Do surgical emergencies stay at home? Observations from the first United States Coronavirus epicenter

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BACKGROUND: During the coronavirus disease 2019 pandemic, New York instituted a statewide stay-at-home mandate to lower viral transmission. While public health guidelines advised continued provision of timely care for patients, disruption of safety-net health care and public fear have been proposed to be related to indirect deaths because of delays in presentation. We hypothesized that admissions for emergency general surgery (EGS) diagnoses would decrease during the pandemic and that mortality for these patients would increase.

METHODS: A multicenter observational study comparing EGS admissions from January to May 2020 to 2018 and 2019 across 11 NYC hospitals in the largest public health care system in the United States was performed. Emergency general surgery diagnoses were defined using International Classification Diseases, Tenth Revision, codes and grouped into seven common diagnosis categories: appendicitis, cholecystitis, small/large bowel, peptic ulcer disease, groin hernia, ventral hernia, and necrotizing soft tissue infection.

RESULTS: A total of 1,376 patients were admitted for EGS diagnoses from January to May 2020, a decrease compared with both 2018 (1,789) and 2019 (1,668) ($p < 0.0001$). This drop was most notable after the stay-at-home mandate (March 22, 2020; week 12). From March to May 2020, 3.3%, 19.2%, and 6.0% of EGS admissions were incidentally COVID positive, respectively. Mortality increased in March to May 2020 compared with 2019 (2.2% vs. 0.7%); this difference was statistically significant between April 2020 and April 2019 (4.1% vs. 0.9%, $p = 0.045$).

CONCLUSION: Supporting our hypothesis, the coronavirus disease 2019 pandemic and subsequent stay-at-home mandate resulted in decreased EGS admissions between March and May 2020 compared with prior years. During this time, there was also a statistically significant increase in mortality, which peaked at the height of COVID infection rates in our population. (J Trauma Acute Care Surg. 2021;91: 241–246. Copyright © 2021 Wolters Kluwer Health, Inc. All rights reserved.)

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year, including nearly 500,000 uninsured patients. New York City Health and Hospitals consists of 11 unique and functionally independent acute care hospitals, 6 long care facilities, and multiple community centers. This offers a unique opportunity to study the effect of the COVID-19 pandemic on EGS admissions across a multi-institutional system hard hit at the peak of its impact. We hypothesized that admissions for EGS diagnoses would decrease during the pandemic. Based on the assumption that patients would delay their care, we also hypothesized that mortality for these patients would increase compared with prior years.

PATIENTS AND METHODS

Following institutional review board approval, data were collected and queried from billing records across all 11 NYC H+H acute care hospitals. Common EGS diagnoses with corresponding International Classification of Diseases, Ninth Revision, diagnosis and procedure codes were chosen based on published data. These codes were then converted to International Classification of Diseases, Tenth Revision, Clinical Modification and grouped into seven diagnoses categories: appendicitis, cholecystitis, intestinal (including all indications for urgent small and large bowel resections), peptic ulcer disease, groin hernias, ventral hernias, and necrotizing soft tissue infection (Supplemental Digital Content, Tables 1 and 2, http://links.lww.com/TA/B974). All inpatients with these diagnoses admitted between January and May for years 2018 to 2020 were studied. Patient data abstracted from the common system-wide billing record included age, sex, race/ethnicity, insurance payor status, COVID status, length of stay, and in-hospital mortality. To analyze EGS admissions in 2020, a weekly rolling average was used to track patterns of hospital admission over the 5-month time period in all 3 years.

Statistical analyses were performed using SAS software version 9.4 (Cary NC). Descriptive statistics were calculated for all measured variables by year of admission.

### TABLE 1. Patient Characteristics

| Diagnosis                      | 2018 (n = 1,789) | 2019 (n = 1,668) | 2020 (n = 1,376) | 2020 (N = 1,376) |
|--------------------------------|-----------------|-----------------|-----------------|-----------------|
| Age, median (IQR)              | 53.0 (30.0) [15–102] | 53.0 (30.0) [15–102] | 54.0 (30.0) [15–100] | 54.0 (30.0) [15–100] |
| Sex, n (%)                     |                 |                 |                 |                 |
| Female (n = 2,282)             | 847 (47.3)      | 801 (48.0)      | 634 (46.1)      | 615 (46.5)      |
| Male (n = 2,551)               | 942 (52.7)      | 867 (52.0)      | 742 (53.9)      | 709 (53.6)      |
| Payor (missing, 6), n (%)      |                 |                 |                 |                 |
| Commercial (n = 696)           | 208 (11.7)      | 246 (14.8)      | 242 (17.6)      | 236 (17.9)      |
| Government (n = 3,891)         | 1,454 (81.4)    | 1,359 (81.5)    | 1,078 (78.5)    | 1,032 (78.1)    |
| Self-pay (n = 240)             | 124 (6.9)       | 62 (3.7)        | 54 (3.9)        | 54 (4.1)        |
| Race (missing, 1), n (%)       |                 |                 |                 |                 |
| Asian (n = 279)                | 106 (5.9)       | 95 (5.7)        | 78 (5.7)        | 77 (5.8)        |
| Black (n = 1,472)              | 548 (30.6)      | 509 (30.5)      | 415 (30.2)      | 404 (30.5)      |
| White (n = 555)                | 210 (11.7)      | 178 (10.7)      | 167 (12.2)      | 161 (12.2)      |
| Other (n = 2,111)              | 693 (38.7)      | 761 (45.6)      | 657 (47.8)      | 626 (47.3)      |
| Declined (n = 23)              | 3 (0.2)         | 0 (0.0)         | 20 (1.5)        | 19 (1.4)        |
| Unknown (n = 110)              | 44 (2.5)        | 28 (1.7)        | 38 (110)        | 36 (2.7)        |
| Ethnicity (missing, 8), n (%)  |                 |                 |                 |                 |
| Hispanic (n = 1,317)           | 659 (36.8)      | 497 (29.8)      | 161 (11.8)      | 154 (11.7)      |
| Non-Hispanic (n = 2,115)       | 937 (52.4)      | 697 (41.8)      | 481 (35.1)      | 469 (35.6)      |
| Declined (n = 143)             | 92 (5.1)        | 41 (2.5)        | 10 (0.7)        | 9 (0.7)         |
| Unknown (n = 1,250)            | 101 (5.7)       | 432 (25.9)      | 717 (52.4)      | 686 (52.1)      |
| Diagnosis, n (%)               |                 |                 |                 |                 |
| Appendicitis (n = 885)         | 258 (14.4)      | 335 (20.1)      | 292 (21.2)      | 283 (21.4)      |
| Cholecystitis (n = 1,416)      | 541 (30.2)      | 506 (30.3)      | 369 (26.8)      | 363 (27.4)      |
| Intestinal (n = 1,280)         | 552 (30.9)      | 376 (22.5)      | 352 (25.6)      | 328 (24.7)      |
| Peptic ulcer disease (n = 696) | 245 (13.7)      | 262 (15.7)      | 189 (13.7)      | 182 (13.8)      |
| Gastrocutaneous hernia (n = 242) | 80 (4.5)        | 95 (5.7)        | 67 (4.9)        | 66 (5.0)        |
| Ventral hernia (n = 274)       | 99 (5.5)        | 91 (5.5)        | 84 (6.2)        | 84 (6.3)        |
| Necrotizing soft tissue infection (n = 40) | 14 (0.8)       | 3 (0.2)         | 23 (1.7)        | 18 (1.4)        |
| Mortality, n (%)               | 15 (0.8)        | 20 (1.2)        | 27 (2.0)        | 23 (1.7)*       |
| Length of stay, median (IQR) [range], d | 3.0 (3.0) [1–147] | 3.0 (4.0) [1–143] | 3.0 (4.0) [1–147] | 3.0 (4.0) [1–147]** |

*p = 0.0167.

**p < 0.001.

IQR, interquartile range.
Continuous measures were reported as mean and SD, if normally distributed; median and interquartile ranges were applied when nonnormal. Categorical measures were reported as frequencies and percentages. Student’s t tests (or Wilcoxon rank sum tests) were used for continuous data. Categorical group measures were compared using \( \chi^2 \) statistics (or Fisher’s exact tests, in cases where \( \chi^2 \) assumptions were unmet). Generalized Poisson regression models were used to calculate mortality rates and 95% confidence intervals. Post hoc comparisons were used to test for significant differences between the years for each month. All statistical tests used a two-sided \( \alpha \) of 0.05 for significance.

RESULTS

A total of 1,376 patients were admitted to NYC H + H for all 7 selected EGS diagnoses between January 1 and May 30, 2020. This was approximately a 20% decrease compared with admissions over the same period in both 2018 (1,789) and 2019 (1,668). From March to May of 2020, there were 52 (3.8%) of these EGS patients with COVID-positive status. Patient characteristics are detailed further in Table 1. Age and sex composition were similar with a median age in the fifth decade and slight male predominance across all 3 years. Payor status was also similar, with more than 75% of patients using government insurance across the years. Regarding self-reported demographics, there was an increase in nonreporting (“unknown” ethnicity) over time; however, the proportions of other racial and ethnic identifiers remained stable. Cholecystitis was the most frequent reason for admission in all 3 years, but intestinal diagnoses were the most frequent in COVID-positive patients.

To better analyze the decrease in EGS admissions in 2020, a weekly rolling average was used to track patterns of hospital admission over the 5-month period in all 3 years (Fig. 1). From January to early March (weeks 1–11), there were approximately 9.3 to 13.8 EGS admissions per day per year, with no meaningful difference among the 3 years. The week of the March 22nd mandate (week 12), there were approximately 8.1 admissions per day in 2020, compared with 11.7 in 2018 and 12.1 in 2019. Emergency general surgery admissions for 2020 continued to decrease after this date, with a nadir of 4.2 admissions in week 14. Figure 2 compares average daily EGS admissions before and after March 22nd of each year. During 2020, there was a statistically significant decrease in average daily EGS admissions after the March 22nd mandate (11.7 vs. 9.2 admissions, \( p < 0.0001 \)). This phenomenon was not present in either 2018 (12.0 vs. 12.2 admissions, \( p = 0.71 \)) or 2019 (10.9 vs. 11.8 admissions, \( p = 0.19 \)).

Both in-hospital mortality rate (7.7% vs. 1.7%, \( p = 0.017 \)) and hospital length of stay (6.0 vs. 3.0 days, \( p < 0.001 \)) were significantly increased in COVID-positive patients compared with those who were COVID-negative in 2020. Compared with 2019, there was a higher rate of mortality for January to May of 2020 (2.0% vs. 1.2%; however, this was not statistically significant in our study group. Looking specifically at monthly mortality after the mandate (Fig. 3), mortality was significantly increased in April (4.1% vs. 0.9%, \( p = 0.045 \)) and May (0.4% vs. 0.0%, \( p < 0.001 \)) of 2020 compared with 2019. Because of coding discrepancies, specifically a change in the International Classification Diseases, Tenth Revision, coding, 2018 was excluded from mortality analysis.

Further stratification of mortality by diagnosis category and COVID status is shown in Table 2. Intestinal diagnoses carried the highest mortality in all 3 years (1.6%, 4.0%, and 4.5%, respectively). Two categories, cholecystitis and groin hernia, had zero mortality. In four of five of the remaining categories, deaths occurred predominantly in COVID-negative patients; the exception to this was necrotizing soft tissue infection. Of the 27 EGS

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**Figure 1.** Seven-day rolling average of EGS admissions, January to May 2018 to 2020.
patients who expired in 2020, only 4 (14.8%) were COVID positive.

**DISCUSSION**

The global COVID-19 pandemic changed the way surgeons practice. Many surgical societies and governing bodies have strongly recommended that hospitals cancel elective surgeries during the initial height of the pandemic.\(^7,^{15,16}\) Because most health care systems obliged and elective surgeries were canceled, only true surgical emergencies remained. Our study examined the impact these societal changes had on the admission rate and mortality of EGS patients in the NYC municipal hospital system. The findings of this study support our primary hypothesis that, during the height of the COVID pandemic in NYC in the spring of 2020, EGS admissions were noted to decline compared with the same time in 2018 and 2019. Other authors have noted a decline in the admission rates of numerous other medical and surgical diseases during similar quarantine conditions.\(^10,^{17,18}\) Therefore, our observation of decreased admissions during the NYC quarantine is not completely surprising. It is not unreasonable to postulate that the decline in admissions is a direct result or in part related to the citywide stay-at-home order and generalized public fear of presenting to a hospital during the quarantine. While evidence to support this notion is scant, increased rates of home deaths in NYC...
Notwithstanding and to the best of our knowledge, our study is the largest and the only multicenter study to look at EGS cases during a period of quarantine in a major COVID epicenter. We demonstrate a clear decrease in the number of EGS admissions during the spring of 2020 when NYC was the national epicenter for COVID-19. Further multicenter investigation is warranted to confirm the findings of our study and may help further delineate the reasons for the rise in mortality we see in EGS patients during the pandemic.

AUTHORSHIP
C.T.D. contributed in the study design, data analysis, article writing, submission preparation, and article revision. A.L. contributed in the study design, data analysis, article writing. E.R.L., S.M., E.C., S.H.R., J.M., and S.H.T. contributed in the article review. M.E.S. contributed in the study design, data analysis, and article review.

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DISCLOSURE
The authors declare no conflicts of interest.

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