

Maximizing the Calm Before the Storm: Tiered Surgical Response Plan for Novel Coronavirus (COVID-19)

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Abstract:

The novel coronavirus (COVID-19) was first diagnosed in Wuhan, China in December 2019 and has now spread throughout the world, being verified by the World Health Organization as a Pandemic on March 11th. This had led to the calling of a national emergency on March 13th in the United States. Many hospitals, healthcare networks, and specifically Departments of Surgery are asking the same questions of how to cope and plan for surge capacity, personnel attrition, novel infrastructure utilization, and resource exhaustion. Herein, we present a tiered plan for surgical department planning based on incident command levels. This includes Acute Care Surgeon deployment (given their critical care training and vertically integrated position in the hospital), recommended infrastructure and transfer utilization, triage principles, and faculty, resident and advanced care practitioner deployment.

Introduction:

The novel coronavirus that began in Wuhan, China in December 2019, now termed SARS-CoV-2, has caused a global impact on the health, politics, and economy in 3-short months. The clinical syndrome from the virus, now termed COVID-19, can consist of mild respiratory symptoms and fever, to ARDS and death in severe cases. This has led to the disease being officially classified as a pandemic on March 11, 2020 and The United States Declared a State of Emergency on March 13, 2020.¹ At the time of this writing (March 19th), there are over 220,000 confirmed cases worldwide, 9,415 cases in the US with 150 deaths.² Many countries states and cities have instituted school, gathering, restaurant, and travel bans to mitigate its spread. Patients at older age and with medical comorbidities are at the most risk of requiring hospitalization, ICU care, and at risk for death. In one of the largest epidemiologic studies to date from China with widescale testing, 81% of all infected may have mild symptoms (fever, cough, malaise), 19% required hospitalization, and 5% required critical care; with an overall case-mortality rate of 2.3%. However, age ≥ 80 years was associated with a 14.9% case-fatality rate, 8% in 70-79 decade, and 49.0% in critically ill patients.³

As surgeons watching this even unfold in the US, we urge everyone to be prepared and to create a surgical department action plan in conjunction with key stakeholders and content experts vital to institutional response such as: Emergency Medicine, Anesthesia, Pulmonary Critical Care, Infectious Disease, Internal Medicine, facility and nursing management, and ultimately coordinated under the Incident Command System.⁴ Implementing screening by symptoms and exposure risk and mitigating healthcare personnel exposure to COVID-19 patients who require surgery is a key first step. Experience out of China⁵ and Singapore⁶ have demonstrated that screening by symptoms and routine testing, use of appropriate personal protective equipment

(PPE), as well as a coordinated plan involving all aspects of peri-operative care is essential. However, the early and continued experience in Italy⁷ and Iran have demonstrated that when measures to mitigate the spread of COVID-19 are not implemented early enough, catastrophic scenarios requiring advanced triage criteria, resource management, and extreme flexibility within the healthcare system is required to save as many lives as possible. A review of crisis management principles relevant to healthcare in this Pandemic and a tiered plan to take these factors into account was developed at our facility and presented herein. Key to understanding these concepts is the fact that patient surge is unlike typical mass casualty plans that we have become accustomed with an acute event (minutes to hours) followed by an acute and relatively short response (hours to days), but instead a prolonged course of resource and personal exhaustion (weeks to months).

Our Center

Atrium Health is one of the largest, integrated, public, not-for-profit health care systems in the United States comprising more than 7,500 licensed beds, employing nearly 70,000 people and accounting for more than 12 million patient encounters including 230,000 procedures on an annual basis across acute care and ambulatory facilities in North Carolina, South Carolina and Georgia. Atrium Health Carolinas Medical Center, Atrium Health Mercy Hospital and Levine Children's Hospital comprise the Central Division Campus in Charlotte. Carolinas Medical Center is an 874 bed, quaternary care hospital, ACS-verified Level I Adult and Pediatric trauma center. It serves as the University of North Carolina School of Medicine-Charlotte Campus and is the lead institution for the regional Metrolina Trauma Advisory Committee (MTAC). Carolinas Medical Center features a 29-bed dedicated Surgical/Trauma ICU, a separate 29-bed Neurosurgical ICU, 40-bed Medical ICU, 14-bed Cardiac ICU and virtual critical care

services for Atrium Health. Over 300 ICU beds in Atrium Health are monitored virtually. Based on lessons from history, those already learned in the COVID-19 Pandemic, and the following principles were used to create a tiered response plan for use in Surgery Departments throughout the United States. Led by our Division of Acute Care Surgery (ACS) in Coordination with Emergency Management and other stakeholders, this plan has been developed for and is being disseminated through our Department of Surgery and throughout all surgical subspecialties at all our facilities.

Social Distancing

In the earliest weeks of the epidemic in Wuhan, isolation of patients, and then eventual quarantine of family, communities, and then whole cities was seen. While these concepts may be familiar to many, in the past weeks, an old concept, but new to many, has been disseminated to the country to decrease the spread of COVID-19: social distancing. This term includes measures from simply limiting unnecessary activities like in large gatherings such as concerts, marathons, and sports games, to more drastic measures like banning all gatherings more than 50 people, closing schools city-wide and in some cases state-wide, and furloughing non-essential personnel from businesses.⁸ The goal of these measures is to reduce the spread of the virus so that the doubling time of the virus is increased, the purpose being to have fewer patients present in a shorter time period to hospitals.

This has gone viral in the #flattenthecurve movement, with the publication of Carl Bergstrom's graph illustrating the surge in patients on an exponential scale in relationship to the healthcare capacity as a flat line (Figure 1.) Measures such as social distancing would act to slow the spread and prolong the time frame of patients presenting to hospitals. As we have seen in Italy, when the steeper rise occurs, a higher number of deaths occur as patients who need

intensive care and ventilators have long out-paced the available resources, and a rationing and triage of patients is required.⁷ However, with increased testing, meticulous contact tracing, and measured social distancing, South Korea has been able to decrease the rate of spread, and healthcare facilities have not become overburdened.⁹

LOWER AND DELAY THE EPIDEMIC PEAK

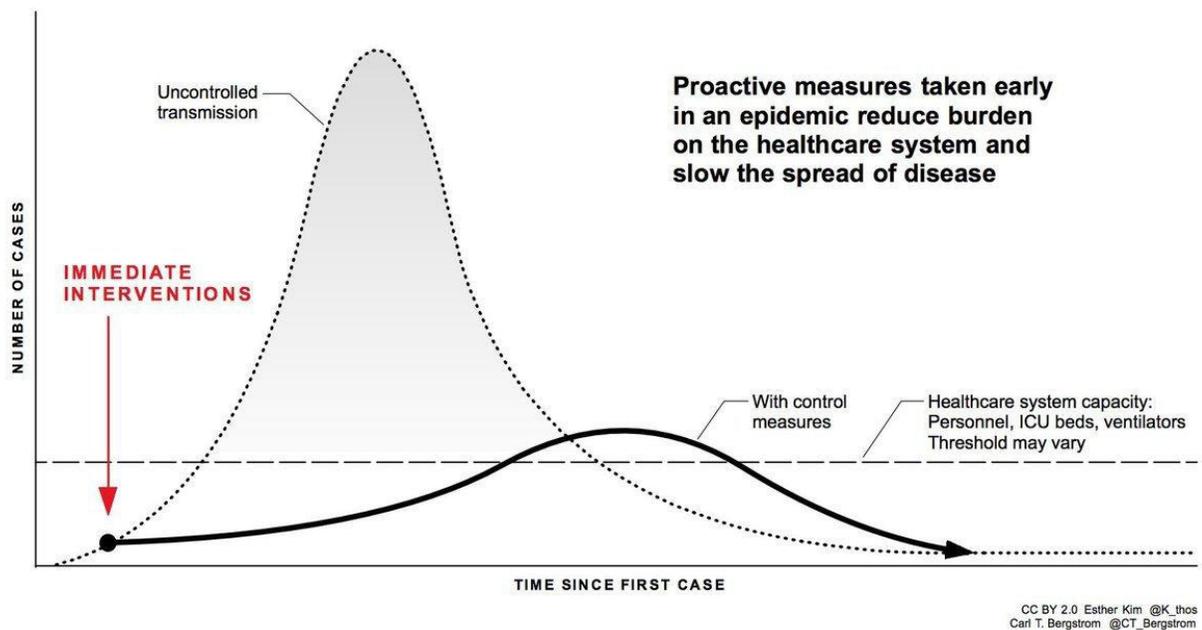


Figure 1. Principle of social distancing to reduce the curve of uncontrolled transmission to levels more sustainable to the healthcare system capacity. (Represented with permission from Carl T Bergstrom)

Resource Management

Optimal disaster response necessitates knowledge, preparedness and coordination to ensure adequate resource availability and allocation. This often requires difficult capacity and financial decisions during a preparation phase to make room for the anticipated influx of patients. Inherent in this, is assessing the number of currently occupied beds, planned procedures and admissions, and the maximum capacity for floor and ICU beds. More novel is

what beds could be created in austere conditions by double bedding hospital and ICU rooms, conversion of PACU, operating rooms, and even hallways into ICU beds. A typical OR could house 3-6 patients depending on its size and could be staffed by CRNA's and Anesthesiologist as elective and even urgent cases are cancelled. Early and proactive bed management is key, as reports from Italy indicate that all non-critical and non-emergent care has ceased as the hospitals are now at 200% capacity.⁷ Given these capacity issues, systems are unable to provide adequate care for patients with everyday emergencies like stroke, myocardial infarction, and trauma. Thus, the early COVID-19 mortality numbers fail to account for many patients who will have a concurrent preventable mortality from other causes as the result of this unanticipated surge and subsequent resource exhaustion.

Oxygen delivery and mechanical ventilation will no doubt be the highest value resource given the presence in critically ill COVID-19 patients of respiratory failure (54%) and ARDS (31%).¹⁰ In general, the experience has been that non-invasive oxygenation modalities such as nasal cannula and BiPAP are ineffective and patients at this stage will need mechanical ventilation. Ingenuity with methods to create new ventilators from spare parts and retrofit old machines such as IPPB into working ventilators will be required. Additionally, if all patients are COVID-19+ as many as 4-patients could be linked in parallel on pressure control settings to attain reasonable minute ventilation and tidal volumes if required.¹¹ Finally, while ventilators will be in high demand, endotracheal tubes are copious, and if family members are willing, bagging of patients by family members when no ventilator is available may be required.

Personnel Attrition

First and foremost, a proactive response is needed to limit the unnecessary interactions and contact of all personnel in an effort to minimize exposure risk as early as possible. As the

situation evolves staffing will become dynamic requiring a coordinated effort among physicians, advanced practice providers, and residents. Clear and definitive leadership will be required to best determine staffing and provider labor allocation for each facility. Buy-in from all respective division chiefs and departmental coordination will define and facilitate staffing levels.

Situational flexibility will be paramount in conjunction with clear and efficient communication and multidisciplinary collaboration. All staffing plans must inherently assume attrition and furloughs required not only as the result of iatrogenic and community exposures, but also due to social instability, and/or resource consumption. As such, agreements should be in place to allow emergency credentialing and expansion of scope of practice to other facilities as necessitated by the needs of the community. In large health systems, or even regional cooperatives, a pool of surgeons can be mobilized to start covering cases at satellite hospitals as surgeons at these facilities are furloughed. Consideration should also be taken to minimize the risk to more senior partners to lower risk roles outside the hospital. Quarantined and senior surgeons can participate in telemedicine and even virtual critical care to increase the capacity to triage patients and care for the critically ill. Additionally, since this will be a prolonged surge if measures of social distancing are successful, consideration to weekly rotating teams off service of faculty, APP's, and residents to not deplete or expose all providers at once.

Principles of the crisis standard of care should be used in disaster response when health care needs overwhelm available resources.¹² At the highest response levels, plans for the advancement of senior residents and fellows to attending status may be required. Given the increased need for critical care expertise at this highest level, emergency general surgery (EGS) and trauma coverage should be transitioned to general surgery trained elective surgeons to allow deployment of any surgical critical care (SCC) trained physicians solely to the intensive care

setting. We recommend a tiered reallocation of Acute Care Surgeons (ACS) faculty as appropriate for each respective facility. At severe manpower shortage levels, non-ACS familiar with high-acuity priorities and hemorrhage control, like vascular, transplant, and hepatobiliary surgeons may be required to take trauma call. Additionally, when supra-maximum patient capacity, with decreasing providers in Critical Care and Internal Medicine, subspecialized surgeons will likely be called to become general physicians to treat the non-critical patients with COVID-19. However, every nurse, therapists, ancillary staff, and physician regardless of specialty should have some basic training of ventilator management given the possibility of provider depletion and expansion of ICU's.

Trainee Allocation

Learners inevitably play a role in large-scale responses, and preparations must strike a balance between patient safety and residents' personal safety. While an emergency plan is focused on patient care, it must also support workforce sustainability in the event of quarantine, illness or injury. Resident participation in emergency preparedness plans is essential in hospitals with training programs. Planning for trainee allocation or quarantine has not been extensively studied. A hospital and graduate medical education department must decide the role trainees will play before their deployment is required, which will likely involve graduated promotion at the highest response level. The role of medical students should be carefully considered with the default response being for them to be dismissed to isolation with the general public. The benefit provided to the affected population by students would be minimal compared to the risk of their exposure.

Evaluations and planning has focused on mass casualty incidents isolated to specific communities.¹³⁻¹⁵ There has been no published and distributed plan instituted for residents in

such a population health scenario as presented by COVID-19. For example, residents' roles in the disaster response to the Boston Marathon bombing was unclear. There was no understanding if residents would be expected to provide surge staffing or if they would be stratified by experience.¹³ Though most hospitals train nurses and attendings for mass-casualty events, fewer than half train residents.^{14,15} This is a gap in medical education that should be addressed as these incidences are unfortunately becoming more frequent. Most resident staffing during crises is managed ad hoc by chief residents or program directors. Communications should be in place, whether by group text, online meeting applications or other local mechanism, so that chief residents act as a liaison between institutional command, attending physicians and resident teams. It is likely that trainees could be asked to work beyond scheduled duty hours. Local graduate medical education leadership should be involved in preparations, and knowledge of ACGME program requirements is essential. It is possible residents will be asked to work beyond accepted duty hours, and these exceptions should be made known to the ACGME, but exemptions should be provided given the national emergency. Graduated autonomy and extension of attending physicians by senior residents as well as battlefield promotions of fellows and Chief Residents will be the most logical progression as the response to the crisis escalates and personnel are furloughed or quarantined.

Advanced Triage Criteria

Unfortunately, in a resource exhaustion and surge capacity, difficult ethical decisions will have to be made on which patients merit the use of a scarce resource. These types of discussions are usually reserved for organ allocation and in cases that require ECMO. Even in a normal situation where your hospital only has one ICU bed, one ventilator, or one ECMO circuit left, the default is to still give it to the first patient that needs that resource. However, more complex in

our current Pandemic scenario, is that the ventilator you are allocating today to the person with a poor chance of survival may deprive that resource tomorrow to the patient with a moderate chance of survival. Several schemas have been created in the past to rationalize the choices that are now in front of many healthcare providers, some of which are to maximize number of life years (favors the young), social value (favors occupations that are deemed valuable in preserving society infrastructure and culture), and instrumental value (those that would have impact on the current outbreak like physicians and nurses).¹⁶

Currently in Italy, reports in over capacity facilities describe making hard decisions to not intubate patients over 65, and no ICU care to patients over 80.¹⁷ This type of rationing is unthinkable to most Americans with the perception that all aspects of healthcare are an inherent right up to and escalating towards death. While many practitioners in the US will rightly not want to set hard limits like this, the withholding of surgery with recognition of futility is readily decided upon. Surgeons inherently understand futility in end-stage cancer, overwhelming sepsis, and advanced age and comorbidities. COVID-19 patients, with progression to ARDS and multiple risk factors, will have similarly dismal potential for survival. Therefore, in the vein of justice and maximizing benefit to all of society, advanced triage criteria based on individual risk factors should be performed before resources become exhausted to ensure that the next salvageable patient has the opportunity to benefit where the current patient likely will not.

Clinic Triage and Telemedicine

Given the rapid changes in technology as well as societal healthcare pressures due to the global pandemic, telemedicine should be the frontline triage for specialty surgery clinics.¹⁸ The limitations for use, such as costs, training, or HIPPA related concerns, may limit the ability to rapidly upload and utilize these platforms for virtual visits, especially when faced with a

rapidly progressing pandemic.¹⁹ However, many of these can be circumvented or expedited in the current state of emergency. For example, during the H1N1 Pandemic, North et al. were able to use telephone screening triage to reduce unnecessary clinic visits yet preserve medical access.²⁰ In our specific ACS clinics pre-operative visits were stopped when the Pandemic was declared and the US was seeing increasing numbers. Post-operative patients still need to be evaluated and managed for many issues, such as drains, wounds, and suture removal.

Due to the time constraints given the increasing community spread, we rapidly developed an ACS clinic patient screening process (eDocument1) that started with already scheduled patients for return to our trauma and EGS clinics. If a patient was determined not to need a virtual or physical visit, a telephone call was used to discuss the appointment and manage patient expectations. This tool evaluated not only if they had medical issues requiring evaluation, but also screened for potential COVID infections, utilizing the institutional infectious disease risk screening questions, embedded within the screening tool (eDocument 2). Utilizing this risk tool allowed a patient that was high risk to be directed to a COVID-19 testing site. All patients designated for upcoming clinics are assessed the week prior to the clinic appointment and determined to: 1. Not need to be seen physically nor virtually and their situation is evaluated by a clinic nurse phone conversation. 2. Be an ideal candidate for a virtual clinic visit or 3. In need of objective data, such as a radiograph or laboratory blood work prior to clinic so the type of clinic visit can be determined. Due to the limited socio-economic resource of most of our patients, many of our patients only have access to Android or Apple smart telephones, if any, so a computer video platform is not always viable.

We outfitted our clinic with 2 computers with video capability for patients calling into a virtual communication app (TEAMS®) so these patients can connect with a computer, or

Android or i-Phone device. We elected to use these technology methods for more rapid preparations for virtual evaluations in the clinics and due to the time constraints of the forced social distancing mandates of the community. After reviewing the previously completed screening tool on a patient, an ACS physician or APP perform the virtual visit utilizing a standard virtual exam template (eDocument 3). With the information gleaned from the screening tool and the virtual exam, a management plan is individualized for each patient and the forms are scanned into patients' electronic medical records along with a documented clinic note.

If a patient requires a physical appointment in our ACS clinic, they are screened again on arrival for symptoms of a potential COVID-19 infection. Only 1 additional care giver or family member can accompany the patient. In order to improve social distancing in the waiting rooms all chairs are kept 6 feet apart. On arrival to the clinic if a patient has any active symptoms of a COVID-19 infection, they are directed to a testing site appropriate for their symptoms per institution protocols. Only 1 nurse and 1 attending can evaluate the patient. Utilizing these methods, in the first week of implementation, out of 21 scheduled ACS clinic patients, we have already identified 19 patients able to be managed by virtual or telephone visits (91% reduction in clinic visit exposure). Contact has been completed and they are being managed virtually revealing a potential 91% reduction in clinic visits. Objective data is being obtained for 2 patients (chest radiographs and laboratory values) in order to determine whether they will require a physical clinic visit. One of these 2 patient has staples that will be removed via a nurse visit or at their primary care provider's office, since they live over 1 hour away from our clinic office. While we are early in the process, transitioning our ACS clinics to a Virtual/Telemedicine Process, with appropriate resources, will continue to allow us to keep patients safe from

exposure, preventing potential exposure risk to healthcare staff, as well as maintaining patient safety and perioperative surgical expectations.

Tiered Response

In reflection of the above principles, led by Acute Care Surgeons with familiarity in Disaster Preparedness and Public Health, in conjunction with the incident command structure, and in an effort to keep in mind a prolonged surge of COVID-19 patients, the following Surgery Department COVID-19 Response Plan was created (Table 1). This has now been disseminated and adapted to each facility, subspecialty surgical service, and is being pivoted to other specialties such as Pulmonary Critical Care and Internal Medicine within Atrium Health. Key in understanding the response level is your individual facilities incident command response level which follows similar structure set by the Federal Emergency Management Agency (FEMA).^{4,12} However, new to this schema is ConditionZero which indicates patient surge and acuity beyond the capacity of the infrastructure and manpower available, a scenario currently being experienced in Italy, Iran, and progressively around the world. Advancement to higher tiers should follow incident command structure, but may also be required within individual specialties, departments, or divisions plans given manpower and resource depletion.

At Alert level, which many facilities in the US have already surpassed, disaster preparedness must begin in earnest and non-time sensitive elective cases, or many cases in high risk patients, should be delayed, cancelled, and rescheduled for no sooner than 3 months in the future. Limitations on non-emergent transfers, non-operating room anesthesia (NORA) cases, and furlough of non-essential non-clinical staff should occur. Clinic triage and telemedicine should be performed whenever able. Prioritization to develop plans for further Tiers and organization of surgeons into potential call back-up pools should be performed. Additionally, in

large health systems and regional collaboratives, efforts to back-up community facilities from larger tertiary departments should be performed to limit transfers required due to quarantined or furloughed surgeons at these sites.

In progression to further tiers, great focus is given the Acute Care Surgeon ability to staff trauma, SCC, and EGS services, given their true vertical integration in the hospital from the ED, OR, floor, and ICU. Given their flexibility, and critical care training, it will be key to support these ACS faculty with non-ACS surgeons to manage EGS and eventually even trauma. This will allow the ACS Surgeons to support expanded ICU's, OR ICU conversion, and ECMO patients. At non-trauma centers, in the community, or with no ACS faculty, General Surgeon coverage and adaptation of this plan will be paramount to cover all surgical and COVID-19 patients. At Level 2, healthcare providers will begin to be furloughed, and decreased resources like blood, ventilators, and PPE will be available. Subsequently, a 50% drawdown of all elective cases should be performed with focus on completing necessary cardiovascular and cancer cases, but patients with high risk factors should be deferred (age >60, DM, HTN, smoking hx, COPD CHF, CAD). A good resource for deciding on the necessity is the Elective Surgery Acuity Scale just released by the American College of Surgeons.²¹ Rearrangements of schedule and service coverage responsibility for residents, APP, and faculty should begin, and cycling of on call teams by several days or a week should be encouraged.

Response Level 1 will have accumulating provider and staff attrition due to quarantine and illness. Additionally, stocks of PPE, blood, ventilators and other essential infrastructure will be diminished by increasing numbers of COVID-19 patients. Therefore, all non-emergent cases should be cancelled, and transfer requests managed at the requesting facility. All surgical transfers should be vetted by an ACS surgeon with situational awareness to assess its acuity,

available resources and beds, and if care may be futile. Expanded ICU beds and staffing by the ACS faculty will be required and non-ACS surgeons required to flex to cover EGS. Teams of younger ACS faculty can be deployed to cover medical ICU's if needed, and expect SCC fellows to have battlefield promotions to junior ICU attending status. ECMO should be reserved for young, non-comorbid patients, with single organ dysfunction and acceptable prognosis. Expect decreasing staff and blood availability as quarantine and social distancing impact the community. Graduated resident autonomy and Chief Resident run floor services will be expected.

Finally, if the surge in patients comes as a tsunami as it did in Italy and Wuhan, Condition Zero will require stretching the infrastructure and manpower beyond the breaking point. In this scenario, ACS surgeons should focus on just ICU patient care, and non-ACS surgeons cover trauma and EGS in a tiered response. Non-emergent cases should not be performed, and non-operative modalities should be pursued if possible for all urgent disease processes. The export of urgent EGS cases may be required to other centers. Advanced triage criteria with consideration of available resources, expected increase in surge volume, patient risk factors, and principles of justice and value unfortunately must be considered for the continuation and betterment of our society. Novel ventilation strategies should be pursued whenever able, and even emergent non-COVID care may need to be triaged or suspended for certain disease processes if the system, facility, and providers are over-leveraged. At this level COVID-19+ healthcare workers may need to continue treating COVID-19 patients given the extreme attrition of personnel at this level.

Principles to Success

Do not lose hope. As Wuhan has taught us with social distancing, strict quarantine and abundant testing, we can beat back this disease and mitigate its effect on our communities. In

any rapidly evolving crisis, certain principles remain key to combating a constantly evolving and austere situation. Act with speed of the plan above perfection of the plan. Flexibility in the face of adversity is required, and those that are not able to deftly change strategies with new information will be battling the past and not preparing for the future. Even in this response plan, adaptation and integration of individual situations will be required. Communication with an assigned structure is vital to ensuring the entire team, service, facility, and system are working on the same page and criteria. Situation reports within each of these strata is vital to understand the situation on the ground as well as the plan for the institution. However, succinctness is required so that worried and overwhelmed providers can quickly process and implement new information and protocols. Most of all, a sense of community, purpose and legacy is paramount to keep us mission focused on the health of our patients and community; support and acknowledgement of our risk and sacrifice as physicians, providers...as healers, are not in vain.

Conclusion

The current COVID-19 Pandemic is causing a paradigm shift for our globalized world in every sector: economic, social, cultural, and even a religious impact. The brunt of the initial surge of patients was weathered in China and has now expanded to almost every country on Earth. All estimates point that the US is on track to have a similar surge of patients like Italy, and therefore now is the time to prepare, coordinate among key stakeholders, set up incident command, and plan for every conceivable contingency. The authors desperately hope that social distancing measures will prevail and that our tiered response plan will not be required at its highest level. However, failure to plan for these eventualities, would make the outcome all the worse if or when they are needed; please use, adapt, share and disseminate for the good of all our

patients. This is the defining moment of our generation, leave a legacy worthy of remembrance.

Godspeed.

References:

1. Control CFD. Coronavirus Disease 2019 (COVID-19). CDC. Situation Summary Web site. <https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/summary.html>.
Published 2020. Accessed 3/16/2020, 2020.
2. COVID-19 Map
Coronavirus COVID-19 Global Cases by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)
2020. <https://coronavirus.jhu.edu/map.html>. Accessed March 16, 2020.
3. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72314 Cases From the Chinese Center for Disease Control and Prevention. *JAMA*. 2020.
4. Tsai MC, Arnold JL, Chuang CC, et al. Implementation of the Hospital Emergency Incident Command System during an outbreak of severe acute respiratory syndrome (SARS) at a hospital in Taiwan, ROC. *J Emerg Med*. 2005;28(2):185-196.
5. Wen X, Li Y. Anesthesia Procedure of Emergency Operation for Patients with Suspected or Confirmed COVID-19. *Surgical infections*. 2020.
6. Ti LK, Ang LS, Foong TW, Ng BSW. What we do when a COVID-19 patient needs an operation: operating room preparation and guidance. *Can J Anaesth*. 2020.
7. Grasselli G, Pesenti A, Cecconi M. Critical Care Utilization for the COVID-19 Outbreak in Lombardy, Italy: Early Experience and Forecast During an Emergency Response. *JAMA*. 2020.

8. Wilder-Smith A, Freedman DO. Isolation, quarantine, social distancing and community containment: pivotal role for old-style public health measures in the novel coronavirus (2019-nCoV) outbreak. *J Travel Med.* 2020.
9. Covid-19 National Emergency Response Center E, Case Management Team KCfDC, Prevention. Contact Transmission of COVID-19 in South Korea: Novel Investigation Techniques for Tracing Contacts. *Osong Public Health Res Perspect.* 2020;11(1):60-63.
10. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet.* 2020.
11. Neyman G, Irvin CB. A single ventilator for multiple simulated patients to meet disaster surge. *Acad Emerg Med.* 2006;13(11):1246-1249.
12. Chacko S, Randolph R, Morsch G. Disaster Medicine: Public Health Preparedness for Natural Disasters. *FP Essent.* 2019;487:17-22.
13. Schlosser KR, Creedon JK, Michelson KA, Michelson CD. Lessons From the 2013 Boston Marathon: Incorporating Residents Into Institutional Emergency Plans. *Pediatrics.* 2017;139(6).
14. Niska RW, Burt CW. Bioterrorism and mass casualty preparedness in hospitals: United States, 2003. *Adv Data.* 2005(364):1-14.
15. Martin SD, Bush AC, Lynch JA. A national survey of terrorism preparedness training among pediatric, family practice, and emergency medicine programs. *Pediatrics.* 2006;118(3):e620-626.
16. White DB, Katz MH, Luce JM, Lo B. Who should receive life support during a public health emergency? Using ethical principles to improve allocation decisions. *Ann Intern Med.* 2009;150(2):132-138.

17. Monella LM. Coronavirus: Italy doctors 'forced to prioritise ICU care for patients with best chance of survival'. *euronews*. 2020.
<https://www.euronews.com/2020/03/12/coronavirus-italy-doctors-forced-to-prioritise-icu-care-for-patients-with-best-chance-of-s>. Published March 13,2020.
18. Hollander JE, Carr BG. Virtually Perfect? Telemedicine for Covid-19. *The New England journal of medicine*. 2020.
19. Nittari G, Khuman R, Baldoni S, et al. Telemedicine Practice: Review of the Current Ethical and Legal Challenges. *Telemed J E Health*. 2020.
20. North F, Varkey P, Bartel GA, et al. Can an office practice telephonic response meet the needs of a pandemic? *Telemed J E Health*. 2010;16(10):1012-1016.
21. COVID-19: Guidance for Triage of Non-Emergent Surgical Procedures [press release]. March 17,2020 2020.

Table 1. Surgery COVID-19 Activation and Response Plan

Activation, threshold for activation/possible ACS impact	Surgery department response		Recommended facility response			
	Department	ACS	Facility	Transfer criteria	Operating room	NORA
Alert						
Pandemic level, increasing prevalence throughout the country; potential impact to facility and system; full surgery compliment; peri-operative staffing normal; school closing in community with impact on staff availability	Contact patients prior to visit to clinic and/or OR to delay surgery if elective and have COVID-19 high risk features; Minimize clinic visits by screening of patients by nursing for urgent visits to present to clinic, all other managed with calls or telehealth evaluation; stay home if sick; all personnel in QI, research, etc without direct patient care to start working from home; prioritize cases for CV, cancer, urgent and emergent status ; APP with no change in role	Maintain current staffing model; replace and/or trade to maintain core service lines as faculty become infected and require quarantine; ACS obtain faculty privileging at other system facilities; Services: EGS service, ICU coverage, trauma service	Focus on avoiding patient presentation to hospital for testing; minimize routine, non-urgent clinic appointments; focus on virtual visits; restriction of visitors to immediate families	Limit non-emergent transfers	Normal operations	Limit to emergent cases only when COVID-19 positive or expected; All procedures done at patient bedside or in OR when at all possible
Level 2						
First confirmed case at facility; potential impact on facility and system; <10% acute surgical faculty depletion; <20% hospital bed availability; <25% ICU bed availability; reduction in peri-operative staff by 10% due to illness; decreased blood bank supply due to social distancing	Reduce elective case volume by 50% with non-time sensitive cases eliminated (focus on required cancer and CV cases); high risk patients (age > 60 y, DM, HTN, smoking history, COPD, CHF, CAD) cancel if not urgent; Reallocation surgical residents, research residents, to ICU and trauma rotations as drawdown on elective cases proceeds; non-ACS APP's to flex to ACS	Maintain current weekday staffing model; ACS Services: EGS service, ICU Services, and trauma services	Daily sitrep huddles with departmental stakeholders and facility leadership; subsequent daily sitrep (may be via email) by department leaders to disseminate information; nursing reassignment, expanded patient ratio; expanded patient cohorting; start aggressive discharge of all non-critical patients	Limit non-emergent transfers to the facility (or within the system) ; institution of an ACS quarterback with knowledge of sitrep, intensive care level, and resource availability for all surgical/SCC/trauma consults, vets all transfer requests	Per service line decrease number of elective cases by 50%, prioritizing surgical urgency and canceling high risk patients	As per alert status

	or medical service lines; All CC credentialed APP to flex to ICU services		to ANY discharge destination; wean all patients as able from ventilation; consider early tracheostomy to allow decreased ventilator time and use; triage criteria initiated for ECMO cannulation; institute virtual clinic visits for all surgical clinics unless urgent problem; limit visitors to 1 per patient, appropriately screened on entry	prior to connection with requesting service; urgent/emergency cases with surgeon capability at outlying facility should be triaged to stay at the sending facility; emergent cases with critical care needs prioritized to tertiary care facility; only urgent/emergent trauma transfers will be accepted with needs for specialized care; ECMO needs patients prioritized with consultation of ECMO team given scarce resources		
Level 1						
Facility at ≥100% capacity; ICU capacity ≥90%; 5 to 20 confirmed admitted cases; decreasing resources of facility; potential impact on the system; denial of discharges from skilled nursing facility, rehab, or other discharge dispositions; 10% to 25% acute care surgical faculty depleted; reduction in	All elective surgery cancelled and no further booking of cancer cases, consider cancelling all invasive CV and cancer if high risk factors (age >60 y, DM, HTN, smoking hx, COPD CHF, CAD); permission to perform any non-urgent case requires additional facility approval; efforts should be made to temporize urgent cases using nonoperative means and discharge patients	Increase proportion of available surgical critical care intensivist to care for COVID-19 ICU patients; ACS faculty responsible for SCC and trauma; older faculty focused toward trauma population and virtual care (virtual clinic or virtual ICU) rather than ICU; EGS transitioned to elective general surgeons; SCC fellow to function as junior faculty	Daily sitrep huddles with departmental stakeholders and facility leadership; Subsequent daily sitrep (may be via email) by department leaders to disseminate information; ICU Expansion: Progressive care, monitored beds, PACU overflow; 2 ICU beds per ICU room, if needed; 2 floor beds per	No non-emergent transfers; ACS quarterback with knowledge of sitrep, IC level, and resource availability for all surgical/SCC/trauma consults, vets all transfer requests prior to connection with requesting service; urgent surgical cases to stay at the transferring	Reduce rooms running by 50%; urgent and emergent surgical cases only	No NORA cases

<p>perioperative staff by 25% due to illness; severely decreased blood bank supply due to social distancing</p>	<p>home at increasing rates for non-COVID-19 diagnoses; general surgery trained faculty are employed to consult and manage EGS cases; tier 1: general surgery; if available transplant, hepatobiliary, vascular, ACS Fellows (trauma coverage); tier 2: If available MIS, colorectal, GI oncology, PGY5 residents, (EGS coverage); tier 3: all other general surgery trained attendings (as needed coverage or backup); all residents redistributed to ICU, EGS, trauma rotations; all CC trained APP flex to cover ICU</p>	<p>for ICU and trauma coverage; ACS services: ICU services, trauma services, virtual critical care, 12 to 24-hour trauma call.</p>	<p>hospital room, if needed; no patient visitation</p>	<p>facility with surgical capability and every effort to discharge them with non-operative means; emergency cases at facilities with surgeon capability will stay at that facility; emergent cases with critical care needs prioritized to nearest available facility with an ICU and surgeon; exhaust nonoperative interventions; ECMO needs patients prioritized with consultation of ECMO team given scarce resources; all trauma transfer requests must be vetted through and ACS staff, only emergent or acute specialized care needs will be transferred; Virtual and telephone management of urgent needs</p>		
<p>Condition Zero</p>						

<p>Facility at >125% capacity ; ICU capacity ≥100% ; >20 confirmed admitted cases; expected exponential increase in admissions; detrimental impact to the system; catastrophic exhaustion of facility and system/regional resources; >40% perioperative staff depleted; >25% acute care surgical faculty depleted; little or no blood availability</p>	<p>All non-emergent cases cancelled; urgent cases transfer to outlying facilities. pursue all nonoperative options for emergent and urgent patients; general surgeons to assist with trauma and EGS coverage; tier 1: general surgery; if available transplant, hepatobiliary, vascular, ACS Fellows (trauma coverage); tier 2: if available MIS, colorectal, GI oncology, PGY5 residents (EGS Coverage); tier 3: all other general surgery trained attendings (as needed coverage or backup); tier 2,3 to cover medical patients when needed; all additional staff, residents, fellows, and APP flex as needed to cover non-surgical COVID-19 patients; advancement of PGY 5 and fellows to junior attending status. creation of PGY5 service for COVID/trauma/EGS, able to take trauma call in attending role with ACS faculty backup; run floor, consults, and if needed ICU level of care; PGY-4 to take position as acting fellow for EGS, trauma, ICU, able to act independently for extension of attending run services for COVID-19 patients all subspecialty fellows promoted to junior attending</p>	<p>Remaining ACS Faculty transition to focus on ICU solely; complete ACS allocation toward ICU patients; (trauma volume expected to decrease and transition to general surgery trained faculty); ACS services: ICU Services, flex ICU/OR ICU, 24-hour trauma call for general surgery staff</p>	<p>Daily sitrep huddles with departmental stakeholders and facility leadership; subsequent daily sitrep (may be via email) by department leaders to disseminate information; ICU expansion: OR conversion to 4 ICU beds; anesthesia reassigned to critical care; physicians assigned to areas outside of expertise for patient care; tandem ventilator and/or novel ventilators; possible intubation with family manual ventilation (bag valve mask) on case by case basis; need for increased cohorting of COVID+ providers in hospital still on duty; creation of morgue overflow areas for expected increase in fatalities</p>	<p>ACS Quarterback with knowledge of sitrep, IC level, and resource availability for all surgical/SCC/trauma consults, vets all transfer requests prior to connection with requesting service; urgent cases to stay at transferring facility and every effort to discharge; urgent cases to transfer to other facilities to prioritize the care of severely ill, severe trauma, critical care needs of remaining patients emergency cases at facilities with surgeon capability will stay at that facility; emergent cases with critical care needs with advanced triage criteria; exhaust nonoperative interventions; ECMO advanced triage criteria; trauma transfers with advanced triage criteria; virtual and telephone</p>	<p>Only urgent/emergent surgical cases only</p>	<p>No NORA cases</p>
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	status for running of own floor COVID-19 medical service; Triage criteria for emergency operations and trauma patients; triage criteria for mechanical ventilation; futility policy for Code Blue Activation in COVID patients; futility policy for trauma activations and admissions			management of urgent needs		
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ACS, acute care surgery; APP, advanced practice provider; CAD, coronary artery disease; CC, critical care; CV, cardiovascular; DM, diabetes mellitus; ECMO, extracorporeal membrane oxygenation; EGS, emergency general surgery; GI, gastrointestinal; HTN, hypertension; IC, incident command; MIS, minimally invasive surgery; NORA, non-operating room anesthesia; OR, operating room; PACU, post-anesthesia care unit; QI, quality improvement; SCC, surgical critical care

eDocument 1. Trauma and EGS Clinic Virtual Visit Process during COVID-19 Crisis

Purpose: To minimize risk to patients and staff by reducing unnecessary clinic visits as well as rapidly identifying patients that may need attention earlier to reduce hospital readmission. The goal is to allow social distancing while protecting our patients from potential issues that could require hospital admission.

1. Designated acute care surgery (ACS) attending and advanced practice provider (APP) will review both the upcoming trauma and emergency general surgery (EGS) clinic appointments and review patient on electronic medical record (EMR). In addition, the Attending will handle requests phoned into the nurse line that may be able to prevent a clinic visit.
2. Patients not needing follow up will be notified by nurse staff.
3. Patients deemed appropriate for virtual visit will be listed for virtual visit screening by nursing staff. (See Virtual visit screening tool)
 - a. If patient has virtual access, then appointment scheduled
 - b. ACS attending or APP will call patient using technology device deemed appropriate from screening tool
 - i. All x-rays and labs will be determined prior to call and patient to get labs and x-rays performed at closest AH site.
 - ii. Medications and supplies and therapies will be ordered as outpatient and an EMR note will be completed.
4. If patient deemed a physical appointment presence is needed (either from screening or from virtual appointment):
 - i. The patient and ONLY one family member are allowed to attend clinic appointment
 - ii. COVID-19 screening will be done at triage front desk. If screening is positive, they will be asked to get testing for COVID-19.
 - iii. If still need to be seen that day due to emergency, a mask will be worn by family member and patient and a dedicated room will be used.
 - iv. Only 1 nurse and 1 physician/APP will examine patient using appropriate PPE and N95 mask
 - v. After completion, PPE will be discarded in red-bag and room wiped down per AH protocol
5. If patient calls into clinic number with a problem, they will be screened by nurse and referred to dedicated ACS clinic attending to be handled immediately via virtual device or phone call to prevent need for physical appointment.

Notes:

1. If a patient or family member is suspected of having COVID-19 they are sent for testing
2. This is a dynamic process and process may change. The goal is to protect patients and staff by allowing safe social distancing while identifying complex issues early so they may be handled
3. We will attempt to use virtual visit capture via "whatsapp" or SKYPE IF patients have access. If not, we will use dedicated I-phone or Samsung video or pictures to evaluate patient and their wounds or concerns.
4. If a patient has staples or sutures, ask them to use the primary care physician. If not available, they can attend clinic appointment and be screened for COVID-19 infections.
5. If physical patient presence necessary, all trauma and EGS patients will be seen
6. All medications, dressing materials, and ostomy supplies will attempt to be handled as a virtual visit and home health scheduled appointments

eDocument 2. Trauma and Emergency General Surgery Clinic Screening Tool for Virtual Evaluation (COVID-19 Crisis)

1. Infectious Disease Risk Screening Questions (If + then referred for testing per admitting hospital Protocol)

Infectious Disease Risk Screening

Infectious Disease Symptoms

- Abnormal bleeding
- Cough greater than 2 weeks
- Diarrhea and/or vomiting
- Difficulty breathing
- Fever
- Hemoptysis
- New or worsening cough
- Night sweats
- Unintentional weight loss greater than 10 pounds

Tuberculosis Risk Factors Inpatient and ED patients only

- Foreign born
- Homeless or in shelter
- Hx of positive ppd or other positive TB test
- Incarcerated within last 2 years
- Intravenous drug user
- Known exposure to TB

Recent Travel Outside the United States

- No recent travel
- Last travel within 21 days
- Sick family/contact last travel within 21 days
- Unable to obtain

Recent Travel Location

- Travel outside United States other than countries below
- China
- Italy
- Japan
- South Korea
- Middle East

- De
- Kir
- Sn

Values are calculations for alerts. They have no clinical value. Do not document in these fields.

TB Alert

TB alert

Symptoms of hemoptysis, or new/worsening cough, or night sweats, or unintentional weight loss greater than 10 pounds and any TB risk factor

Travel History Alert

Ebola travel history alert

Symptoms of abnormal bleeding or fever and travel or contact with sick traveler to Africa within 14 or 21 days

COVID-19 (novel coronavirus)/MERS

Symptoms of fever and difficulty breathing, or hemoptysis, or new/worsening cough and travel or contact with sick traveler to the Middle East (MERS) or China (Novel coronavirus) within 14 or 21 days

If patient screens positive for multiple infectious disease travel risk, click on the Ebola travel history alert and the Coronavirus travel history alert buttons above to document acknowledgement of each alert.

Multiple infectious disease travel alert

2. Do you have access to a smart phone with video capability?
 - a. If so, which type: Samsung: _____ I-Phone: _____ Other: _____
3. Do you have access to computer with video camera? Yes _____ No _____
4. Are you able to download a free app such as "WhatsApp" or SKYPE or TEAMS to assist in videoconferencing?

Yes _____ No _____

(We will provide a free app access, if needed!)

5. Functional Status:

- a. Pain level: 1-2-3-4-5-6-7-8-9-10. Medication needs: _____
- b. Ambulation: Normal _____ Limitations _____
- c. Wounds/Incisions: 1. _____ 2. _____ 3. _____
 - i. Staples/Sutures: _____
 - ii. Clean and dry or drainage? _____
 - iii. Amount of drainage: _____
- d. Drains: None: _____ Yes: 1. _____ 2. _____ Amount(s) _____

6. Hygiene: Bathing: Yes _____ NO _____ if NO, were you told not to bathe? _____

7. PO Intake: Percentage of daily meals: 25% _____ 50% _____ 75% _____ 100% _____

8. Fluid intake _____

9. Bowel Function: constipation _____ Normal _____ Diarrhea _____

10. Urination: Normal _____ Abnormal _____

11. Other issues that patient may have to be addressed:

- a. _____
- b. _____
- c. _____
- d. _____
- e. _____

eDocument 3. Virtual / Telemedicine Acute Care Surgery Clinic History and Virtual Exam Template

History of present illness:

Perform Infectious risk screen. If positive, direct patient to Covid-19 testing center

Discuss and document any presenting symptoms patient may have

Review the previously completed screening tool assessing specific organ issues, diet, breathing, drains, and potential infection

Vitals:

Assess pulse by coaching the patient on how to take their own pulse

Assess respiratory rate and work of breathing

Assess whether patient has fever. If so, document temperature

Exam:

Assess appearance of the individual; mildly ill, moderately, toxic

Note presence of signs of infection

Ask patient to show respiratory effort and use of accessory muscles. Have them take a few deep breaths

Have patient show areas of abdomen, incisions, or previously trauma or surgery. Document areas separately with appearance, swelling, or drainage.

Have patient point to areas of pain and have them describe the pain: site, type, and level

Ask patient to show anything else that they feel is important for your assessment

Have patient palpate the area of concern and document ability to do so

Evaluate any incision sites, redness, swelling, drainage and document

Evaluate time frame of staples or stitches and document appearance and when they should be removed

Evaluate drains and document amounts and appearances

Assessment:

Reconfirm with patient the reasons for “distancing” and supportive therapies as needed

Reiterate with patient the limitations that clinic has using a virtual visit

Discuss with patient any issues determined based on virtual exam

Discuss any labs or radiographs or consultations needed

Recommend any emergency evaluations if issues are noted

Discuss with patient timing of staples, stitches, or drain removal

Discuss with patient the plan, management, and any prescriptions needed

Discuss with patient and/or caregiver timing of next visit