



# The impact of the first wave of the COVID-19 pandemic on the exposure of general surgery trainees to operative procedures

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## Abstract

**Introduction** During the COVID-19 pandemic, the redeployment of operating room (OR) staff resulted in a significant ramp-down of elective surgery. To mitigate the negative effects of the pandemic on surgical education, this study was planned to estimate the impact of the first wave of the pandemic on the participation of general surgery residency and fellowship trainees in operative procedures.

**Methods** This study is a retrospective review of all adult general surgery procedures performed at 3 sites of an academic health care network. Cases performed during the first wave of the pandemic (March–June 2020) were compared to the same period of the previous year pre-pandemic (March–June 2019). Trainees were categorized as junior (Post-Graduate-Year [PGY] 1–2), senior (PGY3–5), or fellows (PGY6–7). Operating exposure was defined as (1) the total number of cases attended by at least one trainee and (2) total time spent in the OR by all trainees (hours). The impact of the pandemic was estimated as percentage of baseline (2019).

**Results** During the first wave of the pandemic, a total of 914 cases were performed, compared to 1328 in the pre-pandemic period (69%). Junior trainees were more affected than senior trainees with reductions in both case volume (68% versus 78% of baseline attendance) and time (68% versus 77% of baseline operating time). Minimally invasive surgery fellows were most severely affected trainees and colorectal fellows were least affected (14% and 75% of baseline cases, respectively). Participation in emergency surgery cases and surgical oncology cases was relatively preserved (87% and 105% of baseline, respectively).

**Conclusions** The first wave of the COVID-19 pandemic reduced operative exposure for general surgery trainees by approximately 30%. Procedure-specific patterns reflected institutional policies for prioritizing cancer operations and emergency surgeries. These findings may inform the design of remediation activities to mitigate the impact of the pandemic on surgical training.

**Keywords** Operative exposure · Surgical education · COVID-19 pandemic

The first case of COVID-19 in Quebec was diagnosed on February 28th, 2020; as a response, the Quebec government implemented a province-wide order of lockdown and self-isolation on March 13, 2020 [1]. One of the key strategies to expand the healthcare system capacity to treat patients with COVID-19 included a mandated cessation of non-essential

surgical procedures to re-deploy staff and liberate hospital beds [2]. This resulted in a significant decline in access to the operating rooms with only urgent procedures being performed. In addition, fear of being infected by COVID-19 during the first wave of the pandemic may have resulted in a significant decrease in number of patients seeking emergency care [3, 4]. Ultimately, this led to a reduction not only in the number of elective surgical procedures being performed, but also emergency procedures. At the same time, measures aiming to limit exposure of health care workers to potentially infected patients needing emergency surgery were implemented, and surgical trainees were redeployed to care for patients with COVID-19. These factors resulted in

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significantly decreased access and participation of surgical trainees in operative cases [5–7].

While there are many adjuncts to facilitate procedural training, such as simulation and on-line curricula [8–11], progressive graduated responsibility in the operating room (OR) is necessary for autonomy and independence of surgical trainees. While longer 5 to 6 years residency training programs may be able to adjust and compensate for a short-term reduction in surgical exposure, trainees in shorter 1–2 year-long fellowships may be more severely impacted. As the pandemic is still ongoing with subsequent waves and new variants appearing, recurrent disruptions in procedural training may have a significant negative impact on the competency of surgical trainees. In addition, this may affect certification decisions in jurisdictions that require attainment of surgical case log benchmarks.

Current available literature reports a reduction in operative exposure for surgical trainees during the pandemic [7, 8, 12]. However, these studies rely on self-reporting by surgical trainees [7, 8, 12]. An objective measure of the effect of COVID-19 on surgical exposure at each level of training is important to inform the development of tailored short- and long-term remediation plans. The objective of this study is to quantify the impact of the first wave of the COVID-19 pandemic (March 2020–June 2020) on the access of general surgery trainees to operative procedures in comparison to the same period of the previous year pre-pandemic (March 2019–June 2019).

## Materials and methods

### Study design

This study involved the use of an institutional database as well as retrospective chart review to retrieve all emergency and elective operating room procedures performed on General Surgery Clinical Teaching Units (CTUs) at the 3 adult sites of the McGill University Health Center (MUHC). The CTUs include Colorectal/MIS, Bariatrics, Trauma, Hepatobiliary, Transplant, Acute Care Surgery and Surgical Oncology. Data were collected for March to June in both 2019 and 2020. Cases performed during the pandemic period (2020) were compared to the pre-pandemic period (2019). All operations involving adult patients ( $\geq 18$  years-old) undergoing elective and emergency surgery performed by a general surgeon attending staff was included in this analysis. The study was approved by the institutional review board (MUHC Research Ethics Board ref. 2021-6972).

General Surgery trainees were defined based on the North American Post-Graduate Year (PGY) System. Trainees were categorized as junior trainee (PGY1-2), senior trainee (PGY3-5) or fellowship trainees ( $> PGY5$ ) if they

were enrolled in a Fellowship Council Accredited program [Advanced GI/Minimally Invasive Surgery (MIS), Bariatric Surgery, Hepatopancreatobiliary Surgery (HPB)] or a Royal College of Physicians and Surgeons of Canada subspecialty training program (Colorectal Surgery).

### Measures

Characteristics of each case were documented. Operating exposure was defined as (1) the total number of cases attended by at least one trainee (“attendance”) and (2) the total time spent in the OR by trainees (“hours”). This time is measured from skin incision to skin closure and excludes anesthesia time and the preparatory time. Breakdown of case categories were defined based on the Fellowship Council Specific Fellowship Type Curricula and Program Requirements [13] for fellow trainees and the Royal College of Physicians and Surgeons of Canada Objectives of Training in the Specialty of General Surgery [14].

### Statistical analysis

Continuous variables are presented as mean  $\pm$  standard deviation (SD). Categorical variables are presented as  $n$  (% total). Statistical analyses were performed using RStudio (version 1.2.1577; RStudio, Inc., Boston, MA, USA). Analysis of variance (ANOVA) was used to compare the continuous outcomes. The impact of the pandemic on categorical variables was estimated as percentage of baseline (2019).

## Results

While patient characteristics were similar between the two periods, the impact of the pandemic varied by case designation (Table 1). The number of oncology cases remained stable, but these made up a larger proportion of cases (24.3% pre-pandemic and 37.2% during the pandemic). The average procedure time was similar between the pre-pandemic and pandemic period ( $110.9 \pm 79.9$  min vs.  $116.1 \pm 85.5$  min,  $p = 0.167$ ). However, the total time in the operating room (including anesthesia time) was significantly higher during the pandemic periods compared to the pre-pandemic baseline ( $159.7 \pm 95.9$  min vs.  $180.5 \pm 128.5$  min,  $p < 0.001$ ), likely due to the implementation of COVID-19 safety protocols.

The number of residents and fellows assigned to the CTUs was similar in the pre-pandemic and pandemic periods (Table 2). The number of eligible cases attended by at least one trainee was lower in the pandemic period compared to the pre-pandemic period (1328 versus 914 cases, 69% of baseline). This difference was more pronounced in May and was less so in June (Fig. 1).

**Table 1** Characteristics of operative cases during the pre-pandemic (March–June 2019) and pandemic (March–June 2020) periods

	2019	2020	Percent of baseline/ <i>p</i> value
Patient characteristics			
Age (years)	55.3 ± 17.7	57.6 ± 15.7	<i>p</i> < 0.001
ASA (> II)	734 (55.3%)	515 (56.3%)	70.2%
Case designation			
Trauma cases	48 (3.6%)	34 (3.7%)	70.8%
Oncology cases	323 (24.3%)	340 (37.2%)	105.3%
Other	957 (72.1%)	540 (59.1%)	56.4%
Urgency			
Emergency	368 (27.7%)	320 (35.0%)	87.0%
Elective	960 (72.7%)	594 (65.0%)	61.9%
Surgical approach			
Laparoscopic	568 (42.8%)	360 (39.4%)	63.4%
Open	746 (56.2%)	542 (59.3%)	72.7%
Conversion	14 (1.1%)	12 (1.3%)	85.7%
Anesthesia type			
Local	40 (3.0%)	42 (4.6%)	105.0%
General	1257 (94.7%)	840 (91.9%)	66.8%
Spinal	31 (2.3%)	31 (3.4%)	100.0%
Total cases	1328	914	68.8%
Time in operating room (minutes)	159.7 ± 95.9	180.5 ± 128.5	<i>p</i> < 0.001
Procedure time (minutes)	110.9 ± 79.9	116.1 ± 85.5	<i>p</i> = 0.167

Information is presented as *n* (% of total cases) or mean ± SD

ASA American Society of Anesthesia Score

**Table 2** Training level and fellowship designation of trainees assigned to the seven Clinical Teaching Units during the pre-pandemic (March–June 2019) and pandemic (March–June 2020) periods

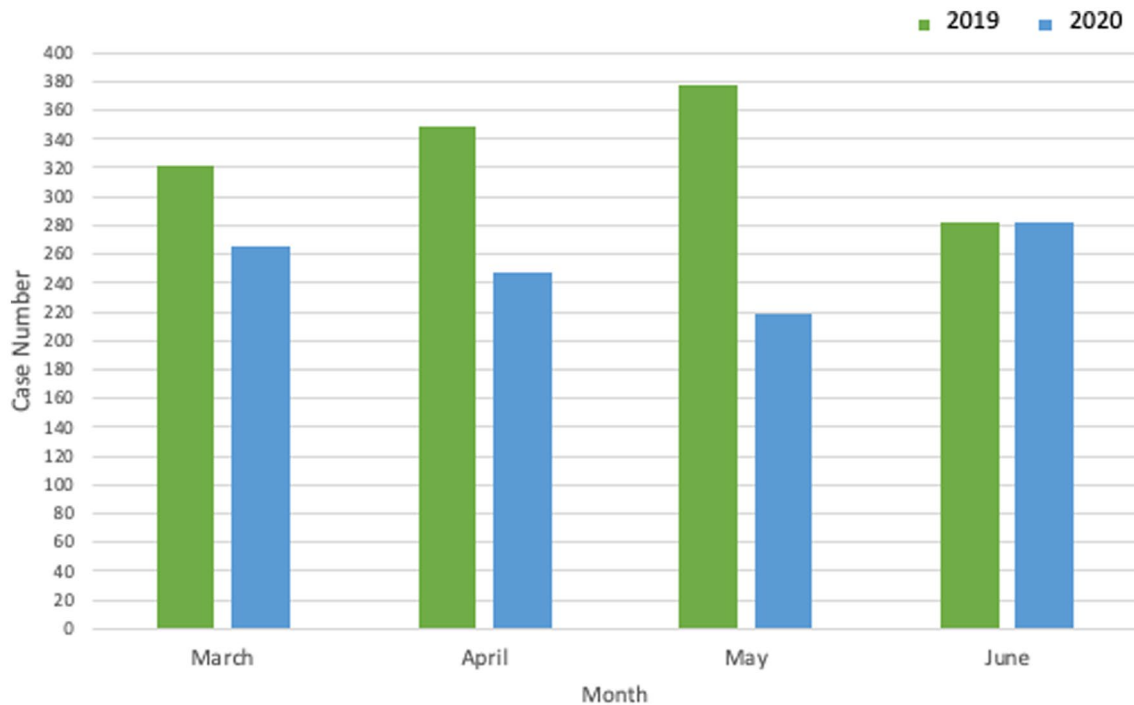
Trainee level	2019	2020
	<i>n</i>	<i>n</i>
Junior trainees	15	14
PGY1	8	7
PGY2	7	7
Senior trainees	15	17
PGY3	5	6
PGY4	5	7
PGY5	5	4
MIS fellow	1	1
HPB fellow	2	2
Colorectal fellow	3	3
Bariatrics fellow	2	2
Total	38	39

*PGY* postgraduate level, *MIS* minimally invasive surgery, *HPB* hepatobiliary and pancreas surgery

The impact of the pandemic varied by training level and specialty (Table 3). Junior trainees were more severely affected than senior trainees during the pandemic period

with 68% case attendance compared to the pre-pandemic baseline [424 cases (2020) vs. 622 cases (2019)] and 68% operating time compared to baseline [753 h (2020) vs. 1115 h (2019)]. Senior trainees attended 73% of the baseline number of cases [582 (2020) vs. 803 (2019)] and had 77% of the baseline operating time [1229.4 h (2020) vs. 1604.8 h (2019)]. Among fellows, the MIS trainee was most severely affected [27.0 h (2020) vs. 155.1 h (2019), 17.4% of baseline] while colorectal trainees were least affected [225.0 h (2020) vs. 252.7 h (2019), 75.4% of baseline]. For all training levels, the decline in time was similar to the decline in number of cases, with the exception of the colorectal fellows who participated in 75.4% of baseline number of cases but had 89.0% of the baseline operating time, suggesting an increase in case complexity.

The impact of the pandemic on OR attendance by trainee level and case type is reported in Table 4. For junior trainees, compared to the pre-pandemic period, there were important reductions in exposure to hernia [32 (2020) vs. 117 (2019), 27% of baseline], cholecystectomy [53 (2020) vs. 85 (2019), 62% of baseline] and thyroid procedures [8 (2020) vs. 27 (2019), 29.6% percent of baseline]. However, exposure to breast and melanoma cases increased while there was no change in exposure to appendectomy cases. For senior



**Fig. 1** Trend of General Surgery operations attended by trainees per month

**Table 3** Trainee operating room exposure as total cases attended and overall operating time (hours) during the pre-pandemic (March–June 2019) and pandemic (March–June 2020) periods

Trainee level		2019	2020	Percent of baseline
Junior	OR attendance (cases)	622	424	68.2
	Overall operating time (hours)	1115.4	752.6	67.5
Senior	OR attendance (cases)	803	582	72.5
	Overall operating time (hours)	1604.8	1229.4	76.6
Fellow	OR attendance (cases)	582	407	69.9
	Bariatrics	133	88	66.2
	MIS	85	12	14.1
	HPB	132	86	65.2
	Colorectal	114	86	75.4
	Overall operating time (hours)	1280.1	975.3	76.2
	Bariatrics	210.9	145.9	69.2
	MIS	155.1	27.0	17.4
HPB	392.7	264.7	67.4	
Colorectal	252.7	225.0	89.0	

OR operating room, MIS minimally invasive surgery, HPB hepatobiliary and pancreas surgery

trainees, the most important declines in procedures included stomach and duodenum [10 (2020) vs. 58 (2019), 17.2% percent of baseline], abdominal wall and hernia [46 (2020) vs. 110 (2019), 41.8% percent of baseline] and transplant procedures [20 (2020) vs. 42 (2019), 47.6% percent of baseline].

However, there was increased exposure of senior trainees to breast [60 (2020) vs. 45 (2019), 27.3% percent of baseline] and colorectal cases [96 (2020) vs. 80 (2019), 120.0% percent of baseline].

The impact of the pandemic on fellowship case exposure is reported in Table 5. The largest impact was on MIS fellow trainees (participated in 19% of baseline cases) and bariatrics fellows (43% of baseline cases), with less impact on colorectal (82% of baseline) and HPB fellows (91% of baseline). For bariatrics fellowship trainees, malabsorptive procedures were less affected than restrictive procedures (77.8% vs. 22.1% of baseline). Colorectal fellow trainees had increases exposure to cases involving the rectum [ $n=26$  cases (2020) vs. 13 cases (2019), 200% of baseline] while colon and perianal cases decreased to 57.9% and 56.2% of baseline, respectively.

## Discussion

In this study, we identified a 30% reduction in exposure to operative procedures for general surgery trainees during the first wave of the COVID-19 pandemic in three adult sites of an academic hospital network. All levels of training (i.e., junior, senior, and fellow trainees) experienced a significant decrease in number of operative cases and total time spent in the operating room. Among fellowship trainees, MIS trainees were more severely affected (14% of pre-pandemic

**Table 4** Procedure types attended by junior and senior trainees during the pre-pandemic (March–June 2019) and pandemic (March–June 2020) periods

	Junior trainee			Senior trainee		
	2019	2020	Percent baseline	2019	2020	Percent baseline
<b>Abdominal</b>						
Abdominal wall & hernia	117	32	27.3	110	46	41.8
Open	76	30	39.5	72	33	45.8
Laparoscopy	41	2	4.9	38	13	34.2
Cholecystectomy	85	53	62.4	104	80	76.9
Liver/advanced biliary	8	8	100.0	23	24	95.8
Pancreas	4	7	175.0	15	17	113.3
Spleen	2	1	50.0	6	4	66.7
<b>Alimentary</b>						
Stomach and duodenum	11	5	45.4	58	10	17.2
Small intestine	27	13	48.1	43	42	97.7
Colon and rectum	52	36	69.2	80	96	120.0
Appendix	46	45	97.8	65	55	84.6
Perianal disease	18	12	66.7	36	24	66.7
Breast	77	93	120.8	45	60	133.3
Lymph node	4	12	300.0	8	7	87.5
<b>Endocrinology</b>						
Adrenal	1	1	100.0	5	4	80.0
Thyroid	27	8	29.6	23	11	47.8
<b>Skin and soft tissue</b>						
Melanoma	28	34	121.4	16	10	62.5
Sarcoma	5	4	80.0	11	8	72.7
Wound management	10	10	100.0	15	13	86.7
<b>Trauma</b>						
Exploratory laparoscopy	7	2	28.6	10	1	10.0
Exploratory laparotomy	1	4	400.0	14	5	35.7
Transplant	19	18	94.7	42	20	47.6
Others	8	10	80.0	16	6	37.5

cases) and colorectal trainees were the least affected (75% of pre-pandemic cases).

While there was a global decrease in operative exposure of all trainees, specific procedures were differentially affected. During the pandemic period, oncology procedures were preserved and there was a higher proportion of emergency surgeries compared to the pre-pandemic baseline. This pattern reflects institutional and governmental prioritization policies [15]. Trauma surgery volumes decreased to 71% of the pre-pandemic baseline likely related to strict stay-at-home orders in Quebec [1] and the decrease in automobile use and sports.

For junior trainees, there was preserved exposure to procedures that are within their learning objectives within our institution, including oncology procedures (i.e., breast and melanoma) and emergency procedures (i.e., appendectomy and wound management). However, exposure to non-oncologic elective procedures for hernia, gallbladder, and perianal diseases was significantly reduced. Senior trainees experienced a similar pattern, with increased or maintained

exposure to procedures with oncologic surgeries involving the pancreas, liver, breast, and rectum. However, their exposure to benign gastric (i.e., bariatrics and foregut) and abdominal wall procedures was significantly reduced. There was also evidence of decreased exposure of junior residents to more complex HPB and colon cases. This is consistent with previous literature that emerged at the introduction of work-hour limitations where reduced intraoperative exposure resulted in decreased time spent in observational and decision-making roles (i.e., first assistant and teacher-assistant), with the primary operating role relatively preserved [16]. These findings corroborate the situational realities of the first wave of the pandemic in Quebec, including decreased availability of testing and personal protective equipment [17] that further limited allowed number of persons in the OR. These findings could be used to inform the organization of educational activities including future supplementary rotations to address identified deficiencies.

To address the lack of access to the OR during the first wave of the pandemic, training programs developed and

**Table 5** Index cases attended by fellowship level trainees during the pre-pandemic (March–June 2019) and pandemic (March–June 2020) periods

Procedures	2019	2020	Percent baseline
<b>Bariatrics</b>			
Restrictive	95	21	22.1
Malabsorptive	45	35	77.8
Complications	10	8	80.0
Total	150	64	42.6
<b>MIS</b>			
Laparoscopic foregut	7	1	14.3
Laparoscopic inguinal hernia repair	29	7	24.1
Laparoscopic ventral hernia repair	12	1	8.3
Laparoscopic solid organ	10	2	20.0
Total	58	11	19.0
<b>HPB</b>			
Liver	33	25	75.8
Pancreas	14	19	135.7
Advanced biliary	3	5	166.7
Donor hepatectomy <sup>a</sup>	5	2	40.0
Liver transplant*	12	7	58.3
Total	64	58	90.6
<b>Colorectal</b>			
Colon	38	22	57.9
Rectum	13	26	200.0
Perianal and incontinence surgeries	32	18	56.2
Pouch procedures	0	2	NA
Total	83	68	81.9

*MIS* minimally invasive surgery, *HPB* hepatobiliary and pancreas surgery

<sup>a</sup>Donor hepatectomy and liver transplant procedures are not part of index cases in hepatobiliary and pancreas fellowship, but they are listed as contributory to complex liver procedure

shared creative strategies including innovative online didactic curriculums, online conferences, and telehealth visits to augment trainees' clinical training [7–12]. Fewer programs reported increasing trainee access to surgical simulators, likely due to the limited access to these simulators at baseline and the decreased access to off-site simulation centers due to campus shutdowns and physical distancing restrictions [10]. However, these measures cannot fully replace the loss of operative experience and operative technical learning among trainees. Using intraoperative video to provide structured feedback and procedural skills teaching could play a role as an adjunct during the COVID-19 pandemic, but this has been underutilized despite strong evidence supporting its role in augmenting trainee technical performance [18–20]. Video-based learning can extend the apprenticeship model to outside of the operating room and play an important role in optimizing learning opportunities during and beyond the COVID-19 pandemic [20].

This study is consistent with others reporting similar decreases in general surgery trainee operative exposure during the pandemic. However, these reports were based on trainee self-reporting through operative logs [8] or national surveys [7, 12] which can be subject to reporting bias [21]. The strength of our study is using our institutional OR database and medical records to track trainee presence and involvement in operative cases. However, this study also has several limitations. Our study was based on the three academic hospitals in our health network and does not include the community hospital experience. However, all hospitals in our region were facing the same limitations that imposed limits on residents' operative exposure such as shortage of personal protective equipment and operating room staff redeployment. We were unable to quantify changes in resident role and extent of involvement in the operating room to examine the quality of intraoperative learning during the pandemic. We also could not evaluate the impact of the decreased OR exposure on competence or performance of trainees—case volume alone is not the only marker of proficiency. Furthermore, given the relatively short period of this study (4 months) and the significant role of local institutional and governmental policies in allocating surgical resources during the pandemic, our findings may not be generalizable to other training programs. Also, the rebound response to address the backlog in surgical cases between the subsequent waves of the pandemic will vary significantly across different countries and healthcare systems.

In summary, we have demonstrated that even though there was a global decrease in operative exposure of about 30% during the first wave of the pandemic, the impact varied by trainee level and fellowship speciality. While junior residents had less exposure to hernia, cholecystectomy, and perianal cases, they had more exposure to oncologic cases. Senior trainees had reduced exposure to benign upper GI cases but more exposure to colorectal cases. For fellowship trainees, the impact of the pandemic was significantly reduced in programs with a high proportion of cancer cases (i.e., colorectal and HPB). These findings are relevant because while longer 5 to 6 years residency training programs may be able to adjust and compensate for a short-term reduction in exposure, 1-year fellowship programs may be more severely affected. While these observed patterns are highly dependent on local policies regarding surgical prioritization, these trends are important to inform mitigation strategies tailored for each level of training.

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## Declarations

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## References

1. Québec GD (2020) Available at <https://www.quebec.ca/en/health/health-issues/a-z/2019-coronavirus/measures-orders-in-council-ministerial-orders>. Accessed on 8 Jun 2021
2. Association CM (2020) Accessed at Deloitte LLP and affiliated entities at <https://www.cma.ca/sites/default/files/pdf/Media-Releases/Deloitte-Clearing-the-Backlog.pdf>. Accessed on 8 Jun 2021
3. De Filippo O, D'Ascenzo F, Angelini F, Bocchino PP, Conrotto F, Saglietto A et al (2020) Reduced rate of hospital admissions for ACS during Covid-19 outbreak in Northern Italy. *N Engl J Med* 383(1):88–89
4. Perea Del Pozo E, Aparicio-Sanchez D, Hinojosa Ramirez F, Pareja Ciuro F, Duran Munoz-Cruzado V, Sanchez Arteaga A et al (2020) A prospective cohort study of the impact of covid19 world pandemic on the management of emergency surgical pathology. *Br J Surg* 107(11):e463–e464
5. Shafi AMA, Atieh AE, Harky A, Sheikh AM, Awad WI (2020) Impact of COVID-19 on cardiac surgical training: our experience in the United Kingdom. *J Card Surg* 35(8):1954–1957
6. Hourston GJM (2020) The impact of despecialisation and redeployment on surgical training in the midst of the COVID-19 pandemic. *Int J Surg* 78:1–2
7. Aziz H, James T, Remulla D, Sher L, Genyk Y, Sullivan ME et al (2021) Effect of COVID-19 on surgical training across the United States: a national survey of general surgery residents. *J Surg Educ* 78(2):431–439
8. Purdy AC, de Virgilio C, Kaji AH, Shields Frey E, Lee-Kong S, Inaba K et al (2021) Factors associated with general surgery residents' operative experience during the COVID-19 pandemic. *JAMA Surg* 156:767
9. Juprasert JM, Gray KD, Moore MD, Obeid L, Peters AW, Fehling D et al (2020) Restructuring of a general surgery residency program in an epicenter of the coronavirus disease 2019 pandemic: lessons from New York City. *JAMA Surg* 155(9):870–875
10. Chick RC, Clifton GT, Peace KM, Propper BW, Hale DF, Alseidi AA et al (2020) Using technology to maintain the education of residents during the COVID-19 pandemic. *J Surg Educ* 77(4):729–732
11. White EM, Shaughnessy MP, Esposito AC, Slade MD, Korah M, Yoo PS (2021) Surgical education in the time of COVID: understanding the early response of surgical training programs to the novel coronavirus pandemic. *J Surg Educ* 78(2):412–421
12. Coyan GN, Aranda-Michel E, Kilic A, Luketich JD, Okusanya O, Chu D et al (2020) The impact of COVID-19 on thoracic surgery residency programs in the US: a program director survey. *J Card Surg* 35(12):3443–3448
13. Council TF (2020) Accessed at The Fellowship Council at <http://fellowshipcouncil.org/about/program-guidelines/>. Accessed on 8 Jun 2021
14. Canada RCoPaSo (2017) Accessed at Royal College of Physicians and Surgeons of Canada at [https://www.royalcollege.ca/rcsite/documents/ibd/general\\_surgical\\_oncology\\_otr\\_e](https://www.royalcollege.ca/rcsite/documents/ibd/general_surgical_oncology_otr_e). Accessed on 6 Jun 2021
15. Bouthillier ME, Lorange M, Legault S, Wade L, Dahine J, Latreille J et al (2021) Prioritizing surgery during the COVID-19 pandemic: the Quebec guidelines. *Can J Surg* 64(1):E103–E107
16. Kairys JC, McGuire K, Crawford AG, Yeo CJ (2008) Cumulative operative experience is decreasing during general surgery residency: a worrisome trend for surgical trainees? *J Am Coll Surg* 206(5):804–811
17. Dyer E (2020) The great PPE panic: how the pandemic caught Canada with its stockpiles down. CBC News, Toronto
18. Trehan A, Barnett-Vanes A, Carty MJ, McCulloch P, Maruthappu M (2015) The impact of feedback of intraoperative technical performance in surgery: a systematic review. *BMJ Open* 5(6):e006759
19. Hodges NJ, Chua R, Franks IM (2003) The role of video in facilitating perception and action of a novel coordination movement. *J Mot Behav* 35(3):247–260
20. Green JL, Suresh V, Bittar P, Ledbetter L, Mithani SK, Allori A (2019) The utilization of video technology in surgical education: a systematic review. *J Surg Res* 235:171–180
21. Veldenz HC, Dennis JW, Dovgan PS (2001) Quality control of resident operative experience: compliance with RRC criteria. *J Surg Res* 98(2):81–84

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