

## Emergency General Surgery during the COVID-19 Pandemic

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### Abstract

#### **Aims**

The global COVID-19 pandemic has impacted upon the delivery of surgical services worldwide. This study investigated its impact on emergency general and vascular surgical activity at a tertiary level hospital in the mid-west of Ireland.

#### **Methods**

Data was retrospectively sourced from the Hospital-In-Patient Enquiry (HIPE) national data collection service from March 1<sup>st</sup> through May 31<sup>st</sup> of 2019 and 2020.

#### **Results**

Records of 1303 patients admitted acutely to general and vascular surgical on-call teams during the two study periods were reviewed. There was no significant difference in the weekly admission rate between 2019 and 2020 (mean 42.15 vs. 49.92). The overall procedural intervention rate decreased from 47.44% [278] in 2019 to 32.01% (209) over the same period in 2020 (OR 0.52,  $p < 0.0001$ ), largely due to a significant decrease in the number of patients undergoing operative intervention (37.88% [222] vs 22.66% [148]). There was a significant decrease in the proportion of patients undergoing surgery for appendicitis (94.87% [112] vs 60.58% [64]). Length of stay for patients admitted in 2020 was shorter than for those in 2019 (mean 7.2 vs 15.5 days).

#### **Conclusion**

In contrast to recently published data, we found no decrease in acute surgical presentations, though there was a significant reduction in acute procedural activity.

## Introduction

The global COVID-19 pandemic has impacted upon the delivery of surgical services worldwide. While the profound effect of pandemic precautions on elective surgery is well described<sup>1</sup>, the relationship between such measures and emergency surgery is relatively unexplored. In an effort to contain virus spread, the Irish government introduced national lockdown restrictions beginning on March 12<sup>th</sup> with school closures and restrictions on large gatherings. On the 24<sup>th</sup> of March, almost all businesses were closed, and on March 27<sup>th</sup> all non-essential travel was restricted. Since then, the country has been subject to various levels of restrictions regarding travel, social interaction and economic activity, with a significant impact on daily life.

Medical professionals both in Ireland and elsewhere have raised concerns that fear of contracting COVID-19 in hospital and the fear of overburdening healthcare systems as a result of messaging from public health bodies may be discouraging people from seeking healthcare for non-COVID illnesses<sup>2-4</sup>. Emergency department presentations decreased by 29% in March 2020 compared to March 2019 in the United Kingdom<sup>5</sup>. Emergency departments in Italy noted a 50% reduction in presentations from February 21<sup>st</sup> to April 3<sup>rd</sup> in 2020 compared with 2019 data<sup>6</sup>, a 54% reduction in presentations with abdominal pain.

A 73-88% decrease in attendances was noted across Italian pediatric emergency departments in March 2020<sup>7</sup>. In Ireland, Temple Street Children's University Hospital recorded a 51.45% decrease in overall attendances in March and April of 2020 vs 2018 and 2019 data, including a 27.3% reduction in 'surgical' presentations<sup>8</sup>. For international comparison, there was a significant decrease in acute surgical presentations to an Italian emergency department during the height of the pandemic<sup>9</sup>.

Furthermore, concerns regarding limited operating theatre capacity, ventilator capacity, personal protective equipment availability and the risk of viral dissemination led to the introduction of significant practice changes in several jurisdictions<sup>10</sup>. Non-operative management was emphasized where possible, and laparoscopy was initially discouraged in most circumstances<sup>10</sup>.

This study sought to explore whether the COVID-19 pandemic has resulted in reduced numbers of emergency surgical admissions to an academic teaching hospital in the mid-West of Ireland. Primary outcomes were the number of emergency surgical admissions from March 1st through May 31st, 2020 compared to the same period in 2019. Secondary outcomes included the rate of change for each diagnosis, the rate of operative intervention, the rate of diagnosis-specific operative intervention, and length of stay.

## Methods

This retrospective observational cohort study is reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement. This study was undertaken in an academic tertiary referral hospital admitting acute adult and pediatric surgical patients in the Mid-West of Ireland.

Data was retrospectively sourced from the Hospital-In-Patient Enquiry (HIPE) national data collection of health and social care services. The HIPE database is coded by trained personnel according to the Australian Classification of Health Interventions (8<sup>th</sup> edition) and the International Classification of Diseases, 10<sup>th</sup> revision, Australian Modification (2013). Data was sourced on all non-elective inpatient episodes for patients admitted under the care of a consultant general or vascular surgeon from March 1<sup>st</sup> through May 30<sup>th</sup> of 2019 and 2020. HIPE data was manually cross-referenced with emergency theatre and endoscopy suite logs as well as IR procedure logs. Discrepancies and additional cases not captured by HIPE data for emergent general and vascular surgical admissions were added manually.

Data was fully anonymized prior to analysis. Variables included age, gender, admission date, primary diagnosis, primary procedure code applicable, and discharge date. Statistical analysis was performed using GraphPad Prism software (GraphPad Prism version 8.4.2 (464) for MacOS, GraphPad Software, La Jolla California USA, [www.graphpad.com](http://www.graphpad.com)). Normally distributed data were analyzed by comparing means using non-paired t-tests. Non-normally distributed data were analyzed using the Mann-Whitney *U* test. Categorical variables were compared using the  $\chi^2$  test. Data is presented as mean (range) unless otherwise specified. A p-value of <0.05 was determined to be statistically significant. This study is adequately powered to detect a 10% difference in weekly admission rates with an  $\alpha$  of 0.05 and power of 80%.

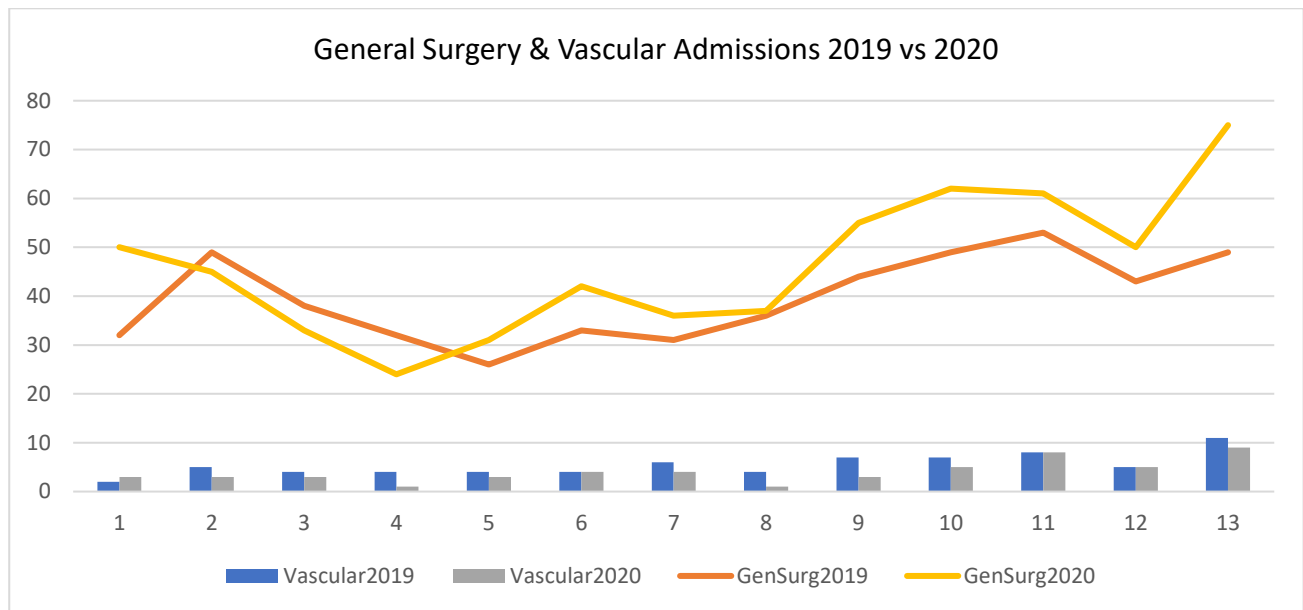
## Results

A total of 694 patients were admitted from March 1<sup>st</sup> – May 31<sup>st</sup> in 2020 compared to 609 patients over the same period in 2019. Of these, 41 patients in the 2020 cohort and 23 patients in the 2019 cohort were transferred to the care of other services (e.g. urology, gynaecology, etc.) shortly after admission and were not included, leaving 653 and 586 patients respectively for analysis. Baseline demographics are outline in table 1 below.

| <b>General Surgery</b>      | <b>2019</b>      | <b>2020</b>      | <b>p-value</b>    |
|-----------------------------|------------------|------------------|-------------------|
| Total (N)                   | 515              | 601              |                   |
| Female (%)                  | 238 (46.2%)      | 304 (50.5%)      | 0.1498            |
| Mean age (range)            | 44 (0.2 - 93)    | 44 (0.1 - 100.9) | 0.82              |
| Mean length of stay (range) | 6.7 (1 - 86)     | 4.4 (1-49)       | <b>&lt;0.0001</b> |
| <b>Vascular</b>             | <b>2019</b>      | <b>2020</b>      | <b>P-value</b>    |
| Total                       | 71               | 52               |                   |
| Female                      | 19 (26.76%)      | 14 (26.92%)      | > 0.99            |
| Mean age (range)            | 68 (29.5 - 98.9) | 68 (15.1 - 93.4) | 0.79              |
| Mean length of stay (range) | 15.5 (1-64)      | 7.2 (1-32)       | <b>0.0003</b>     |
| <b>Totals</b>               | <b>586</b>       | <b>653</b>       |                   |

**Table 1:** Baseline demographics and length of stay for all patients admitted emergently under General and Vascular surgery, March 1<sup>st</sup> – May 31<sup>st</sup>, 2019 and 2020.

There was no significant difference in the total weekly general and vascular admission rate for between the 2019 and 2020 cohorts (mean 42.15 vs. 49.92,  $p = 0.18$ , figure 1). There was no significant difference in mean weekly emergency general surgery admissions (36.69 vs 45.92,  $p = 0.0844$ ), or mean emergency vascular admissions (4 vs 5.46,  $p=0.09$ ).



**Figure 1:** Trends in general and vascular surgery admissions March – May 2019 and 2020.

Table 2 outlines the relative change in overall admission numbers, and incidence rates for the ten most common discharge diagnosis codes.

| Diagnosis                  | Total Admissions 2019 (%) | Mean Weekly Admission Rate 2019 | Total Admissions 2020 (%) | Mean Weekly Admission Rate 2020 | Difference in means 2020 vs 2019 (95% CI) | p            |
|----------------------------|---------------------------|---------------------------------|---------------------------|---------------------------------|---|--------------|
| Appendicitis               | 117 (20.0%)               | 9.00                            | 105 (16.1%)               | 8.08                            | -0.92 (-4.05 - 2.21)                      | 0.55         |
| Unspecified abdominal pain | 66 (11.3%)                | 5.08                            | 81 (12.4%)                | 6.23                            | +1.16 (-1.27 - 3.60)                      | 0.33         |
| Cholecystitis              | 33 (5.6%)                 | 2.54                            | 34 (5.2%)                 | 2.62                            | -0.01 (-1.17 - 1.15)                      | 0.99         |
| Head Injury                | 25 (4.3%)                 | 1.92                            | 68 (10.4%)                | 5.23                            | <b>+2.97 (1.06 - 4.88)</b>                | <b>0.004</b> |
| Diverticulitis             | 33 (5.6%)                 | 2.54                            | 21 (3.2%)                 | 1.62                            | -0.91 (-2.06 - 0.25)                      | 0.12         |
| Acute Pancreatitis         | 18 (3.1%)                 | 1.38                            | 28 (4.3%)                 | 2.15                            | +0.75 (-0.25 - 1.75)                      | 0.5          |
| Diabetic foot ulcer        | 25 (4.3%)                 | 1.92                            | 16 (2.5%)                 | 1.23                            | -0.69 (-1.58 - 0.19)                      | 0.12         |
| GI bleeding                | 27 (4.6%)                 | 2.08                            | 16 (2.5%)                 | 1.23                            | -0.77 (-1.56 - 0.02)                      | 0.055        |
| Intestinal Obstruction     | 31 (5.3%)                 | 2.38                            | 14 (2.1%)                 | 1.08                            | <b>-1.29 (-2.44 - 0.14)</b>               | <b>0.03</b>  |
| Gastritis                  | 8 (1.4%)                  | 0.62                            | 26 (4.0%)                 | 2.00                            | <b>+1.39 (0.46 - 2.31)</b>                | <b>0.005</b> |

**Table 2:** Mean weekly admission rates for the ten most common discharge diagnoses, March – May 2019 vs 2020.

A significant increase in head injury admissions was observed from March – May of 2020 compared to 2019 (mean weekly admission rate 5.23 vs 1.92,  $p=0.0004$ ). Further analysis of these cases revealed an increase in head injuries secondary to falls (mean weekly admission rate 1.23 vs 3.00,  $p=0.338$ ) and road traffic accidents, though neither increase was statistically significant (mean weekly admission rate 0.08 vs 0.38,  $p = 0.07$ ). There was, however, a statistically significant increase in head injuries secondary to alleged assault (mean weekly admission rate 0.08 vs 1.077,  $p = 0.003$ ) and a 4-fold increase in head injuries secondary to road traffic accidents, though this increase was not statistically significant (mean weekly admission rate 0.08 (2019) vs 0.38 (2020),  $p = 0.07$ , see supplementary data). A significant decrease in weekly admissions for intestinal obstruction was observed in 2020 (mean 1.08 vs 2.38,  $p = 0.03$ ), while weekly admissions with a diagnosis of gastritis increased (mean 2 vs 0.62,  $p =0.005$ ).

The overall procedural intervention rate decreased from 47.44% (278/586) March – May 2019 to 32.01% (209/653) over the same period in 2020 (OR 0.52, 95% CI 0.41 – 0.65,  $p <0.0001$ ). While there was no significant difference in patients undergoing endoscopy (7.17% [42/586] vs 7.35% [48/653], OR 1.03, 95% CI 0.67 – 1.56,  $p = 0.91$ ) or interventional radiology (IR) procedures (3.75% [22/586] vs 2.45% [16/653] OR 0.64, 95% CI 0.33 – 1.25,  $p = 0.19$ ), there was a significant decrease in the number of patients undergoing operative intervention (37.88% [222/586] vs 22.66%, [148/653] OR 0.48, 95% CI 0.38 – 0.61,  $p <0.0001$ ). Table 3 shows the operative/endoscopic/IR procedural rates for the ten most common discharge diagnoses between March and May in 2019 compared to the same period in 2020.

There was a significant decrease in the proportion of patients undergoing surgery for appendicitis (94.87% [112/117] vs 60.58% [64/104] OR 0.08, 95% CI 0.04 – 0.19,  $p <0.0001$ ) while there was no significant difference in intervention rates for the remainder of the 10 most frequent discharge diagnoses. The overall length of stay for patients admitted from March - May of 2020 was shorter than for those in the 2019 cohort (mean 7.2 days vs 15.5 days,  $p=0.0003$ ).

A total of 294 (48.8%) admissions underwent PCR testing for SARS-CoV-2. Of these, 7 were positive (positivity rate 2.44%). Of these positive patients, four underwent procedural intervention; three underwent surgical procedures (incision and drainage of abscess, temporary ileostomy and repair of an obstructed/strangulated hernia) while one patient underwent emergent biliary stenting in the endoscopy suite.

|                            | 2019    |    |           |                               |                 | 2020    |    |           |                               |                 |   |                   |
|----------------------------|---------|----|-----------|-------------------------------|-----------------|---------|----|-----------|-------------------------------|-----------------|---|-------------------|
|                            | Surgery | IR | Endoscopy | Total Procedural Intervention | No Intervention | Surgery | IR | Endoscopy | Total Procedural Intervention | No Intervention | Procedural intervention 2019 vs 2020, Odds Ratio (95% CI) | P                 |
| Appendicitis               | 111     | 1  | 0         | 112                           | 5               | 63      | 1  | 0         | 64                            | 40              | <b>14 (5.43 - 33.84)</b>                                  | <b>&lt;0.0001</b> |
| Unspecified Abdominal Pain | 0       | 0  | 3         | 3                             | 6               | 1       | 0  | 6         | 7                             | 76              | 0.52 (0.14 - 1.98)  | 0.5131            |
| Cholecystitis              | 4       | 1  | 4         | 9                             | 2               | 0       | 1  | 2         | 3                             | 30              | 3.75 (1.00 - 13.73)                                       | 0.11              |
| Head Injury                | 2       | 0  | 0         | 2                             | 2               | 2       | 0  | 0         | 2                             | 66              | 2.75 (0.41 - 18.00)                                       | 0.31              |
| Diverticulitis             | 5       | 1  | 2         | 8                             | 2               | 2       | 1  | 3         | 6                             | 16              | 0.82 (0.25 - 2.79)  | 0.76              |
| Acute Pancreatitis         | 0       | 2  | 2         | 4                             | 1               | 0       | 1  | 2         | 3                             | 25              | 2.38 (0.56 - 10.30)                                       | 0.41              |
| Diabetic Foot Ulcer        | 16      | 3  | 0         | 19                            | 7               | 11      | 1  | 0         | 12                            | 4               | 0.91 (0.25 - 3.45)  | >0.9999           |
| GI Bleeding                | 2       | 2  | 10        | 14                            | 1               | 2       | 0  | 8         | 10                            | 6               | 0.60 (-18 - 1.96)   | 0.53              |
| Intestinal Obstruction     | 14      | 1  | 2         | 17                            | 1               | 4       | 2  | 1         | 7                             | 8               | 1.29 (0.39 - 4.53)  | 0.76              |
| Gastritis                  | 0       | 0  | 1         | 1                             | 7               | 0       | 0  | 5         | 5                             | 21              | 0.60 (0.05 - 4.36)  | >0.9999           |

**Table 3:** Surgical, IR and endoscopic intervention rates for the ten most common discharge diagnoses.

## Discussion

This is the largest study to date of the impact of the initial stage of the Covid-19 pandemic on emergency general and vascular surgical activity in an Irish setting. There are several notable findings. Firstly, we demonstrated no significant decrease in the rate of admissions for emergency general/vascular surgery from March through May of 2020 as compared to the same period in 2019, despite stringent lockdown measures imposed during this period. This stands in contrast to several other recent publications from Irish surgical units showing a significant decrease in emergency admissions across various specialties<sup>11-13</sup>. This suggests that variations in presentation pattern may not be predictable based on the introduction of lockdown restrictions alone, and that observed decreases in acute presentations elsewhere may not be replicated at a local level, across various subspecialties or populations. The implication for work force planning of this finding should be noted, as reassigning surgical non-consultant hospital doctors to other services (for example, acute medical teams) to deal with future surges may leave acute surgical services short-staffed to deal with high emergent admission volumes.

Secondly, in keeping with guidelines issued by governing bodies around that time, we observed a statistically significant reduction in overall procedural intervention rate 2020. This was mainly driven by a decrease in operative interventions, with IR and endoscopic procedures carried out on emergent general surgical admissions largely similar. The only significantly different diagnosis-specific intervention rate was observed for patients with acute appendicitis, with a significant increase in non-operative management; we have previously published our appendicitis experience elsewhere<sup>14</sup>. While the impact of the current global pandemic on elective surgery has been well explored<sup>1</sup>, further studies will be required to analyze the impact of non-operative management of emergent surgical conditions on future presentations. An increase in recurrent presentations for surgical conditions such as appendicitis will need to be factored into recovery plans for delivery of surgical care.

There was a significant increase in the number of head injuries admitted to the general surgical teams. A substantial increase in falls and assault accounts for most of this overall increase. Examining the Irish literature on this topic, Fahy et al noted a 21% overall decrease in radiographically proven trauma<sup>13</sup>. Interestingly they demonstrated an increase in falls from greater than 2 metres (specifically ladders) during lockdown, and an overall 17% increase in domestic activity trauma, which would be in keeping with our findings. By contrast, O'Connell et al demonstrated a 70% reduction in head injury admission in their cohort from a similar period<sup>11</sup>. It is important to note that our data concerns patients admitted with head injury without other major skeletal trauma and does not address orthopedic admissions. Additionally, head trauma needing urgent neurosurgical intervention would usually be transferred immediately after appropriate workup and stabilization in the emergency department, and thus would likely not be captured here.

There was also a significant increase in the number of patients admitted with gastritis during this time period. We speculate that this may have been secondary to increased domestic alcohol consumption which has been reported during the initial stages of the pandemic<sup>15, 16</sup>, though our study did not record data related to alcohol intake. We also found a significant decrease in intestinal obstructions, in contrast with other studies which identified reduced physical activity and dietary changes during the lockdown period as potential contributors to increased intestinal obstruction rates<sup>17</sup>.

Finally, we demonstrated a significant reduction in length of hospital stay during our study timeframe. A considerable reconfiguration of hospital infrastructure occurred during this period, most notably with the creation of a temporary 'field hospital' where patients with low acuity presentations were transferred in order to maintain main site capacity. This, coupled with the significant reduction in operative intervention, helps to explain the shorter length of stay observed.

This study encompasses a detailed review of the largest acute surgical cohort published to date in Ireland during the Covid-19 era. As such, we feel that it reflects the 'real-world' acute general and vascular surgical experience. Our 3-month study period straddles the beginning of the COVID-era restrictions and details the significant impact on urgent admission and procedural activity in a university hospital.

This is a retrospective study and is therefore subject to the usual biases of such studies. We focused on emergent admissions to the general and vascular services only, as presentations to our acute surgical assessment unit (ASAU) that deemed suitable for discharge home by the ASAU team were not brought to the attention of the on-call team. Capturing this 'presentations' data accurately is difficult, and thus we are unable to comment on overall presentation rates. This data pertains to general and vascular surgery admissions in a tertiary-level academic hospital in the mid-West of Ireland which is the central hub of a 4-hospital referral network for acute surgical conditions and thus the external validity of our findings may not be generalizable to other settings or populations.

In conclusion, that trends in emergent general/vascular surgical admissions and procedural activity during pandemic conditions are likely not predictable or generalizable across specialties or populations. Future bed capacity and work force planning during times of crisis should consider a possible continuation or increase in emergent surgical presentations.

#### **Ethical Approval:**

Local IRB ethical approval was obtained prior to commencement of the study.

#### **Declaration of Conflicts of Interest:**

The authors declare that there is no conflict of interest.

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