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Impact of the Covid-19 pandemic on rates of emergency department utilization and hospital admission due to general surgery conditions

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Abstract

Background Recent literature reports a decrease in healthcare-seeking behaviours by adults during the Covid-19 pandemic. Given that emergency general surgery (GS) conditions are often associated with high morbidity and mortality if left untreated, the objective of this study was to describe and quantify the impact of the Covid-19 pandemic on rates of emergency department (ED) utilization and hospital admission due to GS conditions.

Methods This cohort study involved the analysis of an institutional database and retrospective chart review. We identified adult patients presenting to the ED in a network of three teaching hospitals in Montreal, Canada during the first wave of the Covid-19 pandemic (March13–May13, 2020) and a control pre-pandemic period (March13–May13, 2019). Patients with GS conditions were included in the analysis. ED utilization rates, admission rates and 30-day outcomes were compared between the two periods using multivariate regression analysis.

Results During the pandemic period, 258 patients presented to ED with a GS diagnosis compared to 351 patients pre-pandemically (adjusted rate ratio (aRR) 0.75; $p < 0.001$). Rate of hospital admission during the pandemic was also significantly lower (aRR $= 0.77$, $p < 0.001$). Patients had a significantly shorter ED stay during the pandemic (adjusted mean difference 5.0 h; $p < 0.001$). Rates of operative management during the pandemic were preserved compared to the pre-pandemic period. There were no differences in 30-day complications (adjusted odds ratio (aOR) 1.46; $p = 0.07$), ED revisits (aOR 1.10; $p = 0.66$) and (re)admissions (aOR 1.42; $p = 0.22$) between the two periods.

Conclusion There was a decrease in rates of ED utilization and hospital admissions due to GS conditions during the first wave of the Covid -19 pandemic; however, rates of operative management, complications and healthcare reutilization were unchanged. Although our findings are not generalizable to patients who did not seek healthcare, it was possible to successfully uphold institutional standards of care once patients presented to the ED.

Keywords Covid-19 · General surgery conditions · Surgical outcomes · Emergency room utilization

In December 2019, a novel coronavirus (Covid-19) was identified as the causative agent of an outbreak of pneumonia [1]. In the coming months, the virus had spread world-wide to cause a major global pandemic [1]. The first case of Covid -19 in Quebec, Canada was diagnosed on February 28th, 2020 [2]. As a response, in line with the World Health Organization recommendations [3], the Quebec government implemented a province-wide order of lockdown and self-isolation on March 13, 2020 which lasted until the end of June of 2020 (first pandemic wave in Quebec) [2]. To expand the healthcare system capacity to treat patients with Covid-19, the Quebec Ministry of Health and Social Services employed a comprehensive strategy which included the repurposing of surgical care infrastructure and delaying non-essential surgical procedures [4]. In other words, hospitals across the province had to limit surgeries to only

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urgent cases, including those presenting to the emergency department (ED) requiring prompt intervention.

Recent literature supports that patients' fear of being infected by Covid-19 [5] and concerns about oversaturation of EDs have led to an alarming decrease in emergency care-seeking behaviours around the world [1, 6–8]. As a result, recent studies have reported an increase in morbidity rates [9] and, in countries such as Italy, there has been a significant increase in mortality which cannot be fully explained by Covid-19 cases alone [10]. Since the beginning of the pandemic, significant efforts have been devoted to developing a better understanding of the Covid-19 disease process, prevention, and treatment. However, there has been limited focus on the collateral damage of this pandemic on patients requiring care for other serious illnesses.

Emergency general surgery conditions such as hollow viscus perforation, appendicitis, acute cholecystitis, and diverticulitis represent a unique group of acute illnesses with high risk of morbidity and mortality if left untreated [11, 12]. Therefore, delayed seeking of emergency care by patients suffering from these conditions may lead to debilitating and life-threatening disease progression. A better understanding of changes in patterns of ED presentation of patients with acute general surgery conditions can shed light on the collateral healthcare damage of the Covid-19 pandemic and inform the organization of emergency surgery capacity going forward. Therefore, the aim of this study was to assess the extent to which the COVID-19 pandemic impacted rates of emergency department (ED) utilization and hospital admissions due to general surgery conditions in comparison to a control pre-pandemic period.

Materials and methods

Study design and participants

This cohort study involved the analysis of an institutional database (MUHC Data Warehouse) supplemented by retrospective chart review. The study was approved by our institutional research ethics board (ref. MUHC REB MP-37-2021-6721). Analysis and reporting were in accordance with the STROBE Statement for cohort studies (Supplementary Material) [13]. The institutional database was used to identify and retrieve all the ED visits of patients with general surgical conditions presenting to adult hospitals that are part of the McGill University Health Centre (MUHC).

Adult (≥ 18 years) patients who visited the ED during the first two months after the implementation of the government mandated lockdown were identified. This period was defined as March 13–May 13, 2020 (pandemic period) and the corresponding period the year before was defined as the pre-pandemic baseline (March 13–May 13, 2019).

Those with a confirmed diagnosis of a general surgical condition, based on the American Association for the Surgery of Trauma (AAST) compiled list of emergency general surgery pathologies [14] were included. As per AAST, trauma and post-transplant patients were excluded. Cardiovascular and plastics surgery emergencies that are not managed by general surgeons in Canadian tertiary care centres were also excluded.

Outcomes

The primary outcomes for this study were a priori defined as:

The number of patients presenting the ED with general surgery conditions.
The number of hospital admissions of patients presenting to the ED with general surgery conditions.

Secondary a priori outcomes included:

ED length of stay, defined as the number of hours lapsed between triage and discharge from the ED or admission to an inpatient care unit;
ED wait times, defined as three different entities: time to be seen by a medical doctor (MD), time to completion of consults, and time to admission from the ED. These time periods were calculated in hours from the time of arrival triage;
Hospital length of stay, defined as the number of days lapsed between admission to an inpatient unit and hospital discharge (or death);
Duration of symptoms prior to ED presentation, defined as the number of days of symptoms (of the chief complaint) prior to presenting to ED;
30-day complications, defined as any medical or surgical complications up to 30 days after the index presentation to ED [15];
30-day ED revisits, defined as any visit to the ED up to 30 days after the index presentation to the ED;
30-day (re)admission, defined as any non-elective medical or surgical admission or readmission to the hospital 30 days after the index presentation to the ED;

Data collection and follow-up procedures

Data regarding the ED episode of care (i.e. time of triage, triage categories, mode of arrival, time of first encounter by MD, time of general surgery consult fulfillment, final diagnosis, time, and type of admission) were available through our institutional database. Triage categories used at the MUHC are based on the Canadian triage and acuity scale [16]. Patient demographics (i.e. age, sex, body mass

index, medical comorbidities, psychiatric comorbidities, average household income) and patient outcome data (i.e. complications, ED revisits, (re)admissions) were obtained from retrospective review of electronic medical records. Medical comorbidities were classified based on the Charlson Comorbidity Index (CCI) and categorized into patients with high comorbidity (CCI > 2) versus low comorbidity (CCI ≤ 2)[17]. Psychiatric comorbidities were recorded [18] and presented in two categories (no psychiatric comorbidity versus presence of any psychiatric comorbidity). Patient income (average household income) was used as a surrogate measure for patient socioeconomic status. This measure was calculated based on the patients' postal code which was accessible through a publicly available online tool (PRIZM® Premier) developed by Environics Analytics (https://prizm.environicsanalytics.com). Patients were divided into groups, based on income quantiles. Across the MUHC hospitals, Covid-19 testing (polymerase chain reaction technique) was not universally done for all the ED visits during the first wave of the pandemic. Test results from patients presenting with potential COVID-related symptoms were collected when available.

General surgery diagnoses were grouped into the following categories: anorectal disease, appendicitis, bowel obstruction, cancer diagnosis (primary diagnosis), cholangitis, diverticulitis, Gallstone diseases, gastrointestinal bleed, hollow viscus perforation, soft tissue infection, all-cause pancreatitis, and postoperative complications. Bowel obstruction diagnosis consisted of small and large bowel obstruction regardless of cause. Gallstone diseases were defined as patients with biliary colic, acute cholecystitis, choledocholithiasis and stone cholangitis. Cholangitis category included all non-stone causes of cholangitis (i.e. post instrumentalization and stenting, or obstructing mass). Soft tissue infection consisted of severe cellulitis, abscess, and necrotizing fasciitis.

Statistical analysis

The sample size for this study was based on the number of eligible patients presenting to the ED during the study periods; as such, no formal sample size calculation was conducted. Continuous variables were summarized using mean and standard deviation or median and interquartile range, as appropriate. Categorical variables were summarized using frequencies and percentages. Chi-square and Student's t tests were used for univariate analyses of categorical and normally distributed continuous variables, respectively. Poisson exact test was used for univariate comparison of count data (number of patients presenting to ED with general surgery condition, number of hospital admissions and number of patients with each diagnostic category).

To improve precision and address potential between-group differences in patient characteristics, multivariate regression analysis was used for comparison of a priori defined primary and secondary outcomes. Poisson regression was used for analysis of count estimates (ED visits with general surgery diagnosis and hospital admissions with general surgery diagnosis). Logistic regression was used for analysis of binary outcomes (30-day complication, 30-day ED revisits and 30-day readmissions). Linear regression was used for analyzing continuous outcomes (ED length of stay, hospital length of stay and duration of symptoms prior to presentation). Estimates were adjusted for sex, age, CCI category, psychiatric comorbidities, and income quantiles [17, 19–24]. All statistical tests were 2-sided and statistical significance was set at $p < 0.05$. We conducted a complete case analysis (with no imputation of missing data) as there were no missing data for primary outcome measures and the rate of missing data for secondary outcomes and covariates were less than 5% (Supplementary Material) [25]. Statistical analyses were performed using RStudio (version 1.2.1577; RStudio, Inc., Boston, MA, USA).

Results

During the pre-pandemic period (March13-May13, 2019), 351 patients presented to the ED with a confirmed general surgery diagnosis, compared to 258 patients during the pandemic period (March13-May13, 2020) ($p < 0.001$). This represents a 27% decrease in the number of patients presenting to the ED with general surgery conditions in comparison to the pre-pandemic baseline. Patient demographics were similar between the two time periods, including age (55.2 ± 19.6 years [2019] versus 55.3 ± 19.6 [2020]), sex (53.0% male [2019] versus 52.0% male [2020]) and CCI (57.0% with low comorbidity [2019] versus 58.5% low comorbidity [2020]) (Table 1).

Emergency department care characteristics for these patients are described in Table 2. According to the Canadian triage and acuity scale, there were 128 [2019] versus 77 [2020] patients presenting to the ED with emergent care needs (60.1% of baseline [2019]). Duration of symptoms prior to presentation to the ED was not significantly different between the two time periods (3.7 ± 6.2 days [2019] versus 3.7 ± 5.6 days [2020], $p = 0.98$). Length of ED stay (25.2 ± 20.7 days [2019] versus 20.1 ± 16.0 days [2020], $p < 0.001$) and time to admission (14.6 ± 11.9 days [2019] versus 12.4 ± 8.4 days [2020], $p < 0.001$) were significantly shorter during the pandemic period.

The distribution of general surgery diagnoses in the ED during the pandemic and pre-pandemic periods is described in Fig. 1. Presentations due to anorectal disease, appendicitis, bowel obstruction, cancer diagnosis, cholangitis,

Table 1 Patient demographics during the pandemic (March13-May13, 2020) and pre-pandemic (March13-May13, 2019) periods

	2019	2020	*p*-value
Age, years	55.2 ± 19.6	55.3 ± 19.6	0.96
Sex (Male), *n* (%)	183 (53.0%)	135 (52.0%)	0.96
BMI, Kg/m^2	34.1 ± 56.7	29.1 ± 24.0	0.33
Medical comorbidities			
Charlson Comorbidity Index ($\leq$2), n (%)	200 (57.0%)	151 (58.5%)	0.70
Psychiatric comorbidities, *n* (%)	42 (12.0%)	20 (7.8%)	0.09
Income, CAD	85,368 (51,637)	85,368 (53,132)	0.24
1st Income Quantile, *n* (%)	71 (20.2%)	62 (24.0%)	
2nd Income Quantile, *n* (%)	89 (25.3%)	81 (31.4%)	
3rd Income Quantile, *n* (%)	88 (25.1%)	56 (21.7%)	
4th Income Quantile, *n* (%)	92 (26.2%)	55 (21.7%)	
Total, n	351	258	< 0.001

Data are presented as *n* (% total), median (IQR), or mean ± standard deviation

BMI Body Mass Index, *CAD* Canadian Dollars

Table 2 Emergency department care characteristics for general surgery patients during the pandemic (March13–May13, 2020) and pre-pandemic (March13–May13, 2019) periods

	2019	2020	*p*-value
Patients with general surgery diagnosis, *n*	351	258	**< 0.001**
Canadian triage and acuity scale, *n* (%)			
Level 1: Resuscitation	0	0	0.19
Level 2: Emergent	128 (36.5%)	77 (29.8%)	
Level 3: Urgent	156 (44.4%)	130 (50.4%)	
Level 4: Less urgent	55 (15.7%)	38 (14.7%)	
Level 5: Non-urgent	7 (2.0%)	10 (3.9%)	
Mode of arrival, *n* (%)			0.16
Ambulance	99 (28.2%)	59 (22.9%)	
Personal Means	247 (70.4%)	196 (76.0%)	
Missing	1 (0.3%)	3 (1.2%)	
Symptom duration (days)	3.7 ± 6.2	3.7 ± 5.6	0.98
Length of ED stay (hours)	25.2 ± 20.7	20.1 ± 16.0	**< 0.001**
Time to be seen by MD (hours)	2.8 ± 2.8	1.4 ± 1.4	**< 0.001**
Time to completion of consults (hours)	4.7 ± 7.2	4.6 ± 5.8	0.86
Time to admission (hours)	14.6 ± 11.9	12.4 ± 8.4	**0.02**

Data are presented as *n* (% total) or mean ± standard deviation

ED Emergency Department, *MD* Medical Doctor

diverticulitis, pancreatitis, and postoperative complications were significantly more prevalent during the pre-pandemic than the pandemic period. Presentations attributed to hollow viscus perforation, gallstone disease and gastrointestinal bleeding diagnosis were not significantly different between the two periods.

There was a significantly lower number of hospital admissions during the pandemic compared to the pre-pandemic period (179 versus 235 patients, respectively, *p* < 0.001). The proportion of patients treated with interventional radiology (8.0% [2019] versus 10.1% [2020], *p* = 0.37) or operative procedures (78.4% [2019] versus 70.3% [2020], *p* = 0.96) was not significantly different between the two periods.

Among patients with appendicitis and gallstone disease, rates of operative treatment were similar in the pandemic and pre-pandemic periods. 30-day outcomes including ED revisits (16.8% [2019] versus 17.4% [2020], *p* = 0.84), (re)admissions (8.3% [2019] versus 10.9% [2020], *p* = 0.28), and complications (17.1% [2019] versus 22.1% [2020], *p* = 0.12) were not significantly different between the two periods (Table 3).

The risk-adjusted comparison of primary and secondary outcomes is described in Table 4. After adjusting for covariates, the rate of ED visits for general surgery diagnoses was 25% lower during the pandemic period versus the pre-pandemic baseline [adjusted rate ratio = 0.75,

Fig. 1 Distribution of general surgery diagnoses in the emergency department during the pandemic (March13-May13, 2020) and pre-pandemic (March13-May13, 2019) periods.*Indicates statistical significance ($p < 0.05$). Bowel obstruction diagnosis consists small and large bowel obstruction regardless of cause. Gallstone diseases are defined as patients with biliary colic, acute cholecystitis, choledocholithiasis and stone cholangitis. Cholangitis category includes all non-stone causes of cholangitis such as post instrumentalization, stent and obstructing mass. Soft tissue infection consists of cellulitis, abscess, and necrotizing fasciitis
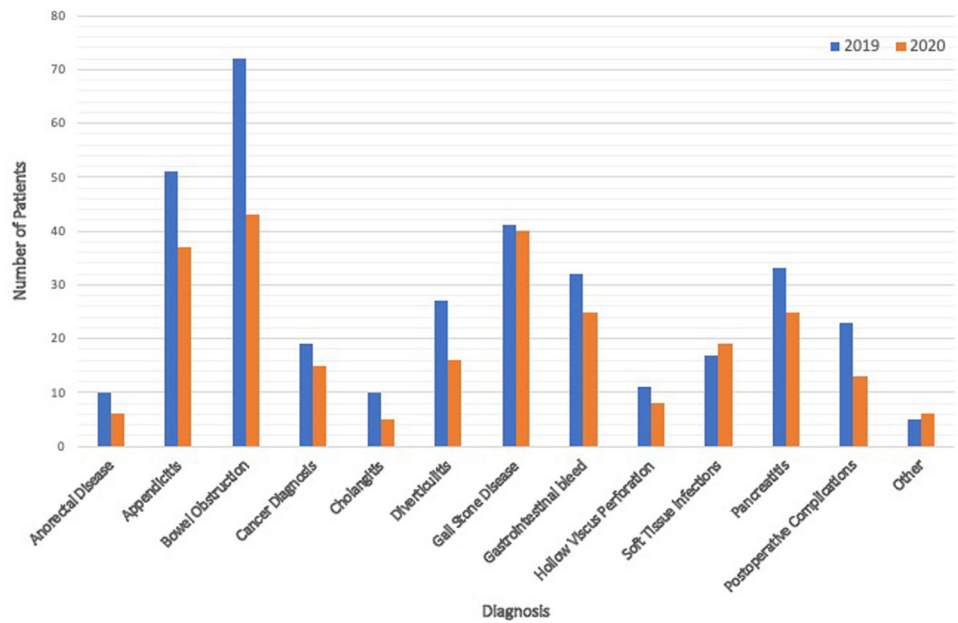
Table 3 In-hospital course and 30-day outcomes during the pandemic (March13–May13, 2020) and pre-pandemic (March13–May13, 2019) periods

	2019	2020	p-value*
Hospital admissions, n (%)	235 (67.0%)	179 (69.4%)	**< 0.001**
Covid-19 testing (positive/total tested)	NA	3/138	NA
Treatment			
Interventional radiology, n (%)	28 (8.0%)	26 (10.1%)	0.37
Surgery, n (%)	115 (32.8%)	84 (32.6%)	0.96
Appendicitis treated with surgery, n (% of all appendicitis)	40 (78.4%)	26 (70.3%)	0.38
Gallstone disease treated with surgery, n (% of all Gallstone disease)	22 (56.4%)	19 (52.8%)	0.57
ICU Admission, n (%)	26 (7.4%)	18 (7.0%)	0.84
30-day ED revisit, n (%)	59 (16.8%)	45 (17.4%)	0.84
30-day readmission, n (%)	29 (8.3%)	28 (10.9%)	0.28
30-day complications, n (%)	60 (17.1%)	57 (22.1%)	0.12
Intra-abdominal bleeding/infection/sepsis	13 (21.7%)	14 (24.6%)	
Medical complications	17 (28.3%)	12 (21.1%)	
Recurrence	21 (35%)	16 (28.1%)	
Pain	1 (1.7%)	10 (17.5%)	
Postoperative ileus	4 (6.7%)	3 (5.3%)	
Wound complications	4 (6.7%)	2 (3.5%)	
In-hospital death, n (%)	8 (2.3%)	10 (3.9%)	0.25
Length of hospital stay (days)	8.7 ± 14.0	6.3 ± 9.5	**0.03**
ICU length of stay (days)	8.5 ± 13.4	5.6 ± 9.8	0.40

Data are presented as n (% patients presenting to the emergency department) or mean ± standard deviation

ICU Intensive Care Unit, *ED* Emergency Department

$p < 0.001$]. Hospital admissions where 23% lower [adjusted rate ratio = 0.77, p < 0.001]. The risk-adjusted ED length of stay was significantly shorter during the pandemic period (adjusted mean difference = − 5.0 h, $p < 0.001$). The risk-adjusted hospital length of stay was not significantly different between the two periods (adjusted mean difference = − 1.67 days, p = 0.14). Similarly, risk-adjusted 30-day outcomes (complication, ED revisits and readmission) were not significantly different between the pandemic and pre-pandemic periods (Table 4).

Table 4 Risk-adjusted comparison of primary and secondary outcomes between the pandemic (March13-May13, 2020) and pre-pandemic (March13-May13, 2019) period

	Adjusted rate ratio[a]	Confidence interval	*p*-value
ED visits with general surgery diagnosis	0.75	0.64, 0.88	<0.001
Hospital admissions with general surgery diagnosis	0.77	0.63, 0.94	<0.001
	Adjusted mean difference[b]	Confidence interval	*p*-value
ED length of stay, hours	−5.0	−8.1, −2.0	<0.001
Hospital length of stay, days	−1.67	−3.89, 0.54	0.14
Duration of symptoms prior to presentation, days	0.06	−0.93, 1.06	0.90
	Adjusted odds ratio[c]	Confidence interval	*p*-value
30-day ED revisit	1.10	0.70, 1.71	0.66
30-day readmission	1.42	0.81, 2.48	0.22
30-day complication	1.46	0.97, 2.22	0.07

[a]Adjusted rate ratio signifies the rate of ED visits for general surgery diagnosis during the pandemic versus the pre-pandemic baseline after adjusting for covariates

[b]Adjusted mean difference signifies the difference in length of ED stay during the pandemic versus the pre-pandemic baseline after adjusting for covariates

[c]Adjusted odds ratio signifies the odds of having a 30-day complication in patients presenting to ED with general surgery conditions during the pandemic period versus the pre-pandemic baseline after adjusting for covariates

All regression analyses were adjusted for sex, age, Charlson Comorbidity Index, psychiatric comorbidities, and income quantiles

ED Emergency department

Discussion

In this study, we identified a significant decrease in risk-adjusted rates of ED utilization by patients with general surgery pathologies during the first wave of the Covid-19 pandemic (25% reduction in comparison to the pre-pandemic baseline). Among these patients, there was also a significant decrease in hospital admissions (23% reduction comparted to the pre-pandemic baseline). Our findings are in keeping with a trend of reduced overall ED usage by patients due to the Covid-19 pandemic in Canada and internationally [6, 8, 26–28]. In our study, there were no differences in the acuity of presentations based on the Canadian triage and acuity scale. This highlights that the observed decrease in care-seeking behaviour was not only limited to patient with non-urgent pathologies but extended to more urgent conditions with possible serious consequences [9, 26, 29]. Length of symptoms before ED presentation during the pandemic was comparable to the pre-pandemic period. Rates of ED presentations for more severe conditions such as hollow viscous perforation, or more worrisome visual symptoms such as severe soft tissue infection and gastrointestinal bleeding were also not different between the two time periods. However, during the pandemic, we observed a significant decrease in presentations for conditions that often present with more general symptoms (low-grade fever, abdominal pain, or vomiting) such as pancreatitis, appendicitis, bowel obstruction and diverticulitis. Although there is increasing

evidence that some of the latter conditions can be successfully treated with conservative management [30–33], the impact of delayed ED presentation and treatment initiation after symptom onset remains uncertain and increased morbidity cannot be excluded.

In comparison to the pre-pandemic baseline, patients with general surgery conditions presenting to the ED during the pandemic experienced a significantly lower length of ED length of stay, waiting time before assessment by a medical doctor and time to hospital admission. This was likely the result of institutional directives to optimize workflow in ED intake (i.e. faster patient assessment) and discharge (faster disposition decision) [34], gaining momentum from previous initiatives aimed at decreasing ED process times in Canada and the United States [28, 34]. In our institutions, an observed improvement in hospital bed management, communication between admitting services and emergency providers has been instrumental for improving ED care during the pandemic. Diverting simpler cases to primary care clinics and using telehealth has also been of great value. Moving forward, lessons learned during the pandemic may help diverting non-emergent patients from hospitals, enabling a better balance between supply and demand for ED care [34]. Even though the institutional directives to optimize patient flow and disposition planning were directed to both emergency department and hospital wards, length of stay was only significantly decreased in the ED but not in inpatient units. This can be explained by the fact that

our center has a longstanding enhanced recovery culture at postoperative wards; [35] therefore, it is possible that flow of patients through these units was already optimized before the pandemic.

Although, during the pandemic, we observed an absolute decrease in the number of emergency operations owing to the decreased rate of ED presentation, the proportion of general surgery conditions treated with an operation or interventional radiology remained stable compared to the pre-pandemic baseline. Similar trends were seen when patients presenting with appendicitis and gallstone disease were analysed separately. Furthermore, we found that risk-adjusted 30-day outcomes (complications, ED revisits and (re)admissions) were not significantly different in patients presenting to the ED during the pandemic versus the pre-pandemic period. Previous literature has described an increase in complications rates among patients with cardiac conditions and patients undergoing emergency general surgery during the pandemic [29, 36]. In our cohort, proficient patient flow management, coordination and communication between our network hospitals potentially contributed to the uphold of standards of care and positive patient outcomes. For example, whenever a patient in need for surgery presented to a network hospital experiencing limited OR availability due to Covid-related resource restrictions, they were transferred to another hospital for timely operation.

Understanding the reasons for avoidance of ED is crucial for devising future interventions to avoid unnecessary health seeking delays during and beyond the pandemic [10, 29]. This assessment, which was not within the scope of our work, has been addressed in recent literature. Wong et al. used qualitative patient interviews to identify reasons for ED avoidance during the pandemic and introduce actionable solutions to encourage a more educated ED utilization among patients [29]. The most common identified reasons for ED avoidance were as follows: (a) perception of hospitals as infectious reservoirs, (b) lack of awareness about hospitals' risk mitigation efforts, and (c) disconnect between vulnerable population and their support network who assist with healthcare visits [29]. Proposed solutions included physical division of the ED to separate patients receiving care for respiratory illness from other patients, and transparent communication regarding risk mitigation strategies used in the hospital [29]. The use of such strategies may further encourage patients with general surgery conditions to seek ED care in a timely manner.

To our knowledge, this study is the first to describe the patterns of ED utilization by patients with general surgery conditions during the Covid-19 pandemic. Our findings add to previous literature assessing rates and outcomes of emergency general surgery procedures and general surgery admissions during the pandemic [37]. A strength of our study is that we used rigorous statistical methodology,

adjusting our analysis for multiple confounders including medical and psychiatric comorbidities, and socioeconomical status. Our study was conducted in a large academic health network with a catchment area of 1.9 million persons encompassing 63% of the provincial landmass [38]. The network includes quaternary, tertiary, and community hospitals and was significantly involved and impacted by the Covid-19 pandemic. Our results should be interpreted with some limitations in mind. Given the nature of our study, we did not conduct a formal sample size calculation; therefore, some of our non-statistically significant results may be due to type II error. Data regarding patient outcomes (i.e. complications, ED revisits, (re)admissions) were obtained via review of institutions electronic medical records. Therefore, visits and complications detected in other hospitals may not have been captured. However, as per provincial regulations, patients presenting to another hospital would be repatriated to their 'home' hospital after initial work-up (i.e. if a patient had a cholecystectomy at the MUHC and presents with bile leak to another hospital in Montreal, they will be transferred back to the MUHC for admission and management). It is important to note that our findings only apply to general surgery patients who presented to our health network's ED during the first wave of the pandemic and not to patients who did not seek ED care. We were not able to find other studies in the literature addressing this question, this could be due to the difficulty of reliably identifying this population. Studies with longer term follow-up would be better for characterizing rates and patterns of morbidity in patients with delayed ED presentation.

In conclusion, our study supports that there was a significant decrease in rates of ED utilization and hospital admissions due to general surgery conditions during the first wave of the Covid-19 pandemic. This finding corroborates trends seen in ED utilization by patients with other medical conditions [6, 28]. Reduced ED utilization was observed across a wide range of disease acuities and extended beyond non-urgent conditions. We were able to uphold our institutional standard of care for general surgery conditions, as demonstrated by stable rates of operative management, complications and healthcare reutilization. This was made possible with proficient patient flow management and effective coordination between our network hospitals.

Declarations

Disclosures Saba Balvardi, Josie Cipolla, Nawar Touma, Tharaniya Vallipuram, Natasha Baron, Reginold Sivarajan, Pepa Kaneva, Sebas-

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