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DElayed COloRectal Cancer Care during COVID-19 Pandemic: Global Perspective from an International Survey (DECOR-19)

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** Listed in Appendix 1
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Endorsement: This Survey was endorsed by the following International Societies: American Society of Colon and Rectal Surgeons (ASCRS), Asia-Pacific Federation of Coloproctology (APFCP), Chinese Society of Coloproctology, Egyptian Society of Colon and Rectal Surgeons (ESCRS), European Society of Coloproctology (ESCP), German Society for Coloproctology (DGK), International Society of University Colon and Rectal Surgeons (ISUCRS), Italian Society of Colorectal Surgery (SICCR), Korean Society of Coloproctology, LatinAmerican Association of Coloproctology (ALACP), Malaysian Society of Colorectal Surgeons (MSCRS), Philippine Society of Colon and Rectal Surgeons (PSCRS), Philippine Society of General Surgeons (PSGS), Portuguese Society of Coloproctology, Portuguese Society of Surgery (SPCIR), Russian Association of Coloproctology, South African Colorectal Society (SACRS), Swedish Society of Colorectal Surgery, Turkish Society of Colon and Rectal Surgery (TKRCD) and Venezuelan Coloproctology Society. The Societies had no role in study design, data collection, analysis and interpretation, or in the writing of this report. The views expressed are those of the authors and not necessarily those of the Societies.

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Article Summary

Global changes in both diagnostic and therapeutic practices in colorectal cancer care were evident in this survey conducted to analyze the impact of COVID-19 outbreak. The importance of this finding is that changes were associated with differences in health care delivery systems, hospital’s preparedness, resources availability, and local COVID-19 prevalence rather than geographical variations. These findings may help adopting preventing measures during future virus surges.
ABSTRACT

Background: The widespread nature of coronavirus disease 2019 (COVID-19) has been unprecedented. We sought to analyze its global impact with a survey on colorectal cancer (CRC) care during the pandemic.

Methods: The impact of COVID-19 on preoperative assessment, elective surgery, and postoperative management of CRC patients was explored by a 35-item survey, which was distributed worldwide to members of surgical societies with an interest in CRC care. Respondents were divided into two comparator groups: 1) ‘delay’ group: CRC care affected by the pandemic; 2) ‘no delay’ group: unaltered CRC practice.

Results: A total of 1,051 respondents from 84 countries completed the survey. No substantial differences in demographics were found between the ‘delay’ (745, 70.9%) and ‘no delay’ (306, 29.1%) groups. Suspension of multidisciplinary team meetings, staff members quarantined or relocated to COVID-19 units, units fully dedicated to COVID-19 care, personal protective equipment not readily available were factors significantly associated to delays in endoscopy, radiology, surgery, histopathology and prolonged chemoradiation therapy-to-surgery intervals. In the ‘delay’ group, 48.9% of respondents reported a change in the initial surgical plan and 26.3% reported a shift from elective to urgent operations. Recovery of CRC care was associated with the status of the outbreak. Practicing in COVID-free units, no change in operative slots and staff members not relocated to COVID-19 units were statistically associated with unaltered CRC care in the ‘no delay’ group, while the geographical distribution was not.
Conclusions: Global changes in diagnostic and therapeutic CRC practices were evident. Changes were associated with differences in health-care delivery systems, hospital’s preparedness, resources availability, and local COVID-19 prevalence rather than geographical factors. Strategic planning is required to optimize CRC care.
INTRODUCTION
The widespread nature and impact of the coronavirus disease 2019 (COVID-19) pandemic has been unprecedented.¹ The global transmission of the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2) has been rapid because of the high infectivity and a relatively high rate of asymptomatic carriers in a highly mobile and interconnected global world.² As of August 20th 2020, the World Health Organization (WHO) confirmed 22,256,220 cases of COVID-19 globally, including 782,456 deaths.³ A lack of preparedness and a lack of appreciation of the gravity of the pandemic have led to significant strains on health care systems around the world. In the first half of 2020, most nation’s health care resources were overwhelmed by the COVID-19 and many hospitals essentially became coronavirus accepting hospitals during the emergency phase.⁴, ⁵ The impact of COVID-19 on global oncological care has been profound.⁶-⁸ COVIDSurg Collaborative estimated that 28,404,603 elective operations were cancelled or postponed worldwide during the 12 weeks of peak disruption, with 38% being for cancer.⁴ Colorectal cancer (CRC) is the third leading cause of cancer related deaths globally. The pandemic has led to major disruptions and delays in CRC practice, which may adversely affect survival outcomes for several years to come.⁸

The primary aim of our survey was to analyze the global impact of the COVID-19 outbreak on both diagnosis and treatment of CRC. The secondary aim was to explore which factors were associated with changes in CRC care or with unaffected practice.

METHODS
Surgical divisions treating CRC across the world were eligible to participate, including those in countries that did not currently have COVID-19 outbreaks during the study-period. Only one collaborator per surgical division was eligible to take part, although multiple divisions from the same hospital could participate in the survey. To obtain a representative sample of participants, national and international surgical societies with interest in CRC care from six geographical regions were asked to endorse the study and disseminate the survey by e-mail to their members. The societies had no role in study design, data collection, analysis and interpretation, or in the writing of the report. To overcome the temporal bias of distribution, the link to the online survey was made available for three weeks, from May 20-June 10, 2020. A newsletter with a reminder was sent every week. Informed consent was obtained by voluntary participation and no compensation was offered. The study was registered at ClinicalTrials.gov (NCT 04488549).

Survey
A 35-item survey on Delayed Colorectal cancer care during COVID-19 pandemic (DECOR-19) (Appendix 2) was designed by the steering committees formed by the principal investigators. Meetings were conducted via teleconference to define the appropriateness, feasibility and preliminary validity of the questions to include. Further validation of the survey was achieved by pilot testing on 10 surgery residents to ensure adequate sentence construction and correct interpretation of the questions. We elected not to delay the survey process by performing a formal full validation to glean insights from the results in an expeditious manner in this critical period.
The platform ‘Online surveys’ (formerly BOS – Bristol Online Survey), developed by the University of Bristol, in accordance with the COnsolidated criteria for Reporting Qualitative Research (COREQ) and the CHEcklist for Reporting Results of Internet E-Surveys (CHERRIES statement)\(^9\) (Appendix 3) was used. Proprietary survey software and local servers were used to ensure data protection. The fully de-identified dataset was kept on password protected computers. Responses were single or multiple choice, numeric, and open text. All questions were set as mandatory fields with real-time validation and automated skip logic to prevent missing data and avoid illogical or incompatible responses. No randomization of items was used. Quantitative data were automatically collected by the software and exported to a tabulated format. Estimated mean time to complete the survey was 10-15 minutes.

The survey was structured in the following four sections:

1. **Demographics and personal practice (Q.1-Q.13):** including respondents’ gender, country, hospital-level, total number of hospital beds, specialty-specific (Q.8: general surgery/colorectal surgery) division, annual volume of CRC surgery and laparoscopic CRC resections in the division, and average long-course chemoradiation therapy (CRT)-to-surgery interval in for rectal cancer.

After demographics, respondents were asked if they experienced any delay in CRC care (Q.14). There were two comparator groups: 1) ‘no delay’: respondents were redirected to a single question (Q.35) investigating the reasons of unaffected practice; 2) ‘delay’: respondents continued the survey with the following sections:

2. **Hospital response to COVID-19 emergency (Q.15-Q.22):** to capture the current status of CRC care, exploring the overall changes in term of resources allocation. The section
included: hospital’s preparedness to COVID-19, readily availability of external facilities for CRC surgery, presence of cancer care coordinator, personal protective equipment (PPE) availability, status of elective CRC surgery, elective CRC patients needing urgent surgery, CRC patients status, staff members status;

3. **Delay in CRC care** (Q.23-Q.33): investigating any delays across the various fields of practice (i.e. endoscopy, radiology, surgery, radiotherapy, oncology, histopathology, multidisciplinary team [MDT] meetings) and the relative reasons, any change in the original management plan and types of complication determining a shift from elective to emergency surgery;

4. **Recovery of CRC care** (Q.34): assessing the recovery of CRC practice at the date of the survey completion (fully recovered, improved, persistently limited).

**Statistical analysis**

Continuous variables were summarized by means and standard deviations (SD), and categorical variables by proportions. Comparisons of categorical variables across groups were made by Pearson’s chi-square tests. A series of hierarchical binary and ordinal logistic regression models were performed to assess the association between respondents’ preferences and their characteristics, with geographical area as random effect. The Brant test was performed to assess the proportional odds assumption in the ordinal logistic model. Uni- and multivariable hierarchical logistic models were fitted to explore the association between delay and a pre-defined set of covariates (demographics, hospital characteristics and respondents’ personal practice in CRC care). To assess the factors associated with the
recovery of practice, it was first calculated the time interval in days between the date of achievement of the 100th COVID-19 positive case in the respondent’s country and the date of recovery (fully recovered or improved) or the date of persistently limited CRC care and then fitted a zero inflated negative binomial regression.\textsuperscript{10} Adjustments to the \textit{P}-values for multiple testing were not performed, and statistical significance was assessed using alpha=0.05. All analyses were performed using Stata 16 (StataCorp LLC, College Station, TX, USA).

RESULTS

Twenty national and international surgical societies from six geographical regions endorsed the study and disseminated the survey to their members in the time frame (May 20-June 10, 2020) (Figure 1).

Demographics and Personal Practice

A total of 1,051 respondents, representing 1,051 colorectal or surgical divisions, from 84 countries (Figure 1) completed the survey and were included in the final analysis: Europe 603 respondents (57.4%), Asia 218 (20.7%), North America 120 (11.4%), South America 68 (6.5%), Africa 27 (2.6%) and Oceania 15 (1.4%). The mean interval between the achievement of the 100th COVID-19 case in each respondent’s country and the date of survey completion was higher for respondents from North America (70 days) and Europe (64 days) (Figure 2). Mean time spent to complete the survey was 10.8 (SD, 3.8) minutes.

Respondents were mostly men (78.7%), practicing in general surgery divisions (76.3%) and academic hospitals (61.1%) with mid to high bed volume (>250 beds, 89.2%) (Table 1). A large majority of divisions (78.8%) performed >50 colon cancer surgeries per year, with 31.5%
reporting this case volume for rectal cancer. Thirty-five percent of respondents reported regular use of laparoscopy in >75% of cases in CRC surgery (Table 1). Most respondents (70.7%) indicated 8-12 weeks as the optimal long-course CRT-to-surgery interval in rectal cancer. Demographics and personal practice were consistent across the geographical regions and the only difference in this proportional distribution was found in the annual number of surgeries for rectal cancer more frequent in Asia (Table 1).

Overall, 745 respondents (70.9%) experienced some delays in CRC care (‘delay’ group) and 306 respondents (29.1%) did not (‘no delay’ group). These two groups were substantially homogeneous for all demographics, and personal practices (Table 2). The geographical distribution between the two groups was also similar and proportionally consistent with the overall population of 1,051 respondents.

**Hospital Response to COVID-19 Emergency**

Among 745 respondents in the ‘delay group’, 694 (93.2%) reported that their hospitals had participated in the emergency with by either providing fully dedicated support (16.8%) or partially dedicating (76.4%) clinical activities to the management of SARS-CoV-2 patients (Table 3): 1) 97.3% (725 respondents) reported that elective surgery was affected by COVID-19. Three hundreds and seventy-six (50.5%) respondents reported that surgical capacity was reduced (>50% according to 186 respondents) and 349 (46.8%) stated that elective surgery was temporarily suspended (≥5 weeks according to 296 respondents); 2) 85.6% (638 respondents) reported that PPE was readily available; 3) 64.3% (479 respondents) reported that their hospitals relocated resources to COVID-19 free external facilities for elective CRC surgery; 4) 52.1% (388 respondents) reported that staff members were diagnosed with SARS-
CoV-2 and were quarantined; 5) 45.4% (338 respondents) reported that staff members were relocated from surgical divisions to COVID-19 units (>40% of staff in 94 divisions). The geographical distribution of the respondents did not significantly impact on hospitals’ organization.

COVID-19 significantly affected CRC care. Among the 745 respondents of the ‘delay’ group (Table 3): 1) 48.9% (365 respondents) reported a change of the initial surgical plan; 2) 48.5% (364 respondents) stated that MDT meetings were suspended; 3) 40.3% (300 respondents) referred that CRC patients refused surgery during the COVID-19 emergency phase; 4) 26.6% (198 respondents) reported that they had patients who developed COVID-19 post-operatively; 5) 26.3% (196 respondents) reported that CRC patients originally planned for elective operations needed urgent surgery; 6) 26.2% (195 respondents) performed CRC surgery in COVID-19 patients.

**Delay in CRC care**

Multivariable hierarchical logistic regression model (Table 4) showed a 38% lower risk (OR=0.62, 95%CI 0.45-0.85, \(P=0.003\)) of delay among respondents from non-academic teaching vs. academic hospitals and a 72% higher risk (OR=1.72, 95%CI 1.07-2.76,\(P=0.026\)) among those reporting high vs. low case volume of colon cancer surgeries (Table 4).

Overall in the ‘delay group’ (745 respondents), the original surgical management plan was changed according to 365 (48.9%) respondents and the original protocol of neoadjuvant therapy was changed according to 157 (21.1%) respondents. Changes were more likely to occur among respondents reporting staff members quarantined (OR 1.38, 95%CI 1.01-1.90, \(P=0.045\)) or relocated to COVID-19 units (OR 1.55, 95%CI 1.13-2.13, \(P=0.006\)).
Endoscopic procedures for CRC were the most affected diagnostic techniques by COVID-19 emergency (73.7% [549/745] of respondents). The delay in radiology was reported by 45% (335/745) of respondents (Table 5). Multivariable hierarchical logistic regression model (Table 6) demonstrated the following effects on the risk of delay in endoscopy: 1) 82% higher risk for delays (OR=1.82, 95%CI 1.26-2.62, P=0.001) in divisions where staff members were relocated to COVID-19 units; 2) 58% higher risk for delays (OR=1.58, 95%CI 1.10-2.27, P=0.013) in divisions where staff members were quarantined; 2) 64% lower risk for delays (OR=0.36, 95%CI 0.15-0.84, P=0.017) in high volume hospitals (vs. low volume hospitals); 3) 42% lower risk for delays (OR=0.58, 95%CI 0.36-0.99, P=0.045) in divisions partially dedicated to SARS-CoV-2 (vs. fully dedicated).

Multivariable hierarchical logistic regression model (Table 7) demonstrated the following effects on the risk of delay in radiology: 1) 69% higher risk for delays (OR=1.69, 95%CI 1.23-2.33, P=0.001) in divisions where staff members were relocated to COVID-19 units; 2) 56% higher risk for delays (OR=1.56, 95%CI 1.01-2.40, P=0.045) in divisions with medium volume of annual rectal cancer surgeries (vs. low volume); 3) 39% higher risk for delays (OR=1.39, 95%CI 1.01-1.90, P=0.042) in divisions where MDT meetings were suspended; 4) 48% lower risk for delays (OR=0.52, 95%CI 0.24-0.81, P=0.003) when PPE was readily available.

Delays in diagnostics for CRC beyond 4 weeks were more prevalent in North America, with 53 out of 64 respondents (83%) reporting delays in the endoscopic procedures and 22 out of 32 respondents (69%) reporting delays in the radiological investigations (Figure 3).
Surgery

Colorectal cancer surgery was delayed in 58.3% (434/745) of divisions. For the majority of respondents (90.1% [391/434]), the delay was 5-8 weeks beyond normal wait time, exceeding 8 weeks for 43 respondents (9.9%) (Table 5, Figure 3). Multivariable hierarchical logistic regression model (Table 6) demonstrated the following effects on the risk of delay in surgery:

1) 40% higher risk for delays (OR=1.40, 95%CI 1.02-1.92, P=0.039) in divisions where MDT meetings were suspended; 2) 51% lower risk for delays (OR=0.49, 95%CI 0.36-0.77, P=0.002) in divisions partially dedicated to COVID-19 (vs. fully dedicated); 3) 41% lower risk for delays (OR=0.59, 95%CI 0.37-0.93, P=0.023) when PPE was readily available, and 4) 33% lower risk for delays (OR=0.67, 95%CI 0.45-0.99, P=0.045) among respondents from general surgery divisions (vs. colorectal divisions).

Overall, 48.9% (365/745) of respondents changed the original surgical plan (multiple alternatives): from laparoscopic to open (37.3%, 136/365); from colorectal resections to CRT (28.2%, 103/365); from Transanal Minimally Invasive Surgery (TAMIS)/ Transanal Endoscopic Microsurgery (TEM) to neoadjuvant radiotherapy (19%, 69/365); from colorectal resections to stenting (10%, 37/365); from robotic to open (8.0%, 29/365); from robotic to laparoscopic (6.0%, 22/365) and from TAMIS/TEM to abdominal surgery (4.2%, 15/365). The reported reasons for changes in surgical plans (multiple alternatives) were: shortage of theatre slots (52%, 190/365 respondents), shortage of staff members and personnel (30%, 111/365), disease progression (28%, 103/365) and concerns over aerosolization in laparoscopic/robotic surgery (18%, 64/365).
Overall, 26.3% (196/745) of respondents reported that CRC patients scheduled for elective surgery needed urgent surgery due to (multiple alternatives): bowel obstruction (73%), bowel perforation (28%) or bleeding (18%) (Suppl. Fig. 1).

**Neoadjuvant CRT**

One hundred and ninety-six of 745 respondents (26.3%) reported that neoadjuvant CRT was postponed for rectal cancer patients (Table 5, Figure 3). The delay was ≤4 weeks for 61.7% (121/196) of respondents and ≥5 weeks for 38.3% (75/196) of respondents.

Overall, 21.1% (157/745) of respondents changed the original oncological plan for rectal cancer patients from neoadjuvant CRT and surgery to surgery only (86%, 135/157) and from long-course CRT to short-course CRT (13%, 22/157).

In addition, 43.5% (324/745) of respondents also reported that the long-course neoadjuvant CRT-to-surgery interval for rectal cancer patients was prolonged beyond the optimal 8-12 weeks interval (43.2% [140/324] of respondents ≥5 weeks) (Table 5). A factor statistically associated to this delay was the suspension of MDT meetings (OR 1.64, 95%CI 1.20-2.24, \( P=0.002 \)).

**Histopathology**

Histopathological assessment was affected for 17.6% (131/745) of respondents. The delay was more prevalent in South America (19/57, 33.3%; \( P<0.001 \)) (Table 5, Figure 3). Multivariable hierarchical logistic regression model (Table 6) demonstrated the following effects on the risk of delay in histopathology: 1) 77% lower risk for delays (OR=0.63, 95%CI 0.08-0.62, \( P=0.004 \)) in non-teaching hospitals (vs. academic hospitals); 2) 66% lower risk for delays (OR=0.44, 95%CI
0.26-0.75, \( P=0.002 \)) when PPE was readily available; 3) 64\% lower risk for delays (OR=0.36, 95\%CI 0.15-0.83, \( P=0.017 \)) in mid-high bed volume hospitals (vs. low bed volume); and 4) 206\% higher risk for delays in divisions where MDT meetings were suspended (OR=2.06, 95\%CI 1.23-2.26, \( P=0.001 \)).

**Recovery of CRC care**

Recovery of CRC care at the date of the survey completion (May 20-June 10, 2020) (Appendices 4-5) mirrors the status of the outbreak throughout the geographical regions. Overall, CRC care was ‘improved but not fully recovered’ to pre-COVID status for 56.4\% (420/745) of respondents. The highest prevalence was in Europe (65.9\%, 278/422) and North America (58.5\%, 48/82). At the time of survey, in these two regions there were nations both at the peak and at the transition phase of the emergency. CRC care status was ‘persistently limited’ for 26\% (194/745) of respondents. The highest prevalence was in Africa (75\%, 12/16) and South America (72\%, 41/57), two regions where most nations were at the initial phase of the emergency at the time of the study. A ‘fully recovered’ CRC practice was reported by 17.6\% (131/745) of respondents. The highest prevalence was in Asia (25.3\%, 40/158), where some nations were at the end of the emergency phase at the time of the survey. These data are consistent with the zero-inflated negative binomial regression model (Table 7) exploring the interval (days) between the date of achievement of the 100\textsuperscript{th} COVID-19 case and the date of recovery of CRC care. ‘Persistently limited’ practice was significantly associated with a shorter interval (mean interval ratio 0.41 [95\%CI 0.35-0.47]; \( P<0.001 \)) compared to ‘fully recovered’ practice.
Multivariable hierarchical logistic regression model (Table 7) demonstrated the following effects on recovery of CRC practice: 66% higher risk of ‘persistently limited’ practice (OR=1.66, 95%CI 1.22-2.45, P=0.001) in divisions where staff members were quarantined and 35% lower risk of ‘persistently limited’ practice (OR=0.65, 95%CI 0.43-0.97, P=0.036) in divisions with medium volume of annual rectal cancer surgeries (vs. low volume).

**Analysis of the ‘no delay’ group**

The ‘no delay’ group included 29% (306/1,051) of respondents. The reasons reported for unaltered CRC practice were (more than one factor could be reported): 1) preservation of resources for CRC care (62%, 190/306); 2) no changes in operative slots (47%, 144/306); 3) no delay in diagnostics (42%, 129/306); 3) surgical staff not redeployed from surgical divisions to COVID-19 units (41%, 125/306); 4) no change in ICU bed capacity for CRC patients (32%, 98/306); and 5) no change in surgical bed capacity for CRC patients (29%, 89/306). A combination of ≥3 of factors was reported by 64% (196/306) of respondents (Figure 4).

Three main statistically significant reasons for unaltered CRC care comparing the ‘no delay’ to the ‘delay’ group were identified: 1) practicing in COVID-free divisions (16% vs. 7%, P<0.001); 2) no change in operative slots (47% vs. 3%, P<0.001) and 3) staff members not redeployed from surgical divisions to COVID-19 units (59% vs.45%, P=0.037) (Suppl. Fig. 2).

**DISCUSSION**

COVID-19 introduced a global challenge for the management of CRC. In our survey, changes in both diagnostic and therapeutic practices were reported by 71% (745/1,051: ‘delay’ group) of respondents. Endoscopic and radiologic procedures were highly affected by the COVID-19
emergency. Elective CRC surgery was impacted for almost all respondents (97.3%), with planned procedures being temporarily suspended (46.8%) or capacity reduced (50.5%). Our results are consistent with an earlier survey on the global impact of COVID-19 in CRC patients, completed by 289 surgeons in April 2020 during the emergency phase.\textsuperscript{11} This study showed that outpatients services, cancer screening, diagnostics and treatment were all transiently suspended. Another study on elective oncological surgery in Italy during the COVID-19 emergency phase, demonstrated that 70% of surgical divisions had a reduction of hospital beds with an associated 76% reduction of surgical activity due to the relocation of resources.\textsuperscript{12} Evidence is limited regarding the effect of diagnostic or surgical delays on CRC specific outcomes.\textsuperscript{12-13} Maringe et al.\textsuperscript{8} estimated a 17% increase in the number of deaths of CRC patients up to year 5 as a result of diagnostic delays due to the COVID-19 pandemic in United Kingdom. In a retrospective cohort study, Lee et al.\textsuperscript{14} reported that the diagnosis-to-treatment interval (DTI) for all CRC, regardless of cancer staging, should not exceed 30 days. In another cohort study, Kucejko et al.\textsuperscript{15} reported that the ideal timing of definitive resection in colon cancer is between 3 and 6 weeks after initial diagnosis to achieve a modest but significant improvement in overall survival. The COVID-19 pandemic has increased the DTI for CRC. Turaga and Girotra\textsuperscript{16} reported that CRC surgery can be safely delayed beyond the normal wait time up to 4 weeks without having a significant impact on patient survival or cancer progression. However, in our survey, 58.3% of respondents in the ‘delay group’ reported that COVID-19 prolonged DTI to $\geq5$ weeks beyond normal wait time. Moreover, 43.5% of respondents reported a prolonged long-course CRT-to-surgery interval for in rectal cancer patients to $\geq5$ weeks beyond the optimal 8-12 weeks interval. Indeed, according to Turaga and
Girotra\textsuperscript{16}, this delay is less likely to cause harm. They reported that a postponement period of 6 weeks beyond the optimal long-course CRT-to-surgery interval for rectal cancer patients may be considered safe. Nevertheless, it remains unclear whether a prolonged time interval to surgery beyond the current recommended interval of 8 to 12 weeks results in increased morbidity or better pathological response.\textsuperscript{17-20}

COVID-19 also increased the risk of urgent surgery or changing the decision-making process.\textsuperscript{21,22} In this survey, 26.3\% (196/745) of respondents reported that CRC patients scheduled for elective surgery needed urgent surgery. Moreover, 49\% (365/745) of responders changed the original surgical plan and 21\% (157/745) changed the original oncologic plan. Reasons for the changes were shortage of theatre slots, shortage of staff members and personnel, disease progression and concerns over aerosolization in laparoscopic/robotic surgery. Regarding this last factor, however, a number of Societies (Society of American Gastrointestinal and Endoscopic Surgeons, European Association of Endoscopic Surgery and Australian College of Surgeons) reported that laparoscopy may be appropriate.\textsuperscript{13} The closed cavity in laparoscopy enables smoke control and airborne particles in the abdomen can be safely eliminated through filtered evacuation systems.\textsuperscript{23-26} Although there is no compelling evidence that laparoscopy increases the risk of airborne transmission, appropriate safety measures are recommended. All members of the surgical team should wear appropriate PPE,\textsuperscript{14} and the pneumoperitoneum should be slowly released in a controlled manner to minimize the spread of airborne particles.\textsuperscript{26,27} Despite these guidelines, 45.2\% of respondents in the current study changed their surgical approach from laparoscopic/robotic to open.
The COVID-19 pandemic changed the functioning and organization of hospitals around the world. During the surge, restrictive measures were adopted to reduce COVID-19 exposure and to preserve human and material resources. In our survey, we found that delays in CRC care were associated with differences in health care delivery systems, hospital’s preparedness, resources availability, and local COVID-19 prevalence, while the geographical distribution of the respondents did not impact significantly. Important factors included hospitals dedicating their services to COVID-19 care, quarantine and/or redeployment of staff, MDT meetings suspension, and the lack of readily available PPE (Table 8). These factors mirror the statistically significant reason for unaffected CRC practice in the ‘no delay’ group: practicing in COVID-free divisions, no change in number of operative slots, and staff members not redeployed from surgical divisions to COVID-19 units.

The recovery of health care systems is a complex process due to the impact of cancelled and postponed operations. Recommended principles for rescheduling have been outlined by the American College of Surgeons (ACS), American Hospital Association, American Society of Anesthesiologists, and the Association of Perioperative Nurses. ACS also provided principles for the safe resumption of elective surgery organized in two parts: core facility checklist items (general facility policies, structures and processes, outcomes reporting) and surgery-specific checklist items (policies, structures and processes, outcomes reporting) including measures to protect the patient and protocols in place for safe protection of medical first line teams. In our survey, recovery of CRC care was associated to the stage of the virus outbreak at the time of study completion. Independent of the geographical region, the likelihood of reduced CRC
practice was 66% higher among respondents reporting staff members quarantined ($P=0.001$) and 35% lower among those working in divisions with medium volume of rectal cancer surgeries (compared to low volume; $P=0.036$).

Our results indicate that cancer pathways need to swiftly be re-established and maintained at a near normal throughput, with attention to the backlog of patients, in order to reduce the impact of the COVID-19 pandemic.\textsuperscript{33} Hospitals need to assume standard-of-care when the benefits exceed COVID-related mortality.\textsuperscript{34,35} However, Caricato et al.\textsuperscript{36} reported that oncological programs proposed in Italy to guarantee elective surgical activity were only successful in 19% of the regions. In the current study, we identified a crucial role of MDT meetings in on CRC care. Meetings suspension was associated with delays in radiology, surgery and histopathology and prolonged the CRT-to-surgery interval (Table 8).

In our survey, the relative homogeneity of delays seemed to reflect the lack of any absolute relation to either the geographical location or the status of the outbreak. Specifically, even within geographical regions at the same time points, some hospitals had delays while others did not. Thus, delays or lack thereof appeared to be more due to individual hospital’s organization and preparedness. The plans implemented at hospitals at which no delays were experienced could be shared as ‘best practices’ so that other facilities could avail themselves of avoiding delays during future virus surges. Conversely, the geographical distribution was important if we consider the recovery of CRC care, because the status of the outbreak was associated with the recovery of standard clinical activities in those hospitals who were most affected by the COVID19 emergency.
Our study has several limitations inherent in surveys, including voluntary participation and recall and selection bias. The respondents included a preponderance of male general surgeons from large academic centers in Europe, Asia, and North America (Figure 1). Therefore, data from all global regions is not equally distributed or robust. This geographic distribution mirrored the areas of highest prevalence of COVID-19 at the time of survey distribution (https://www.who.int/docs/default-source/coronaviruse/situationreports/20200530-covid19-sitrep131.pdf?sfvrsn=d31ba4b3_2) (Figure 2). It is therefore reasonable to assume that surgeons from countries with low COVID-19 case-prevalence were less motivated to take part.

Another limitation is the lack of a formal full validation process of the survey, which was elected to obtain results in an expeditious manner in this critical period. The impact of subsequent surges is also unknown, as the long-term effect of the delays on diagnosis and/or treatment. Despite these limitations, our data provide important insights regarding the impact of COVID-19 pandemic in CRC care.

CONCLUSION

During the COVID-19 pandemic, global changes in both diagnostic and therapeutic CRC practices were evident. This problem cannot be solved by sharing best practices as the inability to render CRC care was directly related to the hospital’s preparedness and availability of resources rather than to geographical factors. Future surges may again challenge human and material resources. Therefore, a solution to this disparity could potentially be addressed
by sharing resources and/or transfer of patients among institutions. The implementation of such practices may nevertheless be challenging because of differences in health care systems.

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Table 1. Demographics across six geographical regions (N=1,051 global respondents)

|                          | N=1,051 (100%) | Asia (20.7%) | Europe (57.4%) | N.America (11.4%) | S.America (6.5%) | Africa (2.6%) | Oceania (1.4%) |
|--------------------------|----------------|-------------|---------------|------------------|------------------|--------------|---------------|
| Gender                   |                |             |               |                  |                  |              |               |
| Males                    | 827 (78.7)     | 218 (83.9)  | 659 (76.1)    | 120 (75.5)       | 70 (80.4)        | 24 (88.9)    | 12 (80.0)     |
| Females                  | 224 (21.3)     | 35 (16.1)   | 144 (23.9)    | 27 (17.5)        | 12 (17.6)        | 3 (11.1)     | 3 (20.0)      |
| Type of hospital         |                |             |               |                  |                  |              |               |
| Academic                 | 642 (61.1)     | 165 (75.7)  | 337 (55.9)    | 57 (47.5)        | 52 (76.5)        | 23 (82.5)    | 8 (53.3)      |
| Non-academic teaching    | 312 (29.7)     | 34 (15.6)   | 213 (35.3)    | 46 (38.3)        | 14 (20.6)        | 0 (0)        | 5 (33.4)      |
| Non-teaching             | 97 (9.2)       | 19 (8.7)    | 53 (8.8)      | 17 (14.2)        | 2 (2.9)          | 4 (14.8)     | 2 (13.3)      |
| Number of beds           |                |             |               |                  |                  |              |               |
| ≤250                     | 113 (10.8)     | 19 (8.7)    | 55 (9.5)      | 17 (14.2)        | 12 (17.6)        | 8 (29.6)     | 2 (13.3)      |
| 251-750                  | 535 (50.9)     | 80 (36.7)   | 322 (53.3)    | 74 (61.7)        | 47 (69.2)        | 4 (14.8)     | 8 (53.3)      |
| 751-1250                 | 242 (23.0)     | 66 (30.3)   | 136 (21.8)    | 22 (18.3)        | 6 (8.8)          | 8 (29.6)     | 4 (26.7)      |
| >1250                    | 161 (15.3)     | 53 (24.3)   | 90 (15.4)     | 7 (5.8)          | 3 (4.4)          | 7 (26.0)     | 1 (6.7)       |
| Type of division         |                |             |               |                  |                  |              |               |
| Colorectal               | 248 (23.7)     | 60 (27.5)   | 111 (18.4)    | 42 (35.0)        | 19 (27.9)        | 11 (40.7)    | 5 (33.4)      |
| General surgery          | 803 (76.3)     | 158 (72.5)  | 492 (81.6)    | 78 (65.0)        | 49 (72.1)        | 16 (59.3)    | 10 (66.6)     |
| Annual number of colon cancer surgery | | | | | | | |
| ≤50                      | 223 (21.2)     | 52 (23.8)   | 111 (18.4)    | 26 (21.7)        | 19 (27.9)        | 13 (48.2)    | 2 (13.3)      |
| 51-150                   | 516 (49.1)     | 81 (37.2)   | 334 (55.4)    | 51 (42.5)        | 34 (50.0)        | 9 (33.3)     | 7 (46.7)      |
| >150                     | 311 (29.7)     | 85 (39.0)   | 158 (26.2)    | 43 (35.8)        | 15 (22.1)        | 5 (18.5)     | 6 (40.0)      |
| Laparoscopy (%)          |                |             |               |                  |                  |              |               |
| <25                      | 221 (21.0)     | 78 (35.8)   | 89 (14.8)     | 18 (15.0)        | 22 (32.4)        | 14 (51.9)    | 0 (0)         |
| 25-50                    | 172 (16.4)     | 45 (20.6)   | 86 (14.3)     | 17 (14.2)        | 17 (25.0)        | 4 (14.8)     | 3 (20.0)      |
| 50-75                    | 286 (27.2)     | 37 (17.0)   | 194 (32.2)    | 32 (26.6)        | 7 (10.2)         | 7 (25.9)     | 9 (60.0)      |
| >75                      | 372 (35.4)     | 58 (26.6)   | 234 (38.8)    | 53 (44.2)        | 22 (32.4)        | 2 (7.4)      | 3 (20.0)      |
| Annual number of rectal cancer surgery | | | | | | | |
| ≤50                      | 720 (68.5)     | 106 (48.6)  | 455 (75.5)    | 75 (62.5)        | 51 (75.0)        | 23 (85.2)    | 10 (66.6)     |
| 51-150                   | 252 (24.0)     | 73 (33.5)   | 125 (20.7)    | 36 (30.0)        | 12 (17.6)        | 2 (7.4)      | 4 (26.7)      |
| >150                     | 79 (7.5)       | 39 (17.9)   | 23 (3.8)      | 9 (7.5)          | 5 (7.4)          | 2 (7.4)      | 1 (6.7)       |
| Laparoscopy (%)          |                |             |               |                  |                  |              |               |
| <25                      | 277 (26.4)     | 81 (37.2)   | 123 (20.4)    | 21 (17.5)        | 32 (47.1)        | 15 (57.6)    | 5 (33.4)      |
| 25-50                    | 171 (16.3)     | 42 (19.3)   | 92 (15.3)     | 26 (21.7)        | 6 (8.8)          | 2 (7.4)      | 3 (20.0)      |
| 50-75                    | 239 (22.7)     | 30 (13.8)   | 166 (27.5)    | 25 (20.8)        | 7 (10.2)         | 7 (25.9)     | 4 (26.6)      |
| >75                      | 364 (34.6)     | 65 (29.7)   | 222 (36.8)    | 48 (40.0)        | 23 (33.9)        | 3 (11.1)     | 3 (20.0)      |
| Long-course CRT-surgery interval | | | | | | | |
| ≤8                       | 271 (25.8)     | 62 (28.4)   | 172 (28.5)    | 19 (15.7)        | 6 (8.8)          | 11 (40.7)    | 1 (6.7)       |
| 8-12                     | 743 (70.7)     | 152 (69.7)  | 407 (67.5)    | 100 (83.4)       | 54 (79.4)        | 16 (59.3)    | 14 (93.3)     |
| >12                      | 37 (3.5)       | 4 (1.9)     | 24 (4.0)      | 1 (0.9)          | 8 (11.8)         | 0 (0)        | 0 (0)         |
Table 2. Characteristics of the two groups of “delay” and “no delay” colorectal cancer practice (N.1,051 global respondents)

| Characteristic                              | Delay N=745 (70.9%) | No delay N=306 (29.1%) | P     |
|---------------------------------------------|---------------------|------------------------|-------|
| Geographical region                         |                     |                        |       |
| Europe                                      | 422 (56.6)          | 181 (59.2)             | 0.141 |
| Asia                                        | 158 (21.3)          | 60 (19.6)              |       |
| North America                               | 82 (11.0)           | 38 (12.4)              |       |
| South America                               | 57 (7.7)            | 11 (3.6)               |       |
| Africa                                      | 16 (2.1)            | 11 (3.6)               |       |
| Oceania                                     | 10 (1.3)            | 5 (1.6)                |       |
| Peak reached                                |                     |                        |       |
| Yes                                         | 617 (82.8)          | 253 (82.7)             | 0.957 |
| No                                          | 128 (17.2)          | 53 (17.3)              |       |
| Gender                                      |                     |                        |       |
| Males                                       | 586 (78.7)          | 241 (78.8)             | 0.971 |
| Females                                     | 159 (21.3)          | 65 (21.2)              |       |
| Type of hospital                            |                     |                        |       |
| Academic                                    | 482 (64.7)          | 160 (52.3)             | 0.001 |
| Non-academic teaching                       | 199 (26.7)          | 113 (36.9)             |       |
| Non-teaching                                | 64 (8.6)            | 33 (10.8)              |       |
| Number of beds                              |                     |                        |       |
| ≤250                                        | 74 (9.9)            | 39 (12.7)              | 0.156 |
| 251-750                                     | 370 (49.7)          | 165 (53.9)             |       |
| 751-1250                                    | 180 (24.2)          | 62 (20.3)              |       |
| >1250                                       | 121 (16.2)          | 40 (13.1)              |       |
| Type of division                            |                     |                        |       |
| Colorectal                                  | 182 (24.4)          | 66 (21.6)              | 0.362 |
| General surgery                             | 563 (75.6)          | 240 (78.4)             |       |
| Annual number of colon cancer surgery       |                     |                        |       |
| ≤50                                         | 150 (20.1)          | 73 (23.8)              | 0.001 |
| 51-150                                      | 348 (46.7)          | 167 (54.6)             |       |
| >150                                        | 247 (33.2)          | 66 (21.6)              |       |
| Laparoscopy (%)                             |                     |                        |       |
| <25                                         | 168 (22.6)          | 53 (17.3)              | 0.136 |
| 25-50                                       | 125 (16.7)          | 47 (15.3)              |       |
| 50-75                                       | 202 (27.1)          | 84 (27.5)              |       |
| >75                                         | 250 (33.6)          | 122 (39.9)             |       |
| Annual number of rectal cancer surgery      |                     |                        |       |
| ≤50                                         | 494 (66.3)          | 226 (73.9)             | 0.054 |
| 51-150                                      | 190 (25.5)          | 62 (20.3)              |       |
| >150                                        | 61 (8.2)            | 18 (5.9)               |       |
| Laparoscopy (%)                             |                     |                        |       |
| <25                                         | 205 (27.5)          | 72 (23.5)              | 0.114 |
| 25-50                                       | 119 (16.0)          | 52 (17.0)              |       |
| 50-75                                       | 178 (23.9)          | 61 (19.9)              |       |
| >75                                         | 243 (32.6)          | 121 (39.6)             |       |
| Long-course CRT-surgery interval            |                     |                        |       |
| <8                                          | 494 (66.3)          | 226 (73.8)             | 0.413 |
| 8-12                                        | 190 (25.5)          | 62 (20.3)              |       |
| >12                                         | 61 (8.2)            | 18 (5.9)               |       |

CRT: chemoradiation therapy
Table 3. Characteristics of respondents reporting delays in colorectal cancer (CRC) care across six geographical regions (N=745 reporting delayed care)

| Characteristics                                                                 | N=745 (100%) | Asia (158 / 21.2%) | Europe (422 / 56.6%) | N. America (82 / 11.0%) | S. America (57 / 7.8%) | Africa (16 / 2.1%) | Oceania (10 / 1.3%) |
|----------------------------------------------------------------------------------|--------------|---------------------|-----------------------|-------------------------|------------------------|--------------------|--------------------|
| **Hospital involvement in COVID-19 care**                                        | Fully dedicated | 125 (16.8) | 38 (24.1) | 68 (16.1) | 13 (15.9) | 4 (7.0) | 2 (12.5) | 0.0 (0) |
|                                                                                  | Partially dedicated | 569 (76.4) | 102 (64.5) | 326 (77.3) | 68 (82.9) | 53 (93.0) | 11 (68.7) | 9 (90.0) |
|                                                                                  | Not involved | 51 (6.8) | 18 (11.4) | 28 (6.6) | 1 (1.2) | 0.0 (0) | 3 (18.8) | 1 (10.0) |
| **Readily availability**                                                          | External facilities for CRC surgery | 479 (64.3) | 103 (65.2) | 291 (69.0) | 26 (31.7) | 42 (73.7) | 10 (62.5) | 7 (70.0) |
|                                                                                  | Cancer care coordinator | 420 (56.4) | 80 (50.6) | 238 (56.4) | 57 (69.5) | 32 (56.1) | 7 (43.7) | 6 (60.0) |
|                                                                                  | Personal protective equipment | 638 (85.6) | 146 (92.4) | 357 (84.6) | 70 (85.4) | 44 (77.3) | 12 (75.0) | 9 (90.0) |
| **Status of elective CRC surgery**                                               | Temporary put on hold ≤4 weeks | 349 (46.8) | 73 (46.2) | 182 (43.1) | 60 (73.2) | 21 (36.8) | 8 (50.0) | 5 (50.0) |
|                                                                                  | 5-8 weeks | 170 (48.7) | 37 (50.7) | 89 (48.9) | 33 (55.0) | 5 (23.8) | 3 (37.5) | 3 (60.0) |
|                                                                                  | >8 weeks | 126 (36.1) | 28 (38.3) | 64 (35.2) | 20 (33.3) | 11 (52.4) | 1 (12.5) | 2 (40.0) |
|                                                                                  | Temporary reduced ≤50% | 376 (50.5) | 83 (52.5) | 222 (52.6) | 22 (26.8) | 36 (63.2) | 8 (50.0) | 5 (50.0) |
|                                                                                  | >50% | 186 (49.5) | 38 (45.8) | 108 (48.6) | 13 (51.9) | 19 (52.8) | 6 (75.0) | 2 (40.0) |
|                                                                                  | Unaffected | 20 (2.7) | 2 (1.3) | 18 (4.3) | 0.0 (0) | 0.0 (0) | 0.0 (0) | 0.0 (0) |
| **Elective CRC patients**                                                         | Needing urgent surgery | 196 (26.3) | 37 (23.4) | 122 (28.9) | 17 (20.7) | 15 (26.3) | 3 (18.8) | 2 (20.0) |
|                                                                                  | Initial CRC care plan Changed | 365 (49.0) | 86 (54.4) | 206 (48.8) | 31 (78.8) | 30 (52.6) | 9 (56.3) | 3 (30.0) |
|                                                                                  | Refusing surgery | 300 (40.3) | 70 (44.3) | 154 (36.5) | 46 (56.1) | 25 (49.3) | 3 (18.8) | 2 (20.0) |
|                                                                                  | Being COVID-19 + on surgery | 145 (19.5) | 19 (12.0) | 109 (25.8) | 9 (11.0) | 7 (12.3) | 0.0 (0) | 1 (10.0) |
|                                                                                  | Becoming COVID-19 postop. | 198 (26.6) | 28 (17.7) | 146 (34.6) | 8 (9.8) | 13 (22.8) | 2 (12.5) | 1 (10.0) |
| **Staff members**                                                                 | Quarantined <10% | 388 (52.1) | 74 (46.8) | 245 (58.1) | 40 (48.8) | 23 (40.4) | 4 (25.0) | 2 (20.0) |
|                                                                                  | 10-20% | 179 (46.1) | 40 (54.1) | 104 (42.5) | 27 (67.5) | 7 (30.4) | 0.0 (0) | 1 (50.0) |
|                                                                                  | >20% | 153 (39.5) | 28 (37.8) | 100 (40.8) | 11 (27.5) | 10 (43.5) | 3 (75.0) | 1 (50.0) |
|                                                                                  | Relocated to COVID units <20% | 338 (45.4) | 66 (41.8) | 215 (50.9) | 39 (47.6) | 13 (22.8) | 3 (18.8) | 2 (20.0) |
|                                                                                  | 20-40% | 190 (56.2) | 49 (74.2) | 109 (50.7) | 23 (59.0) | 7 (33.3) | 1 (33.3) | 1 (50.0) |
|                                                                                  | >40% | 54 (16.0) | 6 (9.1) | 33 (15.3) | 8 (20.5) | 4 (30.8) | 2 (66.7) | 1 (50.0) |
|                                                                                  | MDT meetings Suspended | 364 (48.9) | 102 (64.6) | 192 (45.5) | 31 (37.8) | 31 (54.4) | 7 (43.8) | 1 (10.0) |
Table 4. Multivariable hierarchical logistic regression model exploring the association between delay and a pre-selected covariate set in colorectal cancer care (N=1,051 global respondents)

|                          | Adjusted Odds Ratio | 95% CI Lower | 95% CI Upper | P   |
|--------------------------|---------------------|--------------|--------------|-----|
| Gender                   |                     |              |              |     |
| Female (reference)       |                     |              |              |     |
| Males                    | 1.01                | 0.73         | 1.41         | 0.948 |
| Type of hospital         |                     |              |              |     |
| Academic (reference)     |                     |              |              |     |
| Non-academic teaching    | 0.62                | 0.45         | 0.85         | 0.003 |
| Non-teaching             | 0.72                | 0.44         | 1.19         | 0.203 |
| Number of beds           |                     |              |              |     |
| <250 (reference)         |                     |              |              |     |
| 251-750                  | 1.06                | 0.67         | 1.70         | 0.797 |
| 751-1250                 | 1.11                | 0.64         | 1.92         | 0.708 |
| >1250                    | 1.03                | 0.56         | 1.91         | 0.922 |
| Type of division         |                     |              |              |     |
| Colorectal (reference)   |                     |              |              |     |
| General surgery          | 1.02                | 0.73         | 1.44         | 0.903 |
| Colon cancer surgeries per year ≤50 (reference) | | | |
| 51-150                   | 0.98                | 0.68         | 1.40         | 0.905 |
| >150                     | 1.72                | 1.07         | 2.76         | 0.026 |
| Rectal cancer surgeries per year ≤50 (reference) | | | |
| 51-150                   | 0.95                | 0.64         | 1.41         | 0.790 |
| >150                     | 0.87                | 0.45         | 1.67         | 0.680 |

CI: confidence interval
Table 5. Delays in colorectal cancer care across six geographical regions (N=745 reporting delayed care)

|                     | N=745 (100%) | Asia (21.2%) | Europe (56.6%) | N.America (11.0%) | S.America (7.7%) | Africa (2.1%) | Oceania (1.3%) | P       |
|---------------------|--------------|--------------|----------------|-------------------|-----------------|---------------|---------------|---------|
| Endoscopy           | 549 (73.7%)  | 109 (69.0%)  | 310 (73.5%)    | 64 (78.0%)        | 47 (82.5%)      | 12 (75.0%)    | 7 (70.0%)     | 0.421   |
| Radiology           | 335 (45.0%)  | 69 (43.7%)   | 199 (47.2%)    | 32 (39.0%)        | 21 (36.8%)      | 10 (62.5%)    | 4 (40.0%)     | 0.336   |
| Neoadjuvant CRT     | 196 (26.3%)  | 47 (29.7%)   | 106 (25.1%)    | 16 (19.5%)        | 22 (38.6%)      | 2 (12.5%)     | 3 (30.0%)     | 0.097   |
| Prolonged CRT interval | 324 (43.5%) | 83 (52.5%)   | 175 (41.5%)    | 26 (31.7%)        | 31 (54.4%)      | 7 (43.8%)     | 2 (20.0%)     | 0.008   |
| Surgery             | 434 (58.3%)  | 90 (57.0%)   | 257 (60.9%)    | 43 (52.4%)        | 34 (59.6%)      | 7 (43.8%)     | 3 (30.0%)     | 0.208   |
| Histopathology      | 131 (17.6%)  | 43 (27.2%)   | 55 (13.0%)     | 9 (11.0%)         | 19 (33.3%)      | 4 (25.0%)     | 1 (10.0%)     | <0.001  |

CRT: chemoradiotherapy
Table 6. Multivariable hierarchical logistic regression model assessing delays in colorectal cancer (CRC) care (N=745 reporting delayed care)

| Type of hospital        | Endoscopy (N.549) OR 95%CI P   | Radiology (N.335) OR 95%CI P   | Surgery (N.434) OR 95%CI P   | Histopathology (N.131) OR 95%CI P   |
|-------------------------|---------------------------------|---------------------------------|-------------------------------|-------------------------------------|
| Academic (reference)    |                                 |                                 |                               |                                     |
| Non-academic teaching   | 0.90 (0.58-1.39) 0.638           | 0.70 (0.48-1.02) 0.065           | 0.95 (0.65-1.39) 0.808         | 0.63 (0.37-1.07) 0.089             |
| Non-teaching            | 0.64 (0.33-1.23) 0.179           | 0.57 (0.30-1.08) 0.083           | 0.91 (0.50-1.67) 0.758         | 0.23 (0.08-0.62) 0.004             |
| Number of beds ≤250 (reference) |                   |                                 |                               |                                     |
| 251-750                 | 0.75 (0.38-1.46) 0.398           | 0.86 (0.48-1.56) 0.627           | 1.11 (0.61-1.98) 0.737         | 0.52 (0.26-1.05) 0.068             |
| 751-1250                | 0.76 (0.35-1.65) 0.485           | 0.91 (0.46-1.79) 0.785           | 1.30 (0.66-2.54) 0.452         | 0.36 (0.15-0.83) 0.017             |
| >1250                   | 0.36 (0.15-0.84) 0.017           | 0.54 (0.26-1.15) 0.110           | 1.00 (0.47-2.11) 0.996         | 0.54 (0.22-1.35) 0.186             |
| Type of division        |                                 |                                 |                               |                                     |
| Colorectal (reference)  |                                 |                                 |                               |                                     |
| General surgery         | 0.83 (0.55-1.30) 0.413           | 0.78 (0.53-1.15) 0.208           | 0.67 (0.45-0.99) 0.045         | 1.49 (0.87-2.54) 0.149             |
| Colon cancer surgery per year ≤50 (reference) |                   |                                 |                               |                                     |
| 51-150                  | 1.51 (0.94-2.42) 0.087           | 1.13 (0.73-1.75) 0.572           | 1.42 (0.92-2.18) 0.114         | 0.78 (0.45-1.33) 0.356             |
| >150                    | 1.77 (0.97-3.22) 0.061           | 0.96 (0.57-1.64) 0.888           | 1.51 (0.89-2.56) 0.126         | 0.73 (0.36-1.44) 0.360             |
| Rectal cancer surgery per year ≤50 (reference) |                   |                                 |                               |                                     |
| 51-150                  | 1.12 (0.68-1.87) 0.652           | 1.56 (1.01-2.40) 0.045           | 0.75 (0.49-1.16) 0.200         | 0.70 (0.38-1.29) 0.247             |
| >150                    | 1.17 (0.52-2.64) 0.705           | 1.86 (0.93-3.71) 0.079           | 1.34 (0.65-2.74) 0.426         | 1.30 (0.55-3.06) 0.547             |
| Hospital response to COVID-19 |                   |                                 |                               |                                     |
| Fully dedicated (reference) |                             |                                 |                               |                                     |
| Partially dedicated     | 0.58 (0.36-0.99) 0.045           | 0.80 (0.52-1.22) 0.295           | 0.49 (0.36-0.77) 0.002         | 0.71 (0.41-1.22) 0.211             |
| Not involved            | 1.04 (0.43-2.51) 0.934           | 0.87 (0.42-1.79) 0.698           | 0.62 (0.29-1.31) 0.208         | 1.77 (0.75-4.14) 0.190             |
| External facilities for CRC surgery |         |                                 |                               |                                     |
| Cancer care coordinator  | 1.03 (0.72-1.47) 0.874           | 0.92 (0.67-1.26) 0.605           | 1.07 (0.78-1.47) 0.681         | 1.47 (0.96-2.26) 0.077             |
| PPE readily available   | 0.70 (0.41-1.21) 0.206           | 0.52 (0.24-0.81) 0.003           | 0.59 (0.37-0.93) 0.023         | 0.44 (0.26-0.75) 0.002             |
| Staff members quarantined | 1.58 (1.10-2.27) 0.013           | 0.79 (0.57-1.10) 0.148           | 1.34 (0.97-1.84) 0.074         | 0.99 (0.64-1.53) 0.971             |
| Staff members relocated  | 1.82 (1.26-2.62) 0.001           | 1.69 (1.23-2.33) 0.001           | 1.34 (0.97-1.85) 0.075         | 1.05 (0.68-1.63) 0.826             |
| MDT meetings suspended | 0.81 | 0.57-1.16 | 0.250 | 1.39 | 1.01-1.90 | 0.042 | 1.40 | 1.02-1.92 | 0.039 | 2.06 | 1.23-2.26 | 0.001 |
Table 7. Multivariable ordinal logistic regression model assessing the recovery of colorectal cancer (CRC) care (N=745 reporting delayed care)

| Fully recovered vs. Improved vs. Persistently limited | Adjusted Odds Ratio | 95% CI | P |
|-------------------------------------------------------|---------------------|-------|---|
| Gender                                                |                     |       |   |
| Female (reference)                                    | 0.91                | 0.64  | 1.30 | 0.611|
| Males                                                 |                     |       |     |     |
| Type of hospital                                      |                     |       |     |     |
| Academic (reference)                                  | 0.81                | 0.57  | 1.16 | 0.257|
| Non-academic teaching                                 | 0.65                | 0.37  | 1.15 | 0.140|
| Non-teaching                                          |                     |       |     |     |
| Number of beds                                        |                     |       |     |     |
| <250 (reference)                                      | 0.59                | 0.34  | 1.04 | 0.066|
| 251-750                                               | 0.62                | 0.33  | 1.17 | 0.138|
| 751-1250                                              | 0.58                | 0.29  | 1.18 | 0.135|
| >1250                                                 |                     |       |     |     |
| Type of division                                      |                     |       |     |     |
| Colorectal (reference)                                | 0.89                | 0.62  | 1.27 | 0.514|
| General surgery                                       |                     |       |     |     |
| Colon cancer surgeries per year                       |                     |       |     |     |
| ≤50 (reference)                                       | 1.06                | 0.70  | 1.59 | 0.797|
| >150                                                  | 1.72                | 0.61  | 1.64 | 0.990|
| Rectal cancer surgeries per year                      |                     |       |     |     |
| ≤50 (reference)                                       | 0.65                | 0.43  | 0.97 | 0.036|
| >150                                                  | 0.97                | 0.50  | 1.87 | 0.926|
| Hospital response to COVID-19                        |                     |       |     |     |
| Partially dedicated                                   | 1.05                | 0.70  | 1.59 | 0.798|
| Not involved                                          | 0.75                | 0.38  | 1.50 | 0.418|
| External facilities for CRC surgery                   | 0.81                | 0.59  | 1.11 | 0.183|
| Cancer care coordinator                               | 0.76                | 0.57  | 1.03 | 0.073|
| PPE readily available                                 | 0.81                | 0.54  | 1.22 | 0.318|
| Staff members quarantined                             | 1.66                | 1.22  | 2.45 | 0.001|
| Staff members relocated                               | 1.09                | 0.81  | 1.47 | 0.572|
| MDT meetings suspended                                | 0.77                | 0.57  | 1.04 | 0.086|

CI: confidence interval; MDT: multidisciplinary team; PPE: personal protective equipment
Table 8. Reasons of delay in colorectal cancer care (N=745 reporting delayed care)

| Delays | Prolonged CRT-surgery interval | Change of original plan |
|--------|-------------------------------|-------------------------|
|        | Endoscopy | Radiology | Surgery | Histopathology |                                |                                |
| Academic hospitals |         |           |         | X          |                                |                                |
| Colorectal divisions |         |           |         | X          |                                |                                |
| High-volume hospitals | X       |           |         | X          |                                |                                |
| Medium-volume of rectal cancer surgery |         |           |         | X          |                                |                                |
| Units fully dedicated to COVID-19 care | X       |           |         | X          |                                |                                |
| PPE not readily available |         | X         |         | X          | X                              |                                |
| Staff members quarantined | X       |           |         | X          |                                | X                              |
| Staff members redeployed to COVID-19 units | X       | X         |         |            |                                | X                              |
| MDT meetings suspended |         | X         |         | X          | X                              | X                              |

CRT: chemoradiotherapy; MDT: multidisciplinary team; PPE: personal protective equipment
LEGEND FOR FIGURES

Figure 1. Geographic distribution with country of origin of respondents (N.1,051)

Figure 2. Geographic distribution of respondents by the interval (days) between the date of achievement of the 100th COVID-19 case in their own country and the date of survey completion

Figure 3. Delay (weeks) in colorectal cancer care across the various fields of practice (745 respondents)

Figure 4. Reported reasons of "no delay" in colorectal cancer care (306 respondents)

Supplementary Figure 1. Types for complication determining a shift from elective to emergency surgery

Supplementary Figure 2. Comparison between “delay” and "no delay" groups in colorectal cancer care (1,051 respondents)
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Sayed Mirza Faraz, Bahrain; Safiyeva Aynur K, Azerbaijan; Sagar Ismail, Malaysia; Sahnan Kapil, UK; Sairafi Rami, Saudi Arabia; Saklami Avashe P, India; Salgado-Nesme Noel NSN, Mexico; Salem Nivry; Samar; Tamilvadius Narimantas E, Lithuania; Sambucci, Italy; Sanchez, USA; Sanchez Robles Juan Carlos, Mexico; Sanmiguel Carlos, Spain; Santacruz Eduardo, Paraguay; Santoni Simone, Italy; Santos Pedro MD, Portugal; Santos Brian U, Argentina; Santos Carlos, Portugal; Sapienza Paolo, Italy; Saracoglu Ayten, Turkey; Saracoglu Kemal T, Turkey; Sardinas Carlos, Venezuela; Sari Ramazan, Turkey; Sarma Diwakar, UK; Sartori Alberto A, Italy; Sasia Diego, Italy; Sbahi Mohammed H, Saudi Arabia; Scabini Stefano, Italy; Scaringi Stefano, Italy; Scheinin Tom M, Finland; Schiavo Marcello, Italy; Schizas Alexis, UK; Sciadone Guido, Italy; Scognamiglio Fabrizio, Italy; Scott Kelley, USA; Scow Jeffrey S, USA; Sechi Raffaele, Italy; Seehra Harkiran, UK; Segering Joerg, Germany; Seluck Mehtap, Turkey;
Selemane Carlos, Mozambique; Seltman Ann, USA; Selvaggi Francesco, Italy; Sensi Bruno, Italy; Seow-Choen Francis, Singapore; Sernagiotto Johanna, Sweden; Serrano González Javier, Spain; Sert Ismail, Turkey; Serventi Alberto, Italy; Sforza Sergio, Italy; Shabbir Jamshed, UK; Shabeeb Fadel, UAE; Shafik Ali, Egypt; Shalaby Mostafa, Egypt; Shanker Bethann, USA; Shanmugam Venkatesh, UK; Sharif Umar, UK; Shehata Ahmed, Egypt; Shelton Andrew, USA; Shinto Akamoto, Japan; Shlyk Daria, Russia; Shukla Amit, UK; Sibio Simone, Italy; Sietze Koopal, Netherlands; Sirikurnpiboon Siripong, Thailand; Sivrikoz Emre, Turkey; Sizonenko Nikolay, Russia; Slavchev Mihail T, Bulgaria; Sniuolis Pranas, Lithuania; Soares Duarte, Qatar; Sojaar Valentin, Slovenia; Sokmen Selman, Turkey; Sokol Thomas, USA; Soldatov Denis, Russia; Soncini Stefania, Italy; Sordo Ricardo, Mexico; Sosa María V, Spain; Sousa Xavier, Portugal; Sozutek Alper, Turkey; Spiezie Giovanni, Italy; Spinelli Antonino, Italy; Stahl Etienne, Mexico; Stefanovic Goran Z, Serbia; Steckel Brian, USA; Stefan Neagu, Romania; Stefanescu Victor, Romania; Steinbagen Randolph, USA; Stella Marco, Italy; Stephens Stephens, Australia; Stevenson Andrew RL, Australia; Stitzenberg Karyn, USA; Strobom Paul, USA; Sturiale Alessandro, Italy; Suwannakij Chanchai, Thailand; Sztipits Tamas, Hungary; Takashi Akiyoshi, Japan; Takkenberg Marijn, Netherlands; Tallon-Aguilar Luis, Spain; Tam Michael, USA; Tammaro Pasquale, Italy; Tan Kerkan, Singapore; Tanner Jürgen, Switzerland; Thanachaol Prasertsin, Thailand; Thiruchelvam Arun, Malaysia; Tamburini Andrea M, Italy; Tamaresha Jily, Ghana; Tang Jinghua, China; Tapiolas Ingrid, UK; Tarey Magnu, Sweden; Tarverdijev Andrej, Russia; Tatarinov Andrey, Russia; Telesca Giovanni, Italy; Tewag Quint, US; Thakur Sukesh, India; Thomas Ekrem, Norway; Thomas Kuruc, Germany; Tiesi Vincenzo, Italy; T. Moemoein, Myanmar; Tita Agustin C, India; Tijmen van Noord, USA; Tkachenko Fedot, Ukraine; Tonello Paolo, Italy; Tookey Richard, USA; Torres Juan, Spain; Troci Albert, Italy; Trompetto Mario, Italy; Tsujinaka Shingo, Japan; Tufo Andrea, Italy; Tunstall-Pedoe Hugh, UK; Tutino Liviu, Romania; Turkmen Serdar, Turkey; Urbaničkis Agris, Lithuania; Ursoattore Aida, Italy; Usmanov Afzal, Pakistan; Uemura Mamoru, Japan; Umar Abdullahi, Nigeria; Urein Jorge, Russian Federation; Usheva Evgeniya, Bulgaria; Usmanov Kamran, Uzbekistan; Umarov Shavkat, Uzbekistan; Uthaiyakan Phattarawiwat, Thailand; Uzun Ali, Turkey; V Duke, USA; Vailati Bruna, Brazil; Vanguri Celestine, Canada; Vannelli Alberto, Italy; Venn Mary L, UK; Vercillo Kristin, USA; Vergara Fernandez Omar, Mexico; Viero Peter, Switzerland; Veronesi Paolo, Italy; Vicente Aline, Brazil; Victor Tomulescu, Romania; Vitzthum Matthias, Germany; Vingri lista Harald, Norway; Vintzileos Andreas, Greece; Visteinurekun Phumcholvilai, Thailand; Vistisen Hans, Norway; Vitiopinoparb Kasidin, Thailand; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostantina, Greece; Voutsaraki Kostan...
### APPENDIX 2: DECOR-19 Survey

| Q1 | The information provided in this questionnaire will be exclusively used for research purposes. It will not be used in a manner which would allow identification of your individual responses. | 1 | Accept |
| Q2 | Email |  |
| Q3 | Gender |  |
| Q4 | Country |  |
| Q5 | Hospital name |  |
| Q6 | Type of hospital | 1 | Academic |
| | | 2 | Non-academic teaching |
| | | 3 | Non-teaching |
| Q7 | Number of hospital beds | 1 | <250% |
| | | 2 | 251-750% |
| | | 3 | 751-1250% |
| | | 4 | >1250% |
| Q8 | Unit type | 1 | Colorectal |
| | | 2 | General surgery |
| Q9 | Number of surgery for colon cancer per year | 1 | <50 |
| | | 2 | 51-150 |
| | | 3 | >150 |
| Q10 | Laparoscopic or robotics for colon cancer (last year’s estimate) | 1 | <25% |
| | | 2 | 26-50% |
| | | 3 | 51-75% |
| | | 4 | >75% |
| Q11 | Number of surgery for rectal cancer per year | 1 | <50 |
| | | 2 | 51-150 |
| | | 3 | >150 |
| Q12 | Laparoscopic or robotics for rectal cancer (last year’s estimate) | 1 | <25% |
| | | 2 | 26-50% |
| | | 3 | 51-75% |
| | | 4 | >75% |
| Q13 | Average interval between completion of long course chemoradiation and surgery for locally advanced rectal cancer | 1 | <8 weeks |
| | | 2 | 8-12 weeks |
| | | 3 | >12 weeks |
| Q14 | Has your unit experienced any flaw/delay in colorectal cancer care (e.g. in undertaking surgery, oncology, radiotherapy, endoscopy, or noting a reduced number of referrals from other centers)? |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Yes                                                                                                                                  |
| 2   | No (skip to Q35)                                                                                                                      |

| Q15 | How has your hospital been preparing for the COVID-19 emergency? |
|-----|-----------------------------------------------------------------|
| 1   | Fully dedicated to COVID-19 patients                             |
| 2   | By creating dedicated pathways and wards to COVID-19 patients    |
| 3   | Not involved at all in COVID-19 patients’ care                   |

| Q16 | Did your hospital establish external connections to COVID-free facilities in order to perform oncologic surgery? |
|-----|-----------------------------------------------------------------------------------------------------------------|
| 1   | Yes                                                                                                              |
| 2   | No                                                                                                               |

| Q17 | Is a hospital-based cancer care coordinator currently available? |
|-----|-----------------------------------------------------------------|
| 1   | Yes                                                                 |
| 2   | No                                                                 |

| Q18 | Are personal protective equipment readily available (adequate for quantity and quality) at your workplace? |
|-----|-----------------------------------------------------------------------------------------------------------------|
| 1   | Yes                                                                                                              |
| 2   | No                                                                                                               |

| Q19 | Status of elective surgical practice |
|-----|-----------------------------------------------------------------------------------------------------------------|
| 1   | Temporarily put on hold                                                                                  |
| 2   | Temporarily reduced (skip to Q19_b)                                                                             |
| 3   | Unaffected (skip to Q20)                                                                                     |

| Q19_a | For how many weeks? |
|-------|---------------------|
| 1     | <=4                 |
| 2     | 5-8                 |
| 3     | >8                  |

| Q19_b | To what extent |
|-------|----------------|
| 1     | <=50%           |
| 2     | >50%            |

| Q20 | Have you ever had a patient refusing elective surgery for colorectal cancer? |
|-----|--------------------------------------------------------------------------|
| 1   | Yes                                                                 |
| 2   | No (skip to Q21)                                                         |

| Q20_a | For what reason(s)? |
|-------|---------------------|
| 1     | Fear of being infected   |
| 2     | Other                  |

| Q20_a_i | If you selected Other, please specify: |
|---------|---------------------------------------|

| Q21 | Has any member of staff in your unit been quarantined after testing COVID-19 positive? |
|-----|--------------------------------------------------------------------------------------|
| 1   | Yes                                                                                   |
| 2   | No                                                                                     |

| Q21_a | If you selected Yes, please specify (%) |
|-------|----------------------------------------|

| Q22 | Has any member of staff in your unit been relocated to ICUs and/or COVID-19 units? |
|-----|------------------------------------------------------------------------------------|
| 1   | Yes                                                                                  |
| 2   | No                                                                                   |

| Q22_a | If you selected Yes, please specify (%) |
|-------|----------------------------------------|

| Q23 | Have you ever experienced prolonged deferral of elective endoscopy for colorectal cancer patients? |
|-----|-----------------------------------------------------------------------------------------------|
| 1   | Yes                                                                                           |
| 2   | No (skip to Q24)                                                                             |
| Q23_a | How many weeks delay on average? |
|-------|--------------------------------|
| 1     | <=4                            |
| 2     | 5-8                            |
| 3     | >8                             |

| Q24   | Have you ever experienced prolonged deferral of elective imaging (EAUS/CT/MRI/PET) for colorectal cancer patients? |
|-------|------------------------------------------------------------------------------------------------------------------|
| 1     | Yes                                                                                                              |
| 2     | No (skip to Q25)                                                                                                 |

| Q24_a | How many weeks delay on average? |
|-------|--------------------------------|
| 1     | <=4                            |
| 2     | 5-8                            |
| 3     | >8                             |

| Q25   | Have you ever experienced delayed turnaround time of histopathology reports for colorectal cancer patients (e.g. pre-op. biopsies)? |
|-------|------------------------------------------------------------------------------------------------------------------|
| 1     | Yes                                                                                                              |
| 2     | No (skip to Q26)                                                                                                 |

| Q25_a | How many weeks delay on average? |
|-------|--------------------------------|
| 1     | <=4                            |
| 2     | 5-8                            |
| 3     | >8                             |

| Q26   | Have multidisciplinary team meetings ever been put on hold? |
|-------|----------------------------------------------------------|
| 1     | Yes                                                                 |
| 2     | No                                                                 |

| Q27   | Have you ever experienced prolonged deferral of neoadjuvant chemoradiation for rectal cancer patients? |
|-------|-----------------------------------------------------------------------------------------------------|
| 1     | Yes                                                                                                  |
| 2     | No (skip to Q28)                                                                                     |

| Q27_a | How many weeks delay on average? |
|-------|--------------------------------|
| 1     | <=4                            |
| 2     | 5-8                            |
| 3     | >8                             |

| Q28   | Prolonged interval between the end of chemoradiation and surgery |
|-------|------------------------------------------------------------------|
| 1     | Yes                                                               |
| 2     | No                                                                |

| Q29   | Have you ever experienced prolonged deferral of surgery for colorectal cancer patients? |
|-------|---------------------------------------------------------------------------------------|
| 1     | Yes                                                                                   |
| 2     | No (skip to Q30)                                                                     |

| Q29_a | How many weeks delay on average? |
|-------|--------------------------------|
| 1     | <=4                            |
| 2     | 5-8                            |
| 3     | >8                             |

| Q29_b | For what reasons (multiple choice question)? |
|-------|---------------------------------------------|
| 1     | Increasing need for restaging deferred patients |
| 2     | Reduced number of referrals                 |
| 3     | Reduced number of theatre slots              |
| 4     | Suspension of multidisciplinary team meetings |
| 5     | Shortage of nurses                          |
| 6     | Shortage of anesthetists                     |
7 | Shortage of surgeons  
8 | Hospital directions  
9 | Reduced number of intensive care unit (ICU) beds  
10 | Reduced number of hospital beds  
11 | Reduced number of referrals from other centers  
12 | Lack of cancer care coordinator  
13 | Lack of personal protective equipment  
14 | Other  

Q29_b_i | If you selected Other, please specify:  
Q30 | Have you ever changed your initial elective treatment plan?  
1 | Yes  
2 | No (skip t Q31)  

Q30_a | In which way?  
1 | Neoadjuvant CRT converted to resection  
2 | Laparoscopy converted to open  
3 | Robotic converted to laparoscopy  
4 | Robotic converted to open  
5 | TAMIS/TEM converted to abdominal (or abdominoperineal) approach  
6 | TAMIS/TEM converted to neoadjuvant CRT  
7 | Resection converted to chemo- or chemoradiotherapy  
8 | Resection converted to endoscopic stenting  
9 | Other  

Q30_a_i | If you selected Other, please specify:  
Q30_b | For what reason(s)?  
1 | Disease progression  
2 | Reduced number of theatre slots  
3 | Shortage of personnel  
4 | Other  

Q30_b_i | If you selected Other, please specify:  
Q31 | Did any patient on the waiting list undergo urgent operation for colorectal cancer?  
1 | Yes  
2 | No (skip to Q32)  

Q31_a | How many on average?  
1 | <=10  
2 | >10  

Q31_b | Do you find this number higher than that observed in a same time period before the outbreak?  
1 | Yes  
2 | No  

Q31_c | For what reason(s)?  
1 | Delayed diagnostics  
2 | Delayed chemotherapy  
3 | Delayed radiotherapy  
4 | Onset of complication  

Q31_c_i | Type of complication (if any)  
1 | Bowel obstruction  
2 | Bleeding  
3 | Bowel perforation  

Q32 | How many colorectal cancer patients were COVID-19 positive at the time of the operation?
| Q33 | How many colorectal cancer patients tested COVID-19 positive in the post-operative period? |
|-----|-----------------------------------------------------------------------------------|
| Q34 | Current colorectal cancer care at your unit                                       |
| 1   | Fully recovered                                                                   |
| 2   | Improved but not yet fully recovered                                              |
| 3   | Still limited                                                                     |

| Q34_a | Since when?                                                                         |
|-------|-------------------------------------------------------------------------------------|
| 1     | COVID-19 did not significantly affect my geographical area                           |
| 2     | Working at a COVID-19-free hospital                                                 |
| 3     | Surgical bed capacity not reduced for COVID-19 care                                 |
| 4     | Operating slots not reduced for colorectal cancer                                   |
| 5     | Intensive care unit bed capacity not reduced for colorectal cancer surgery          |
| 6     | Surgical staff not redeployed to dedicated COVID-19 units                           |
| 7     | No delay in diagnostic assessment of colorectal cancer                              |
| 8     | No delay in oncologic treatment of colorectal cancer                                |
| 9     | Other                                                                              |

| Q35_a | If you selected Other, please specify:                                              |
### Appendix 3. Checklist for Reporting Results of Internet E-Surveys (CHERRIES)\textsuperscript{11}

| Item category                  | Checklist item                  | Page no. | Description                                                                                                                                                                                                 |
|-------------------------------|---------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| **Design**                    | Study design                    | Page 2   | The target population were members of renowned Societies with interest in colorectalology.                                                                                                                |
| **Ethics**                    | Ethics approval                 | Page 2   | This study was exempt from review board approval at Authors’ Institutions.                                                                                                                                   |
|                               | Informed consent                | Page 2   | All participants had already provided informed consent to participate in online surveys. Informed consent for the present survey was obtained from all those agreeing to complete a survey, with participants informed on the welcome page that the survey aimed to assess the delay in colorectal cancer care, that it would take approximately 10-15 minutes to complete, that all responses were confidential and that reporting would be on an aggregate level only. Consent was indicated when respondents clicking the ‘Accept’ button from this page. |
|                               | Data protection                 | Page 3   | Proprietary survey software and local servers were used to ensure data protection. No personal information was linked to survey results in any way. The fully de-identified dataset is kept on password protected computers. |
| **Development and pre-testing** | Open vs. closed survey          | Page 2   | This was an open survey. Participants were recruited through dedicated scientific societies advertisement.                                                                                                    |
|                               | Contact mode                    | Page 2   | The initial contact with the potential participants was made on the Internet.                                                                                                                                |
|                               | Advertising the survey          | Page 2   | The survey was advertised among members of Scientific Societies in the field of colorectalology.                                                                                                            |
| **Survey administration**     | Web/email                       | Pages 2-3| This was a web-based survey, with respondents channeled to ‘Online surveys’ (formerly BOS – Bristol Online Survey) site, developed by the University of Bristol. Responses were collected through the online survey platform and stored on secure local servers. Responses were single or multiple choice, numeric, and open text. The online survey platform is licensed by the Queen Mary University of London for research projects. Voluntary. |
|                               | Context                         | Pages 2-3|                                                                                                                                                                                                             |
|                               | Mandatory/voluntary incentives  | Page 2   | No compensation offered.                                                                                                                                                                                  |
|                               | Time/date                       | Page 3   | Responses were collected between May 20th to June 10th 2020.                                                                                                                                              |
|                               | Item randomisation              | Page 3   | No randomisation of items was used.                                                                                                                                                                         |
| Response rates | Adaptive questioning | Page 3 | Adaptive questioning (branched) was used. Relevant survey items were displayed based on previous responses. The full survey was distributed over 9 pages |
|---------------|----------------------|--------|---------------------------------------------------------------------------------------------------------------------------------|
| Number of screens | Page 2 | A maximum of 5 items were displayed on any one survey page. The full survey comprised a total of 35 items, although because of the adaptive nature of the questionnaire, not all respondents answered all items. |
| Completeness check | Page 3 | All survey items were deemed to be mandatory, and respondents prompted to complete outstanding items before leaving the survey page on which the item was contained. |
| Review step | Page 3 | Respondents were unable to change their responses once submitted. |
| Unique site visitor | Page 2 | Determination of unique visitors was only possible for the closed group of participants who received an email invitation based on IP addresses. |
| View rate | Page 2 | Not applicable. |
| Participation rate | Page 2 | Not applicable. |
| Completion rate | Page 3 | 100%. |
| Preventing multiple entries from same individual | | | |
| Cookies used | Page 3 | No |
| IP check | Page 3 | No |
| Log file analysis | Page 3 | Not used |
| Registration | Page 3 | Not applicable |
| Analysis | | | |
| Handling of incomplete questionnaires | Page 3 | Not applicable |
| Questionnaires with atypical timestamp | Page 3 | No respondents were removed from the survey for completing the items too quickly. The minimum completed survey was timed at approximately 10 minutes. |
| Statistical correction | Page 3 | Not applicable |
Appendix 3. Colorectal cancer care at the date of survey completion across six geographical regions (N=745 reporting delayed care)

| Status                                      | N=745 (100%) | Asia (21.2) | Europe (56.6) | N.America (11.0) | S.America (7.7) | Africa (2.1) | Oceania (1.3) |
|---------------------------------------------|--------------|-------------|---------------|------------------|-----------------|--------------|--------------|
| Fully recovered to pre-COVID status         | 131 (17.6)   | 40 (25.3)   | 73 (17.3)     | 13 (15.9)        | 1 (1.8)         | 1 (6.2)      | 3 (30.0)     |
| Improved but not fully recovered to pre-COVID status | 420 (56.4)   | 70 (44.3)   | 278 (65.9)    | 48 (58.5)        | 15 (26.3)       | 3 (18.8)     | 6 (60.0)     |
| Persistently limited as during the outbreak | 194 (26.0)   | 48 (30.4)   | 71 (16.8)     | 21 (25.6)        | 41 (71.9)       | 12 (75.0)    | 1 (10.0)     |
Appendix 4. Zero-inflated negative binomial regression exploring the interval (days) between the date of achievement of the 100\textsuperscript{th} COVID-19 case and the date of recovery (fully/improved) or the date of persistently limited colorectal cancer (CRC) practice (N=745 reporting delayed care)

| Status of CRC care                        | MIR   | 95%CI Lower | 95%CI Upper | P       |
|-----------------------------------------|-------|-------------|-------------|---------|
| Fully recovered (reference)             | 0.99  | 0.88        | 1.11        | 0.087   |
| Improved                                | 0.41  | 0.35        | 0.47        | <.001   |
| Persistently limited                    |       |             |             |         |

| Gender                                  | MIR   | 95%CI Lower | 95%CI Upper | P       |
|-----------------------------------------|-------|-------------|-------------|---------|
| Female (reference)                      | 0.99  | 0.89        | 1.11        | 0.938   |
| Males                                   |       |             |             |         |

| Type of hospital                        | MIR   | 95%CI Lower | 95%CI Upper | P       |
|-----------------------------------------|-------|-------------|-------------|---------|
| Academic (reference)                    | 1.01  | 0.90        | 1.13        | 0.853   |
| Non-academic teaching                   | 0.97  | 0.81        | 1.17        | 0.778   |

| Number of beds                          | MIR   | 95%CI Lower | 95%CI Upper | P       |
|-----------------------------------------|-------|-------------|-------------|---------|
| <250 (reference)                        | 1.01  | 0.85        | 1.21        | 0.904   |
| 251-750                                 | 1.07  | 0.87        | 1.30        | 0.527   |
| 751-1250                                | 1.01  | 0.81        | 1.26        | 0.921   |
| >1250                                   |       |             |             |         |

| Type of division                        | MIR   | 95%CI Lower | 95%CI Upper | P       |
|-----------------------------------------|-------|-------------|-------------|---------|
| Fully dedicated to CRC care (reference) | 1.07  | 0.96        | 1.20        | 0.241   |
| General surgery                         |       |             |             |         |

| Colon cancer surgeries per year         | MIR   | 95%CI Lower | 95%CI Upper | P       |
|-----------------------------------------|-------|-------------|-------------|---------|
| ≤50 (reference)                         | 1.02  | 0.89        | 1.16        | 0.774   |
| 51-150                                  | 1.03  | 0.88        | 1.20        | 0.728   |
| >150                                    |       |             |             |         |

| Rectal cancer surgeries per year        | MIR   | 95%CI Lower | 95%CI Upper | P       |
|-----------------------------------------|-------|-------------|-------------|---------|
| ≤50 (reference)                         | 1.06  | 0.93        | 1.20        | 0.398   |
| 51-150                                  | 1.17  | 0.95        | 1.44        | 0.150   |
| >150                                    |       |             |             |         |

CI: confidence interval; MIR: mean interval ratio
| Region (No. countries) | 84 countries (No. participants) | Surgical societies |
|------------------------|---------------------------------|--------------------|
| Europe (32)            |                                 | European Society of Coloproctology (ESCP), German Society for Coloproctology (DGK), International Society of University Colon and Rectal Surgeons (ISUCRS), Italian Society of Colorectal Surgery (SICCR), Portuguese Society of Coloproctology, Portuguese Society of Surgery (SPCR), Russian Association of Coloproctology, Swedish Society of Colorectal Surgery, Turkish Society of Colon and Rectal Surgery (TORKS) |
| Asia (26)              |                                 | Asia-Pacific Federation of Coloproctology (APFPC), Chinese Society of Coloproctology, International Society of University Colon and Rectal Surgeons (ISUCRS), Korean Society of Coloproctology, Malaysian Society of Colorectal Surgeons (MSCRS), Philippine Society of Colon and Rectal Surgeons (PSCRS), Philippine Society of General Surgeons (PSGS) |
| North America (8)      |                                 | American Society of Colon and Rectal Surgeons (ASCRS), International Society of University Colon and Rectal Surgeons (ISUCRS) |
| South America (10)     |                                 | International Society of University Colon and Rectal Surgeons (ISUCRS), LatinAmerican Association of Coloproctology (ALACLP), Venezuelan Coloproctology Society |
| Africa (7)             |                                 | Egyptian Society of Colon and Rectal Surgeons (ESCRS), International Society of University Colon and Rectal Surgeons (ISUCRS), South African Colorectal Society (SACKS) |
| Oceania (3)            |                                 | Asia-Pacific Federation of Coloproctology (APFPC), International Society of University Colon and Rectal Surgeons (ISUCRS) |
N=306

- Working in a COVID-19-free divisions
- Surgical beds capacity remained unaltered
- Mild geographic impact of COVID-19
- ICU beds capacity remained unaltered
- Surgical staff not redeployed in COVID-19 units
- No delays in diagnostics
- Operative slots remained unaltered
- Conserved resources for CRC care

Combination:

- ≥3: 64%
- 2: 21%
- 1: 16%
Article Summary

Global changes in both diagnostic and therapeutic practices in colorectal cancer care were evident in this survey conducted to analyze the impact of COVID-19 outbreak. The importance of this finding is that changes were associated with differences in health care delivery systems, hospital’s preparedness, resources availability, and local COVID-19 prevalence rather than geographical variations. These findings may help adopting preventing measures during future virus surges.