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Cross-Sectional Assessment of Surgical Consult Volume to Determine Optimal Residency Staffing During COVID-19 Lockdown

Arash Rahimi-Ardabily, MD,a,* Stephanie Stroever, PhD,b and Royd Fukumoto, MDa

a Nuvance Health, Department of Surgery, Danbury Hospital, Danbury, Connecticut
b Nuvance Health, Department of Research and Innovation, Danbury Hospital, Danbury, Connecticut

Introduction: Since the start of the COVID-19 pandemic, there have been protocols initiated to reduce its transmission. Despite these measures, critical hospital staff are still at risk of infection with subsequent loss of the workforce. The purpose of this study was to determine the difference in surgical consult volume during a COVID-19 pandemic to extrapolate staffing requirements.

Materials and methods: We conducted a single-center cross-sectional study of surgical consult volume during the COVID-19 pandemic. Data were obtained from routine administrative records which track daily volume of all surgical consults, including trauma center activations, performed by the general surgery residency. We compared the mean number of consults across periods defined by salient lockdown and reopening events in the community using one-way analysis of variance.

Results: We found a statistically significant decrease in the mean number of surgical consults during the state-mandated lockdown/stay-at-home orders ($P < 0.001$). However, there was no significant difference in the mean number of surgical consults when only comparing prelockdown and postlockdown (lockdown period excluded).

Conclusions: No change in expected consult volume should be assumed unless there is a complete lockdown. During a complete population lockdown/stay-at-home orders, decreased staffing can be scheduled to allow considerations of decreasing community or in-hospital spread of communicable disease. Once reopening happens, even if only partly, full staffing may be needed to accommodate a return to normal consult volume.

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Introduction

To date there has been over 76 million documented cases of COVID-19 infection and over 898 thousand deaths in the United States alone. Since the start of the pandemic, there have been protocols initiated to reduce the transmission of SARS-CoV-2. These include stay-at-home and work from home orders, protocols for personal protective equipment, social distancing and closing of businesses. Additionally, elective surgical cases were canceled or postponed. Despite these measures, critical hospital staff are still at risk of infection with subsequent loss of the workforce. There
is already a shortage of general surgeons and losing their services would be detrimental. Hospitals arbitrarily initiated skeleton crew scheduling during the COVID-19 pandemic to limit the rate of infection among staff.3,4

Minimal staffing depends on overall surgical volume, which is comprised of both elective care/surgeries as well as emergency care/surgeries. An appropriate staffing level will accommodate both needs. Elective surgeries are a known volume as these are planned, usually weeks in advance, with only a minor adjustment on a day-to-day basis. Emergency care, however, is highly variable. This depends not only on chance, in terms of the onset of pathology, but also on the willingness of patients to seek medical care and also the capacity of a health care system to triage and accommodate noncritical surgical conditions when faced with an overwhelming volume of patients. A community-wide lockdown is anticipated to decrease patient willingness to seek medical care until late in disease process, as a lockdown portrays fear of public spaces in the environment of a highly communicable disease. No metric is available to measure a population’s willingness to seek medical care. We propose using the volume of requested surgical consultations as a general indicator of this willingness to seek care for surgical diseases.

The primary objective of this study was to determine if there were differences in the number of surgical consults performed during the first “wave” of COVID-19 before, during, and after state-mandated lockdowns. This information can be used to plan staffing of a surgical service during the unwinding of a lockdown to meet the competing goals of staff health and resources for patient care.

Materials and Methods

Study design and setting

We conducted a cross-sectional study of surgical consult volume from a single acute care hospital in southwestern Connecticut. The study received approval for exempt status from the Biomedical Research Alliance of New York, Nuvance Health’s Institutional Review Board, prior to initiation. The hospital is a Level II Trauma Center, performs more than 13,000 surgeries each year, and serves as host to a 5-year general surgical residency program. We included surgical consults fielded by the general surgery residency teaching services from the emergency department (ED) and inpatient services from February 23 to August 23, 2020 and excluded outpatient/clinic consultations. Surgical specialties covered were trauma, emergency general surgery, general surgery, bariatric surgery, breast surgery, colorectal surgery, hepatobiliary surgery, surgical oncology, thoracic surgery, and vascular surgery. We obtained cumulative data that is recorded daily per our institutions protocol for surgical consultations.

Variables

We defined the primary dependent variable as the aggregate number of surgical consult referrals on each calendar day (00:00 – 23:59) during the study period. The sampling unit was calendar date and each observation included the count of surgical consults per day.

We defined our independent variables as categorical periods marked by salient events in the community. We defined a community-specific variable based on state-mandated closures in Connecticut, with period 1 defined as the dates 1 mo before the mandatory stay-at-home order (February 23-March 22, 2020) (Fig). We defined period 2 as the time when all nonessential businesses were closed and hospital elective surgeries were prohibited (March 23-May 19, 2020). We defined period 3 as phase 1 reopening (May 20-June 16)5 and period 4 as phase 2 reopening (June 17-August 23).6 February 23, 2020 is the day Connecticut issued the mandatory stay-at-home order.

Lastly, we collected information on the type of surgical consult, the origin/location of the referral, and the type of surgical intervention. We included two categories for the type of surgical consult, which included not trauma and trauma consult. We defined the origin/location of the referral as ED—not trauma, ED—trauma, inpatient unit, or unknown. Finally, we included none, planned, or emergent as the type of surgical intervention performed following the consult.

Statistical methods

We used StataSE version 16 for all statistical analyses and did not have any missing data to adjust. We calculated summary statistics including the mean number of total surgical consults between February 23 and August 23, 2020 and at each time period. We also stratified by type of surgical consult, operative status determined by the consultation, and origin/location of the referral. We tested the assumption of normality with the Shapiro–Wilk prior to performing further analyses. We compared the mean number of consults across community-specific periods using one-way analysis of variance (ANOVA). We selected an alpha of 0.05 a priori for statistical hypothesis testing. The test statistic for ANOVA is F, which reflects the ratio of between-group differences to within-group differences. A P-value less than 0.05 represents a statistically significant difference between groups.

Results

There were 183 calendar days and 1539 total surgical consults from February 23 to August 23, 2020. The Shapiro–Wilk test confirmed the data were normally distributed and acceptable for ANOVA (P > 0.05). The average number of consults for the entire sample was 8.4 (standard deviation = 4.0) per day and a range of 0-23 (Table 1). There were 471 trauma consults, with level II trauma generating the most activity. The ED referred more patients for surgical consults (51.0%) than the inpatient unit (13.2%). Lastly, 336 consults went to the operating room with an average of 1.8 per day (standard deviation = 1.5) and range 0-7.

Overall, we found statistically significant differences in the mean number of surgical consults when examining all four community-specific periods together. Using the community-specific cut-points, we found a statistically significant decrease in the mean number of surgical consults during the
Fig. – Graphical display of surgical consults by day across all 4 community-specific study periods. SD = standard deviation.
state-mandated lockdown (period 2) compared to the period before the state-mandated lockdown (period 1) and after the state-mandated lockdown (periods 3 and 4) ($F = 8.4$, $P < 0.001$). There was not a statistically significant difference in the mean number of surgical consults when we excluded the lockdown period ($F = 0.63$, $P = 0.53$).

### Discussion

The purpose of this study was to determine the difference in surgical consult volume of a surgical residency in reopening phases of a COVID-19 pandemic and to determine if there was a statistically significant difference in the mean number of surgical consults across community-driven periods.  

Appropriate staffing of a surgery residency teaching service requires coordination of clinical volume/patient care needs, educational experience, and in a global pandemic, housestaff safety.\(^7\) The optimal staffing levels allow patients to be appropriately cared for in an educational environment and minimizes unnecessary occupational risk/exposure. Scheduling too few housestaff on service can cause disruptions in safe patient care. It may also negatively impact the learning environment experience should service obligations outweigh educational experiences.\(^7\) Additionally, staffing too many housestaff unnecessarily exposes them to infection and dilutes learning opportunities.

Multiple recent publications\(^3,4\) have described approaches to housestaff staffing during the COVID-19 pandemic. Specifics in how to adjust schedules to meet competing demands of variant clinical care/surgical needs, as well as housestaff safety, consistently report a reduced need for surgical services. This allows consolidation of services and redeployment of workforce to other areas of the health system. No existing literature describes the best process for undoing those changes as the pandemic wanes.  

Furthermore, surgical consult data are not routinely collected resulting in no information in the literature on return of surgical volume before and after a pandemic. This makes it impossible to determine the necessary hospital staffing as pandemics cannot be predicted. These data would have to be collected on a multi-institutional level prospectively at all times in order to catch a pandemic in the data set. This would be nearly impossible to achieve making these data invaluable. At our institution, every surgical consult is recorded and compiled into an email that is sent to the program administrator and all surgical residents for future reference.

Central to determining staffing is an estimate of the actual clinical volume that will occur. Scheduled surgeries are known in advance and easy to plan for. Unscheduled volume, such as trauma, emergency general surgery consultations, and inpatient consultations, can vary widely from day to day even in non-pandemic times. At our institution, a decrease in surgical care was expected and seen with large scale community lockdown orders. Resident staffing of teaching services was decreased to allow remote learning when possible and minimizing resident exposure to COVID-19 infection. Staffing allowed coverage for surgical inpatient care, emergency room and inpatient consultations (including trauma), and minimal operating room coverage for emergency operations only. However, when the lockdown orders were lifted, there was no evidence-base to help plan the return to full staffing levels.

We suggest using the volume of consultations for newly suspected and actual surgical disease as a marker of a population’s willingness to seek surgical care. We found that consult volume returned to predlockdown levels when restrictions were only partially lifted. No additional increase in volume was seen when transitioning from partial to full reopening. Based on this, we recommend that during a complete population lockdown/stay-at-home orders, decreased staffing can be scheduled to allow considerations of decreasing community or in-hospital spread of communicable disease. Once reopening happens, even if only partly, full staffing is needed to accommodate a return to normal clinical volume.

At our institution, we recognized gross changes in surgical consult volume and the potential impact of losing surgical residents during the COVID-19 pandemic. We instituted platoon scheduling which consisted of a chief resident, midlevel, and an intern in each group who would rotate 24 h call. This reduced the amount of residents exposed to patients and each other, as residents work closely together.

The main drawback to this study is the limited focus of the study. This is a single institution descriptive study about the population response to the COVID-19 pandemic in a single

### Table 1 – Summary statistics for surgical consults at a single, acute care hospital in southwestern Connecticut from February 23 to August 23 ($N = 1539$).

| Location of referral          | N (%)  | Mean (SD) per day |
|-------------------------------|--------|-------------------|
| Emergency department (not trauma) | 785 (51.0) | 4.3 (2.6) |
| Emergency department (trauma)  | 471 (30.6) | 2.6 (2.2) |
| Inpatient unit                 | 203 (13.2) | 1.1 (1.2) |
| Unknown origin                 | 80 (5.2)  | 0.4 (0.8)  |

| Surgical intervention | N (%)  | Mean (SD) per day |
|-----------------------|--------|-------------------|
| None                  | 1204 (78.2) | -                |
| Planned               | 125 (8.1)  | 0.7 (0.9)  |
| Emergent              | 210 (13.7) | 1.2 (1.2)  |

SD = standard deviation.
state, Connecticut. In addition to the unique characteristics of a single surgical residency, public response to the COVID-19 pandemic was highly variable across the United States. This includes both public confidence in seeking medical care during different phases of the pandemic as well as degree and effectiveness of government response. Specific local conditions should be considered when using our conclusions. Another limitation of our study is the assumption that consult volume is a valid metric for staffing needs. The pathologies prompting consultation of the surgical service may have shifted during the COVID-19 lockdown. Although we did not specifically collect data on reasons for consultation, we did not anecdotaly notice any major changes in the proportion of trivial versus severe etiologies between study periods. This would be a good additional aspect to investigate, along with the fate of the patients who were not seen by the surgical service during the COVID-19 pandemic, who would have normally been seen. These patients may have presented in later, more acute phases of pathology, requiring more care. Alternatively, the progression of these patients to spontaneous recovery could have informed us on conditions/parameters where surgical care is not actually needed. Ultimately, however, the purpose of our study was to evaluate the workforce requirements during a COVID-19 lockdown. While trivial consultations will require less work overall than more serious surgical consultations, we feel that clinical workload is more correlated to the number of consultations than the severity of consultation.

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Author Contributions
Arash Rahimi-Ardabily, MD performed the data acquisition, interpretation of data, drafting and revising manuscript. Stephanie Stroever, PhD performed the data analysis. Royd Fukumoto, MD performed the study conception, design, revision, and final approval of manuscript for publication.

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