from harmful biohazards and prevent the transmission of COVID-19 (6–9). Given the increased awareness and updated guidelines since COVID-19, our group was interested in studying the effect of the pandemic on the PPE practices of Canadian endoscopists.

We aimed to survey endoscopists across Canada to analyze their use of PPE before the COVID-19 pandemic, and compare it to their intended use after the pandemic ends. We hypothesized that the COVID-19 pandemic would increase awareness of PPE importance and increase the overall PPE use in endoscopists post-COVID-19. We hope to use the results from this study to provide a framework for post-pandemic changes in PPE guidelines.

METHODS

This is a voluntary response, 74-item electronic survey designed following The American Association for Public Opinion Research (AAPOR) Survey Disclosure Guidelines. The survey was conducted with supporting sponsorship from the Canadian Association of Gastroenterologists (CAG) and Canadian Association of General Surgeons (CAGS), and distributed via email from June 2020 to September 2020 to all association members. The CAG has approximately 550 practicing members, and the CAGS has approximately 870 practicing members. Two additional reminders were sent out at monthly intervals through the society newsletters. The survey sample was used as a surrogate for Canadian specialists performing endoscopy. The study protocol was reviewed and approved by the University of Alberta Research Ethics Board (REB: Pro00101565).

Survey development occurred through local multidisciplinary meetings involving three gastroenterologists and one general surgeon; only questions with consensus for inclusion were included in the final survey. The survey was developed to evaluate all types of PPE use including gloves, gowns, masks, N95 respirators, face shields, and hair protection during diagnostic and therapeutic upper and lower endoscopy. Study data were collected and managed using REDCap electronic data capture tools hosted at the University of Alberta (10,11). REDCap (Research Electronic Data Capture) is a secure, web-based software platform designed

to support data capture for research studies, providing (1) an intuitive interface for validated data capture; (2) audit trails for tracking data manipulation and export procedures; (3) automated export procedures for seamless data downloads to common statistical packages; and (4) procedures for data integration and interoperability with external sources.

The questionnaire collected the basic demographics of endoscopists, as well as study outcomes including the use of various PPE items before the COVID-19 pandemic, and the intended use after the COVID-19 pandemic ends. PPE practices were categorized into four endoscopic procedure types: diagnostic upper gastrointestinal (UGI) endoscopy, therapeutic UGI endoscopy, diagnostic lower gastrointestinal (LGI) endoscopy, and therapeutic LGI endoscopy. A list of all questions included in the survey can be found in [Supplementary Appendix 1](#).

Study data were exported from REDCap to STATA 17 (StataCorp, College Station, TX, USA) for statistical analysis. Categorical data were expressed as absolute counts with percentages and no continuous data was presented. Normality testing was performed with the D'Agostino-Pearson normality test to determine the need for nonparametric testing, which was utilized for all subsequent analyses. Bivariate comparisons between groups were carried out using the nonparametric Fisher's exact test to compare PPE use pre-COVID to intended use post-COVID. Statistical significance was set at an alpha of 0.05.

RESULTS

Basic Demographics

A total of 77 participants responded to the survey out of an estimated 1420 recipients (5.4%). Only 66 respondents (85.7%) completed the entire survey. Of the 66 respondents, 15 (22.7%) were between the ages 30 and 39, 28 (42.4%) were age 40 to 49, 10 (15.2%) were age 50 to 59, and 13 (19.7%) were age 60 or greater. There were 35 (53.0%) male and 31 (47.0%) female respondents. There were 20 (30.3%) respondents who practiced in Ontario, 16 (24.2%) in Alberta, 7 (10.6%) in British Columbia, 6 (9.1%) in Manitoba, 5 (7.6%) in Newfoundland and Labrador, 4 (6.1%) in New Brunswick, 3 (4.5%) in Quebec, 3 (4.5%) among the territories, 2 (3.0%) in Saskatchewan, 1 (1.5%) in Nova Scotia, and 1 (1.5%) who preferred not to disclose.

The majority were trained as gastroenterologists (47; 71.2%). Other specialties included 14 (21.2%) in general surgery, 2 (3.0%) in family medicine, 1 (1.5%) in paediatric gastroenterology, 1 (1.5%) in nursing, and 1 (1.5%) who preferred not to disclose. Three respondents (4.5%) were practicing for less than 5 years, 17 (25.8%) were practicing for 5 to 9 years, 15 (22.7%) were practicing for 10 to 14 years, 7 (10.6%) were practicing for 15 to 19 years, 9 (13.6%) were practicing for 20 to 24 years, 14 (21.2%) were practicing for 25 years or more, and 1 (1.5%)

preferred not to disclose. With regards to volume of endoscopic procedures, 6 (9.1%) reported performing less than 10 scopes per week, 23 (34.8%) performed 10 to 19 scopes per week, 24 (36.4%) performed 20 to 29 scopes per week, 6 (9.1%) performed 30 to 39 scopes per week, 2 (3.0%) performed 40 to 49 scopes per week, 3 (4.5%) performed 50 or more scopes per week, and 2 (3.0%) preferred not to disclose. **Table 1** summarizes the demographics of survey respondents.

Diagnostic UGI Endoscopy

There were 65 respondents who reported performing diagnostic UGI endoscopies. Before COVID-19, all 65 (100%) endoscopists routinely wore gloves and 60 (92.3%) wore gowns while performing diagnostic UGI endoscopies. Before COVID-19, only 12 (18.5%) routinely wore masks, 9 (13.8%) wore goggles, 7 (10.8%) wore face shields, 7 (10.8%) wore hair protection, and only 1 (1.5%) wore a respirator. With regards to gowns, 51 (78.5%) endoscopists changed after every procedure, 8 (12.3%) changed only if the gown was soiled, 1 (1.5%) wore the same gown the entire day, and 5 (7.7%) did not wear gowns **Figure 1a**.

After the COVID-19 pandemic ends, no statistically significant difference exists for gloving or gowning for diagnostic UGI studies, with all 65 (100%) endoscopists planning on routinely wearing both gloves and gowns. Although more endoscopists plan on wearing surgical masks ($n = 57, 87.7\%, P < 0.33$) and

N95 respirators ($n = 15, 23.1\%, P = 0.231$), this difference was not statistically significant. However, it appears more endoscopists will wear goggles ($n = 27, 41.5\%, P < 0.001$), face shields ($n = 43, 66.2\%, P = 0.045$), and hair protection ($n = 35, 53.8\%, P = 0.013$). Furthermore, 64 (98.5%) endoscopists will change their gown after every procedure. **Table 2** summarizes PPE usage before and after the COVID-19 pandemic for endoscopists undergoing diagnostic UGI endoscopy.

Therapeutic UGI Endoscopy

There were 60 respondents who reported performing therapeutic UGI endoscopies. Before COVID-19, all 60 (100%) endoscopists routinely wore gloves and 57 (95.0%) wore gowns while performing therapeutic UGI endoscopies. Before COVID-19, only 19 (31.7%) routinely wore face shields, 17 (28.3%) wore masks, 13 (21.7%) wore goggles, 6 (10.0%) wore hair protection, and only 1 (1.7%) wore a respirator. With regards to gowns, 50 (83.3%) endoscopists changed after every procedure, 5 (8.3%) changed only if the gown was soiled, 2 (3.3%) wore the same gown the entire day, and 3 (5.0%) did not wear gowns **Figure 1b**.

After the COVID-19 pandemic ends, all 60 (100%) endoscopists will continue to routinely wear both gloves and gowns while performing therapeutic UGI endoscopies; this was not statistically different than before the COVID-19

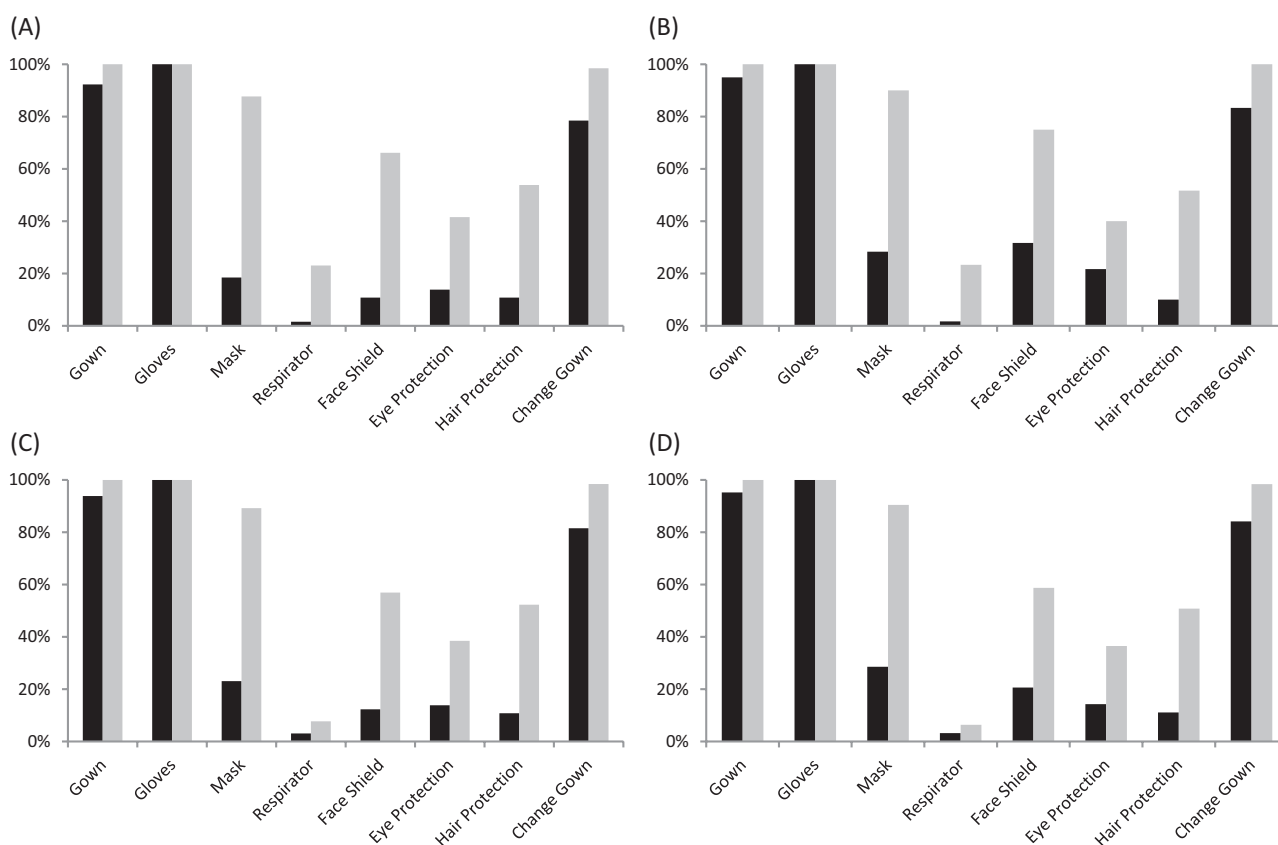


Figure 1. Comparison of pre-COVID-19 (black) and post-COVID-19 (gray) PPE usage rates broken down by endoscopic procedure: (A) diagnostic UGI; (B) therapeutic UGI; (C) diagnostic LGI; and (D) therapeutic LGI.

Table 1. Basic demographics of survey respondents ($N = 66$)

| | <i>n</i> (%) |
|---------------------------|--------------|
| Age | |
| <30 | 0 (0.0) |
| 30–39 | 15 (22.7) |
| 40–49 | 28 (42.4) |
| 50–59 | 10 (15.2) |
| ≥60 | 13 (19.7) |
| Prefer not to disclose | 0 (0.0) |
| Sex | |
| Female | 31 (47.0) |
| Male | 35 (53.0) |
| Prefer not to disclose | 0 (0.0) |
| Specialty | |
| Gastroenterology | 47 (71.2) |
| General Surgery | 14 (21.2) |
| Other | 4 (6.1) |
| Prefer not to disclose | 1 (1.5) |
| Province/Territory | |
| Alberta | 16 (24.2) |
| British Columbia | 7 (10.6) |
| Manitoba | 6 (9.1) |
| New Brunswick | 4 (6.1) |
| Newfoundland and Labrador | 5 (7.6) |
| Ontario | 20 (30.3) |
| Prince Edward Island | 0 (0.0) |
| Quebec | 3 (4.5) |
| Saskatchewan | 2 (3.0) |
| Territories | 3 (4.5) |
| Prefer not to disclose | 1 (1.5) |
| Experience (years) | |
| <5 | 3 (4.5) |
| 5–9 | 17 (25.8) |
| 10–14 | 15 (22.7) |
| 15–19 | 7 (10.6) |
| 20–24 | 9 (13.6) |
| ≥25 | 14 (21.2) |
| Prefer not to disclose | 1 (1.5) |
| Volume (endoscopies/week) | |
| <10 | 6 (9.1) |
| 10–19 | 23 (34.8) |
| 20–29 | 24 (36.4) |
| 30–39 | 6 (9.1) |
| 40–49 | 2 (3.0) |
| ≥50 | 3 (4.5) |
| Prefer not to disclose | 2 (3.0) |

pandemic. Again, more endoscopists will wear surgical masks or N95 respirators but this difference was not statistically significant. However, more endoscopists will routinely wear

Table 2. PPE use during diagnostic upper gastrointestinal endoscopy before and planned after COVID-19 pandemic

| PPE type | Pre-COVID $n = 65n$ (%) | Post-COVID $n = 65n$ (%) | <i>P</i> -value |
|-----------------|-------------------------------|--------------------------------|-----------------|
| Gloves | 65 (100) | 65 (100) | - |
| Gowns | 60 (92.3) | 65 (100) | - |
| Masks | 12 (18.5) | 57 (87.7) | 0.333 |
| Goggles | 9 (13.8) | 27 (41.5) | <0.001 |
| Face Shields | 7 (10.8) | 43 (66.2) | 0.045 |
| Hair Protection | 7 (10.8) | 35 (53.8) | 0.013 |
| Respirator | 1 (1.5) | 15 (23.1) | 0.231 |

Table 3. PPE use during therapeutic upper gastrointestinal endoscopy before and planned after COVID-19 pandemic

| PPE type | Pre-COVID $n = 60n$ (%) | Post-COVID $n = 60n$ (%) | <i>P</i> -value |
|-----------------|-------------------------------|--------------------------------|-----------------|
| Gloves | 60 (100) | 60 (100) | - |
| Gowns | 57 (95.0) | 60 (100) | - |
| Masks | 19 (31.7) | 54 (90.0) | 0.163 |
| Goggles | 17 (28.3) | 24 (40.0) | <0.001 |
| Face Shields | 13 (21.7) | 45 (75.0) | 0.026 |
| Hair Protection | 6 (10.0) | 31 (51.7) | 0.024 |
| Respirator | 1 (1.7) | 14 (23.3) | 0.233 |

goggles ($n = 24$, 40.0%, $P = 0.026$), face shields ($n = 45$, 75.0%, $P = 0.026$), and hair protection ($n = 31$, 51.7%, $P = 0.024$). Again, all 60 (100%) endoscopists plan to change their gowns after every procedure. Table 3 summarizes PPE usage before and after the COVID-19 pandemic for endoscopists undergoing therapeutic UGI endoscopy.

Diagnostic LGI Endoscopy

There were 65 respondents who reported performing diagnostic LGI endoscopies. Before COVID-19, all 65 (100%) endoscopists routinely wore gloves and 61 (93.8%) wore gowns while performing diagnostic LGI endoscopies. Before COVID-19, only 15 (23.1%) routinely wore masks, 9 (13.8%) wore goggles, 8 (12.3%) wore face shields, 7 (10.8%) wore hair protection, and only 2 (3.1%) wore respirators. With regards to gowns, 53 (81.5%) endoscopists changed after every procedure, 7 (10.8%) changed only if the gown was soiled, 1 (1.5%) wore the same gown the entire day, and 4 (6.2%) did not wear gowns Figure 1c.

After the COVID-19 pandemic ends, all 65 (100%) endoscopists will continue to routinely wear both gloves and gowns while performing diagnostic LGI endoscopies.

Table 4. PPE use during diagnostic lower gastrointestinal endoscopy before and planned after COVID-19 pandemic

| PPE type | Pre-COVID _{n = 65n} (%) | Post-COVID _{n = 65n} (%) | P-value |
|-----------------|-------------------------------------|--------------------------------------|---------|
| Gloves | 65 (100) | 65 (100) | - |
| Gowns | 61 (93.8) | 65 (100) | - |
| Masks | 15 (23.1) | 58 (89.2) | 0.188 |
| Goggles | 9 (13.8) | 25 (38.5) | <0.001 |
| Face Shields | 8 (12.3) | 37 (56.9) | 0.008 |
| Hair Protection | 7 (10.8) | 34 (52.3) | 0.012 |
| Respirator | 2 (3.1) | 5 (7.7) | 0.005 |

Table 5. PPE use during therapeutic lower gastrointestinal endoscopy before and planned after COVID-19 pandemic

| PPE type | Pre-COVID _{n = 63n} (%) | Post-COVID _{n = 60n} (%) | P-value |
|-----------------|-------------------------------------|--------------------------------------|---------|
| Gloves | 63 (100) | 63 (100) | - |
| Gowns | 60 (95.2) | 63 (100) | - |
| Masks | 18 (28.6) | 57 (90.5) | 0.170 |
| Goggles | 13 (20.6) | 37 (58.7) | <0.001 |
| Face Shields | 9 (14.3) | 23 (36.5) | <0.001 |
| Hair Protection | 7 (11.1) | 32 (50.8) | 0.011 |
| Respirator | 2 (3.2) | 4 (6.3) | 0.003 |

Additionally, 58 (89.2%) will wear masks, 25 (38.5%) will wear goggles, 37 (56.9%) will wear face shields, 34 (52.3%) will wear hair protection, and 5 (7.7%) will wear respirators. Furthermore, 64 (98.5%) endoscopists will change their gown after every procedure. [Table 4](#) summarizes PPE usage before and after the COVID-19 pandemic for endoscopists undergoing diagnostic LGI endoscopy.

Therapeutic LGI Endoscopy

There were 63 respondents who reported performing therapeutic LGI endoscopies. Before COVID-19, all 63 (100%) endoscopists routinely wore gloves and 60 (95.2%) wore gowns while performing therapeutic LGI endoscopies. Before COVID-19, only 18 (28.6%) routinely wore masks, 13 (20.6%) wore face shields, 9 (14.3%) wore goggles, 7 (11.1%) wore hair protection, and only 2 (3.2%) wore respirators. With regards to gowns, 53 (84.1%) endoscopists changed after every procedure, 5 (7.9%) changed only if the gown was soiled, 2 (3.2%) wore the same gown the entire day, and 3 (4.8%) did not wear gowns [Figure 1d](#).

After the COVID-19 pandemic ends, all 63 (100%) endoscopists will continue to routinely wear both gloves

and gowns while performing therapeutic LGI endoscopies. Additionally, 57 (90.5%) will routinely wear masks, 37 (58.7%) will wear face shields, 23 (36.5%) will wear goggles, 32 (50.8%) will wear hair protection, and only 4 (6.3%) will wear respirators. Furthermore, 62 (98.4%) endoscopists will change their gown after every procedure. [Table 5](#) summarizes PPE usage before and after the COVID-19 pandemic for endoscopists undergoing therapeutic LGI endoscopy.

Discussion

While PPE protocols have existed before the COVID-19 pandemic, there are no mandatory requirements for PPE use, and compliance to PPE recommendations varied. Before COVID-19, it appears that most endoscopists wore only gloves and gowns most of the time. Following the pandemic, endoscopists plan on significantly increasing their use of goggles, face shields, and hair protection. During LGI endoscopy physicians also plan on wearing N95's more commonly. Finally, there appears to be a trend toward increased planned use of surgical masks and N95's during all endoscopic procedures. The renewed emphasis on routine PPE use following the COVID-19 pandemic may serve as a foundation to the development of new PPE guidelines.

Similarly, the American Society for Gastrointestinal Endoscopy (ASGE) published endoscopy specific PPE guidelines that recommend gowns, gloves, eye protection, and masks ([12,13](#)). Since the pandemic, the American Gastroenterological Association has also highlighted the importance of the proper donning and doffing of PPE ([14](#)). Although all endoscopists routinely wore gloves, gown use was not universal. Furthermore, the frequency of gown changes was even fewer than routine gown use. Overall, the study suggests that endoscopists plan to universally wear gloves and gowns following the COVID-19 era. Of the other recommended PPE, reported routine use before COVID-19 ranged from one-fifth to one-third of endoscopists, with the exception of face shield and hair protection use in diagnostic LGI endoscopy. Again, fortunately the COVID-19 pandemic has led to more endoscopists planning on donning these important PPE materials in the future.

Another interesting finding from this study is that before COVID-19 endoscopists donned more PPE for therapeutic procedures compared to diagnostic procedures. Although this was not statistically evaluated and differences were small, endoscopists were more likely to wear all types of PPE for therapeutic procedures. This may be due to the perception of therapeutic procedures carrying a higher risk of exposure to bodily fluids ([9](#)). However, it is unclear whether body fluid exposure or contamination risk differs between therapeutic and diagnostic endoscopy. Regardless, it is notable that following COVID-19, the differences between PPE use for therapeutic and diagnostic endoscopy have decreased and become inconsistent. Although

therapeutic procedures may have previously been perceived to have higher biohazard risk, that perception seems to have decreased. This may be due to increased discussion and information available regarding the risks of all types of endoscopy during the COVID pandemic.

During the COVID-19 pandemic, various authoritative bodies reiterated the importance of universal precautions in endoscopy, with slight changes to previous recommendations. In Canada, the suggested PPE during the pandemic included surgical masks, eye protection, single-use gown, extended gloves, and hairnet at a minimum (8). For endoscopies involving patients who were considered high risk for COVID-19 infection, or the procedure was deemed high risk for COVID-19 transmission (UGI procedures), the additional recommendations from CAG included the use of respirators instead of masks, water-resistant gowns, and double gloving (8). In the hypothetical post-pandemic scenario, endoscopists plan to routinely wear more PPE. Although reported rates increased across the board for all types of PPE, endoscopists are in favour of increasing the use of certain PPE over others. However, routine gowning and gloving were the only two PPE universal adopted. Future studies evaluating the use of PPE during endoscopy following the COVID-19 pandemic would be of interest to evaluate any persistent changes that occur. These studies should also evaluate any differences in PPE use amongst rural or academic endoscopy settings, as this would be of interest. Additionally, ongoing evaluation of feasible evidence based guidelines with dissemination across endoscopists may provide a framework for future development of standardized PPE protocols.

The COVID-19 pandemic has proved to be a trying time for all, but many lessons have been gained from this experience. This study has demonstrated that tribulations such as the COVID-19 pandemic can reinforce the importance of universal precautions. While endoscopists have indicated that they will likely increase their routine use of PPE after the COVID-19 pandemic, the sustainability of these practices will be interesting to monitor in the future. Furthermore, future research will be needed in order to balance the necessity of infection prevention and control with the rising cost of health care and the environmental impact of our practices.

Limitations

This study has a number of limitations. Although every attempt was made to limit the inherent biases of survey analyses, sampling bias was introduced by the selection of the study population. With the goal of surveying all practicing endoscopists in Canada, we tried to limit sampling bias by reaching out to the two largest specialist societies performing endoscopies. However, non-members or endoscopists in other specialties (i.e., Family Medicine with additional training to serve rural

communities) may have been underrepresented. Additionally, our study does not evaluate the effect of local guidelines or regulations that endoscopists must follow; certainly, these local effects may have substantial effects on the planned PPE usage by different physicians and should be considered as we consider our own PPE use and develop future evidence based guidelines. Future studies evaluating PPE use following the pandemic should consider evaluating local guidelines to understand the effect on endoscopists.

Additionally, our study was significantly limited with the low response rate. Non-response bias may be a substantial limitation in our study, which may have further underrepresented certain subgroups. Additionally, while 77 endoscopists began our survey, only 66 completed it suggesting an element of fatigue, which also may bias this study; endoscopists with more interest in PPE use or with more concerns regarding contamination may be more likely to complete our survey. It is possible that this study does not accurately represent Canadian endoscopists and their planned PPE actions. However, it should be noted that the response rate may be underestimated due to uncertainty of the exact number of survey invitation recipients, as well as double counting of members who belonged to both societies. The survey was also designed to be simple and short with mostly yes or no answers to maximize potential responses. Additionally, optional free text comments were included to reduced respondents recall and interpretation biases. While the low response rate may have limited the generality of our results, this is currently the only survey highlighting the PPE practices of Canadian endoscopists.

CONCLUSION

The COVID-19 pandemic has renewed infection control awareness and increased PPE use across all types of endoscopy. This information is valuable for endoscopists as they plan their own PPE use in the future and for governing bodies as they construct feasible evidence based guidelines. Future research to re-poll endoscopists will be interesting to compare their intended and actual PPE use after the pandemic.

SUPPLEMENTARY DATA

Supplementary data are available at *Journal of the Canadian Association of Gastroenterology* online.

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