Dramatic decrease of surgical emergencies during COVID-19 outbreak

Stefano Rausei, MD, PhD, Francesco Ferrara, MD, Tommaso Zurleni, MD, Francesco Frattini, MD, Osvaldo Chiara, MD, Andrea Pietrabissa, MD, Giuliano Sarro, MD, for Italian Association of Hospital Surgeons, and Collected Data Contributors

CONTINUING MEDICAL EDUCATION CREDIT INFORMATION

Accreditation
The American College of Surgeons is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

AMA PRA Category 1 Credits™
The American College of Surgeons designates this journal-based CME activity for a maximum of 1 AMA PRA Category 1 Credit™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Disclosure Information
In accordance with the ACCME Accreditation Criteria, the American College of Surgeons must ensure that anyone in a position to control the content of the educational activity (planners and speakers/authors) has disclosed all relevant financial relationships with any commercial interest. For additional information, please visit the ACCME website (see below for definitions).

Commercial Interest: The ACCME defines a “commercial interest” as any entity producing, marketing, re-selling, or distributing health care goods or services used on or consumed by patients. Providers of clinical services directly to patients are NOT included in this definition.

Financial Relationships: Relationships in which the individual benefits by receiving a salary, royalty, intellectual property rights, consulting fee, honoraria, ownership interest (e.g., stocks, stock options or other ownership interest, excluding diversified mutual funds), or other financial benefit. Financial benefits are usually associated with roles such as employment, management position, independent contractor (including contracted research), consulting, speaking and teaching, membership on advisory committees or review panels, board membership, and other activities from which remuneration is received, or expected. ACCME considers relationships of the person involved in the CME activity to include financial relationships of a spouse or partner.

Conflict of Interest: Circumstances create a conflict of interest when an individual has an opportunity to affect CME content about products or services of a commercial interest with which he/she has a financial relationship.

The ACCME also requires that ACS manage any reported conflict and eliminate the potential for bias during the session. Any conflicts noted below have been managed to our satisfaction. The disclosure information is intended to identify any commercial relationships and allow learners to form their own judgments. However, if you perceive a bias during the educational activity, please report it on the evaluation.

| Authors/Contributors | Nothing to Disclose | Disclosure |
|----------------------|---------------------|-------------|
| All authors          | X                   |             |

| Planning Committee/Editorial Committee | Nothing to Disclose | Disclosure |
|----------------------------------------|---------------------|-------------|
| Ernest E. Moore, Editor                | Haemonetics         | PI           |
|                                        | Shared U.S. Patents  |             |
| Instrumentation Laboratory             | PI                   | Research Support |
| Stago, Humacyn, Prozyme                | PI                   | Research Support |
| Thrombo Therapeutics                   | Co-founder           | Stock       |
| Associate Editors                      |                      |             |
| Ronald V. Maier and Steven Shackford  | X                    |             |
| Editorial Staff and Angela Sauaia      | X                    |             |

Claiming Credit
To claim credit, please visit the AAST website at http://www.aast.org/ and click on the “e-Learning/MOC” tab. You must read the article, successfully complete the post-test and evaluation. Your CME certificate will be available immediately upon receiving a passing score of 75% or higher on the post-test. Post-tests receiving a score of below 75% will require a retake of the test to receive credit.

Credits can only be claimed online

Cost
For AAST members and Journal of Trauma and Acute Care Surgery subscribers there is no charge to participate in this activity. For those who are not a member or subscriber, the cost for each credit is $25.

Questions
If you have any questions, please contact AAST at 800-789-4006. Paper test and evaluations will not be accepted.
C

oravirus disease 2019 (COVID-19) pandemic caused by the severe acute respiratory syndrome coronavirus 2 is currently changing the health, social, and economic world landscape.1–3

Italy was the first European country that suffered a strong impact, in particular in two Northern regions, Lombardy and Veneto. On March 8, 2020, the government decided to extend quarantine measures to all of Lombardy, strict restrictions of people’s movements, and the temporary closure of schools, shops, and industrial activities.4

On March 31, 2020, the number of deaths reached 11,591 with 101,739 positive cases in Italy, and 7,199 deaths and 44,585 positive cases in Lombardy, corresponding to 62.1% and 43.8% of the total number of deaths and positive cases of Italy.5,6 Because of a day-by-day increasing number of affected subjects, a reorganization and dynamic distribution of national and regional health care resources were necessary to define algorithms for the management of patients requiring nonelective surgical procedures. In fact, the massive overload of patients with respiratory symptoms needed a reshaping of emergency departments (EDs), intensive care units (ICUs), and medical wards to improve hospital capacity and increase ICUs and COVID-19 dedicated beds.7,8

In every ED, specific pathways for suspected or confirmed COVID-19 patients have been set up. Consequently, personnel health training, application of infection control measures, and mandatory limitations of surgical activities were implemented. In Lombardy, the purpose of redistribution was to create COVID-free hospitals with dedicated pathways to treat tumors and major traumas.9 Consistently, several national surgical scientific societies and regional health organizations tried to develop protocols and recommendations based on common sense for surgical practice.10–14 Unexpectedly, during the COVID-19 outbreak, also a general decrease in surgical emergency procedures was observed, and some opinions were advanced about this perception.15,16 Nevertheless, no extensive data have been presented to date.

The aim of the present multicenter study, based on the experience of 18 centers of the “Red Zone” in Lombardy, was to analyze the real number of hospitalizations and surgical procedures for emergency surgical disease during COVID-19 pandemic.

PATIENTS AND METHODS

Study Design, Population, and Settings

This is a multicenter observational study including 18 general surgery units performing emergency surgery in hospitals of Lombardy region, Italy. Emergency departments were classified according to the Italian Ministry of Health criteria.17 The recruiting hospitals of this study were homogeneously distributed in the region (Fig. 1) and included four university centers and the most experienced regional trauma centers.

Between April 1 and 30, 2020, data about hospitalizations in surgical units from EDs and surgical emergency procedures performed during March 2019 and March 2020 were collected in an online database through Google Forms platform. Data included the number of surgical beds and ICU beds (without COVID-19), elective oncologic and nononcologic surgical procedures, admissions in surgical units from ED and emergency surgical procedures, and the median age of patients admitted from ED and treated by emergency surgery during the considered periods. Additional data were collected according to the different indications for surgical treatment: appendicitis,
cholecystitis, bowel obstruction, gastrointestinal (GI) perforation, GI bleeding, urgent proctological disease, (nonperforated) diverticulitis, and abdominal trauma. Patients younger than 18 years were excluded.

According to the Lombardy region rules for the COVID-19 pandemic emergency, in particular for surgery, some hospitals were referred to as hub centers for treating trauma and oncologic patients, but all the institutions were authorized to admit and treat nontraumatic surgical emergencies.

At the end of the recruitment period, the online database was downloaded and elaborated for statistical analysis.

**Outcome Measures**

The primary outcomes were the overall rate of admissions for emergent surgical disease and the overall rate of emergency surgical procedures in the study periods. The secondary outcome was the overall surgical rates (among all the diagnosed surgical diseases) in the two considered months.

**Statistical Analysis**

The variables were reported as median and range. The percentage value of the difference between the admissions and procedures of March 2019 ($X$) and the admissions and procedures of March 2020 ($Y$) was calculated by this formula: $X - Y / X$.

The surgical rate (among all the diagnosed surgical diseases) was the ratio between procedures and diseases calculated for each study period.

To compare the variables, this analysis assumed that the data come from two dependent samples, following the same surgical unit through time and the rank sum test (Wilcoxon) was used. The statistical significance level was set at the conventional $p < 0.05$. The results were analyzed using the SPSS 20 statistical software for Windows (SPSS Inc., Chicago, IL).

**RESULTS**

The total number of beds available in the general surgery units was significantly lower in March 2020 than in March 2019 (10 [4–24] vs. 26 [14–76]) for a median decrease of up to 55% (Table 1). Similarly, a significant reduction of elective surgery was observed during the study periods: a 95% decrease for nononcologic procedures (0 [0–18] vs. 34.5 [0–90]) and a 46% decrease for oncologic cases (6 [0–27] vs. 14.5 [0–42]) were documented (Table 1). The ICU beds availability for non-COVID-19 patients was very variable among institutions and did not significantly decrease (4 [0–37] vs. 6.5 [0–43]; $p = 0.407$).

Concerning the topic of this analysis, emergency surgical admissions and surgical operations significantly decreased from March 2019 to March 2020 with a fall in the value of 45% (22 [3–72] vs. 46.5 [10–87]) and 41% (12.5 [5–69] vs. 25.5 [14–61]), respectively (Table 2). This reduction was confirmed by the analysis according to different surgical indications, with the exceptions of admissions and operations for GI bleeding and operations for abdominal trauma (Fig. 2; Supplemental Digital Content, Supplementary Table, http://links.lww.com/TA/B797).

![Figure 1](image_url)  
*Figure 1. Map of Lombardy region with the 18 study centers according to the diffusion of COVID-19 (updated March 31, 2020).*
The statistical significance verified for the difference of admissions for GI perforation was not so relevant (Fig. 2; Supplemental Digital Content, Supplementary Table, http://links.lww.com/TA/B797). Moreover, no significant difference of median age of patients admitted and operated in the two study periods was detected (61.5 [53–79] vs. 63 [52–76]; \( p = 0.959 \) and 58.5 [38–82] vs. 60.5 [42–80]; \( p = 0.887 \)).

The overall ratio between surgical procedures and diseases was not significantly different in the two observation months (54% in March 2020 vs. 63% in March 2019; \( p = 0.619 \)). This ratio was significantly different only for bowel obstruction (with a median increase of 30%) and for GI perforation (with a median decrease of 46%) (Table 3).

**DISCUSSION**

Since the first Italian case of a patient tested positive for severe acute respiratory syndrome coronavirus 2 has been reported (February 21, 2020), the Lombardy region had the highest burdens in Italy.\(^1\) Last March, the public health care system and governmental offices deployed containment measures to all Italian regions to limit COVID-19 spread with a progressive and dramatic impact on hospitals and health care resources.\(^2\) This challenging necessity to redesign hospital services and to shift medical personnel in the ED and medical wards dedicated to COVID-19 patients implied a stringent reduction of elective surgical activities and an organization of hub centers for tumors and major trauma.\(^3\) Nonetheless, since the beginning of the outbreak, an unexpected decrease in surgical emergencies and admissions for surgical disease to ED was commonly perceived among surgeons working in the Red Zones.

**TABLE 1.** Classification of EDs, Number of Beds of the Surgical Units, and Surgical Volume for Elective Surgery in March 2020 (Compared With March 2019)

| Center ID | ED Level | General Surgery Unit Beds | Elective Nononcologic Surgery | Elective Oncologic Surgery |
|-----------|----------|---------------------------|-----------------------------|---------------------------|
|           |          | March 2019 | March 2020 | % Difference | March 2019 | March 2020 | % Difference | March 2019 | March 2020 | % Difference |
| 1         | 2nd      | 76         | 16         | 0.79        | 90         | 0          | 1.00        | 42         | 27         | 0.36        |
| 2         | 2nd      | 24         | 8          | 0.67        | 16         | 0          | 1.00        | 20         | 12         | 0.40        |
| 3         | 2nd      | 16         | 12         | 0.25        | 34         | 5          | 0.85        | 11         | 4          | 0.64        |
| 4         | 1st      | 24         | 10         | 0.58        | 51         | 0          | 1.00        | 14         | 4          | 0.71        |
| 5         | 2nd      | 18         | 24         | −0.33       | 2          | 0          | 1.00        | 0          | 0          | 0.00        |
| 6         | 1st      | 45         | 14         | 0.69        | 69         | 3          | 0.96        | 25         | 8          | 0.68        |
| 7         | 1st      | 32         | 10         | 0.69        | 40         | 0          | 1.00        | 15         | 4          | 0.73        |
| 8         | 1st      | 31         | 20         | 0.35        | 35         | 0          | 1.00        | 17         | 1          | 0.94        |
| 9         | 1st      | 32         | 10         | 0.69        | 15         | 0          | 1.00        | 14         | 1          | 0.93        |
| 10        | First aid| 24         | 24         | 0.00        | 0          | 0          | 0.00        | 3          | 1          | 0.67        |
| 11        | 1st      | 28         | 10         | 0.64        | 15         | 1          | 0.93        | 41         | 27         | 0.34        |
| 12        | 1st      | 22         | 10         | 0.55        | 47         | 2          | 0.96        | 21         | 7          | 0.67        |
| 13        | 1st      | 23         | 16         | 0.30        | 26         | 2          | 0.92        | 10         | 9          | 0.10        |
| 14        | 1st      | 28         | 7          | 0.75        | 38         | 2          | 0.95        | 25         | 14         | 0.44        |
| 15        | First aid| 14         | 10         | 0.29        | 40         | 0          | 1.00        | 13         | 13         | 0.00        |
| 16        | 1st      | 20         | 20         | 0.00        | 29         | 1          | 0.97        | 20         | 25         | −0.25       |
| 17        | 1st      | 30         | 4          | 0.87        | 14         | 0          | 1.00        | 5          | 5          | 0.00        |
| 18        | 1st      | 28         | 8          | 0.71        | 82         | 18         | 0.78        | 10         | 4          | 0.60        |
| Total     |          | 515        | 233        | 0.55        | 643        | 34         | 0.95        | 306        | 166        | 0.46        |

\( p = 0.001 \) \( p < 0.001 \) \( p = 0.001 \)

This multicenter study, collecting data related to March 2019 and March 2020 from 18 Lombardy centers, confirms the...
efficacy of solutions in reducing elective surgical activity (up to 95% for nononcologic and 46% for oncologic diseases; Table 1) and demonstrates the overall decreasing in the demand for surgical care in ED during the COVID-19 outbreak: a fall in the value of more than 40% for ED admissions and emergency surgical procedures (45% and 41%, respectively; Table 2) was calculated for March 2020, compared with March 2019. Particularly, a statistically significant reduction involved all the surgical diseases counting a drop at least 40% (Fig. 2; Supplemental Digital Content, Supplementary Table, http://links.lww.com/TA/B797), with the exceptions of admissions and operations for GI bleeding and operations for abdominal trauma. Even the cases of GI perforation decreased, but not in a statistically relevant way (58 admissions in March 2019 vs. 35 in March 2020; \( p = 0.049 \)). However, unlike the hospital reorganization imposed by the region, in some centers, there was no expected reduction in oncologic surgical operations (Table 1); just as in others, emergency surgical admissions and procedures could appear slightly different (i.e., abdominal trauma in the center 5; Supplemental Digital Content, Supplementary Table, http://links.lww.com/TA/B797).

Nevertheless, this evident lowering of impact on emergency services by surgical diseases needs to be explained. The lockdown measures adopted in Italy and in particular in Lombardy, to flatten the contagion curve of the COVID-19, have undoubtedly forced people to stay at home and to use emergency services only if strictly indispensable for serious reasons. On the other hand, most likely, patients were reluctant to reach the ED to avoid being infected. Similarly, common sense and literature suggestions induced surgeons to modulate surgical timing in case of non-life-threatening conditions and to stress for at-home management of mild-moderate patterns of disease.22–25 Hence,

### Table 3. Surgical Rates Among All the Emergency Surgical Diseases Diagnosed in March 2020 (Compared With March 2019)

| Center ID | Appendicitis | Chole cystitis | Bowel Obstruction | Bowel Perforation | GI Bleeding | Proctologic Disease | Abdominal Trauma | Total |
|-----------|--------------|----------------|-------------------|------------------|------------|---------------------|-----------------|-------|
|           | March 2019   | March 2020     | March 2019        | March 2020       | March 2019 | March 2020          | March 2019      | March 2020 |
| 1         | 0.88         | 0.80           | 0.50              | 0.80             | 0.80       | 1.00                | 1.00            | 0.69    |
| 2         | 0.91         | 0.71           | 1.00              | 1.00             | 0.67       | 0.00                | 0.25            | 0.67    |
| 3         | 0.90         | 0.64           | 0.00              | 0.88             | 0.25       | 0.89                | 0.50            | 1.33    |
| 4         | 0.00         | 0.33           | 0.50              | 0.67             | 0.00       | 0.50                | 0.50            | 0.00    |
| 5         | 0.90         | 0.50           | 0.40              | 0.50             | 0.50       | 0.00                | 0.00            | 0.00    |
| 6         | 1.00         | 0.03           | 0.67              | 1.00             | 0.00       | 0.00                | 0.00            | 0.00    |
| 7         | 1.00         | 1.00           | 1.00              | 0.00             | 0.00       | 0.00                | 0.75            | 0.58    |
| 8         | 1.00         | 0.80           | 0.60              | 0.33             | 1.00       | 0.14                | 0.50            | 0.31    |
| 9         | 1.00         | 0.90           | 1.00              | 0.00             | 0.50       | 0.00                | 0.20            | 0.56    |
| 10        | 1.00         | 0.80           | 0.83              | 0.00             | 0.00       | 0.00                | 0.00            | 1.50    |
| 11        | 0.75         | 0.67           | 0.86              | 0.67             | 0.50       | 0.00                | 0.00            | 0.69    |
| 12        | 1.22         | 1.14           | 0.33              | 1.00             | 0.50       | 0.10                | 0.00            | 0.50    |
| 13        | 1.00         | 0.40           | 0.20              | 0.69             | 1.00       | 0.67                | 1.00            | 0.93    |
| 14        | 1.00         | 1.00           | 0.71              | 1.00             | 0.33       | 0.00                | 1.00            | 0.94    |
| 15        | 1.00         | 0.25           | 1.00              | 1.00             | 0.43       | 1.00                | 0.20            | 0.50    |
| 16        | 1.00         | 1.50           | 2.00              | 0.67             | 0.00       | 2.00                | 1.00            | 0.78    |
| 17        | 0.67         | 1.00           | 1.00              | 0.33             | 1.00       | 0.13                | 0.00            | 0.38    |
| 18        | 1.00         | 0.42           | 1.00              | 1.00             | 0.50       | 0.25                | 0.60            | 0.72    |
| Median    | 1.00         | 0.80           | 0.86              | 0.70             | 1.00       | 0.13                | 0.00            | 0.63    |

\( p = 0.866 \quad p = 0.594 \quad p = 0.011 \quad p = 0.009 \quad p = 0.646 \quad p = 0.102 \quad p = 0.715 \quad p = 0.619 \)
the results of this study confirm that regional rules and people and surgeons’ attitudes negatively affected the number of hospital admissions. What is more, it is not possible to exclude (and to measure) the intriguing phenomenon for which changes in lifestyle during confinement, with particular regard to diet (i.e., low-fat, less convenience food), hygiene (i.e., handwashing and personal hygiene, environmental sanitation), and habits (i.e., less stressing activities), may have contributed to lower the incidence of some surgical diseases. Finally, it cannot be excluded that COVID-19 itself with specific effects on GI tract may have affected incidence of surgical diseases and/or altered their clinical presentation.

In this context, as expected, two results did not seem so consistent and have to be clarified: the statistical decrease of cases of GI perforation and bleeding was only slightly or not significant.

About the first category, it is really surprising even to detect any lowering trend (confirmed by its operations rates), but it could be interesting to discuss it along with the very significant reduction of admissions for diverticulitis (>65%; Fig. 2; Supplementary Digital Content, Supplementary Table, http://links.lww.com/TA/B797). The decrease of complicated diverticular diseases can recognize all the aforementioned causes, but an additional factor, strongly related to GI perforation, might have influenced this figure. The initial warnings about the possible role of non-steroidal anti-inflammatory drugs and corticosteroids in worsening the severity of COVID-19 and, consequently, their minor use may partially explain the decreased incidence of diverticulitis and GI perforation (for demonstrated cause-effect relationships).

Similarly, the decreasing rates of diverticulitis may have implied a reduction of the cases of closed perforation of the colon, included in the multifaceted definition of GI perforation.

With specific regard to GI bleeding (and its nonsignificant fall in value), its clinical presentation generally induces patients to ED, independently from any restriction. Moreover, despite the reduced probability of drug-induced gastric injuries, the diffusion of low molecular weight heparin used at an anticoagulant dose in the treatment of COVID-19 may have affected this result.29,30

Once adjusted for the number of emergency admissions, this analysis confirmed the more immediate perception about the dramatic decrease of emergency surgical procedures. In particular, it tried to measure the conservative approach of surgeons by calculating the ratio between surgical procedures and diseases in March 2020 compared with March 2019 (Table 3). The overall ratio was not significantly different in the two observation months (54% vs. 63%; \(p = 0.619\)); this general result was not consistent with more conservative management of surgical diseases. However, the disease-specific analysis provided conflicting data: this ratio was significantly increased for bowel obstruction (about 30%) and decreased for GI perforation (about 45%) (Table 3).

Literature specifically addressed to the COVID-19 pandemic underlined that indications for emergency surgery must be considered to be the same as before, although a more conservative approach for some diseases could be reasonable to avoid hospital resource overload.22,31 Furthermore, in the case of deferrable treatment, delays due to the achievement of swab test finding and to patients’ hospitalization may contribute to exceeding the optimal timing for surgery. Again, in this situation, the concerns about the use of laparoscopy related to the potential risk of viral dissemination with the pneumoperitoneum more often induce a conservative approach without the drawbacks of an open surgery.24,32–34

With these assumptions, the more aggressive attitude of surgeons toward bowel obstruction observed in this study could be justified from more severe clinical presentations (likely related to a late referral to ED). Contrarily, it seems paradoxical to attribute the reduction of procedures for GI perforation to conservative management by surgeons. More probably, this is a result even due to the aforementioned multifaceted definition of GI perforation.

To provide an accurate interpretation of the results of this study, it seems correct to consider “true” the dramatic decrease of surgical problems during COVID-19 outbreak, despite any therapeutic strategies and logistic difficulties. Other reports have supposed a general decrease in non-COVID emergency activities,\textsuperscript{15,16,35–37} but this is the first multicenter study conducted in a high-incidence country evaluating this suggestive aspect of COVID-19 pandemic.

However, this study has several limitations. First of all, data about COVID-19 status of patients have not been reported, and its consequences in terms of incidence, clinical presentation, and management of surgical diseases have not been evaluated. Second, there were no data about the outcome of operated patients. Similarly, it remains unknown what happened next, if untreated or undertreated, diseases may break out or a higher number of complications may be registered during the subsequent months. This can be an interesting starting point for further studies analyzing follow-up. Third, it was not always easy to discriminate the patients admitted to ED vs. those transferred from another hospital and then underwent surgery: therefore, in some calculations, the operated patients resulted to be more than the admitted ones. Finally, no comparison was made with other areas affected by the COVID-19 outbreak.

In conclusion, the study aimed to confirm the dramatic decrease in surgical emergencies during this unusual period and looking for its reason. Now, it offers some simple tools to understand this particular, nonsecondary, epidemiologic aspect of this pandemic. After follow-up data collection, it will probably help to think over nonsurgical alternative treatment of certain emergencies and face the near future.

AUTHORSHIP
S.R. contributed in the study design, data analysis, data interpretation, and writing. F. Ferrara contributed in the study design, data collection, literature search, and writing. T.Z. contributed in the data collection, literature search, data interpretation, and writing. F. Frattini contributed in the data interpretation and writing. O.C. contributed in the study design and critical revision. A.P. contributed in the study design, data interpretation, and critical revision. G.S. contributed in the study design and critical revision.

ACKNOWLEDGMENTS
We acknowledge Matteo Marconi for English editing, Claudia Gasparini (Lodi), Michela Monteleone, Gaia Coletti, Colomba Frattaruolo (Merate), and Emanuele Di Fratta (Desio) for access to data systems.

DISCLOSURE
The authors declare no conflicts of interest.
