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Managing Resident Workforce and Education During the COVID-19 Pandemic

Evolving Strategies and Lessons Learned

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Background: The novel coronavirus and associated Coronavirus Disease 2019 (COVID-19) is rapidly spreading throughout the world, with robust growth in the United States. Its drastic impact on the global population and international health care is swift, evolving, and unpredictable. The effects on orthopaedic surgery departments are predominantly indirect, with widespread cessation of all nonessential orthopaedic care. Although this is vital to the system-sustaining measures of isolation and resource reallocation, there is profound detriment to orthopaedic training programs.

Methods: In the face of new pressures on the finite timeline on an orthopaedic residency, the Emory University School of Medicine Department of Orthopaedics has devised a 5-pronged strategy based on the following: (1) patient and provider safety, (2) uninterrupted necessary care, (3) system sustainability, (4) adaptability, and (5) preservation of vital leadership structures.

Results: Our 5 tenants support a 2-team system, whereby the residents are divided into cycling “active-duty” and “working remotely” factions. In observation of the potential incubation period of viral symptoms, phase transitions occur every 2 weeks with strict adherence to team assignments. Intra-team redundancy can accommodate potential illness to ensure a stable unit of able residents. Active duty residents participate in in-person surgical encounters and virtual ambulatory encounters, whereas remotely working residents participate in daily video-conferenced faculty-lead, case-based didactics and pursue academic investigation, grant writing, and quality improvement projects. To sustain this, faculty and administrative 2-team systems are also in place to protect the leadership and decision-making components of the department.

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Conclusions: The novel coronavirus has decimated the United States healthcare system, with an unpredictable duration, magnitude, and variability. As collateral damage, orthopaedic residencies are faced with new challenges to provide care and educate residents in the face of safety, resource redistribution, and erosion of classic learning opportunities. Our adaptive approach aims to be a generalizable tactic to optimize our current landscape.

The Challenge: Resident Management and Education During a Pandemic

The daily responsibilities attributed to an orthopaedic surgery resident demand a commitment to proper time management and the ability to prioritize tasks. Under the best of circumstances, there is a balance between clinical work, surgical training, didactics, and academic investigations. The addition of a global catastrophe, such as the novel coronavirus/COVID-19 pandemic, disrupts this balance. Maintaining a healthy resident workforce is critically important to patient care, but it is difficult for residents and other healthcare workers to minimize interpersonal contact and comply with the Center for Disease Control (CDC) recommendations such as 6 feet of “social distancing” and “shelter in place.”¹ based on the potent transmission patterns in the initially affected regions²⁻⁵. The inability to comply with these recommendations when caring for patients puts residents at risk for contracting the illness, which consists of pleuritic chest pain, cough, and fever in most cases^{6,7}. If no replacement is available, a provider who contracts the disease may place patients at risk by foregoing mandated quarantine^{1,8}. This situation must be avoided. For orthopaedic residents, the conflict between pressure to learn and provide care and pressure to stay healthy and avoid illness is difficult to navigate⁹. However, a rapid reorganization of the orthopaedic residency care strategy can mitigate the apparent dissonance between duty to the orthopaedic patient and duty to public well-being. Here, we outline the strategy that we have implemented at an urban, high-volume, multi-institutional orthopaedic department (Emory University School of Medicine, Atlanta, GA) that provides care for a broad array of orthopaedic diagnoses, affecting a demographically diverse patient population.

The Strategy

Restructuring of the resident component of care delivery is necessary during a pandemic that requires interpersonal distancing, prolonged periods of isolation, and societal commitment to avoid disinhibited spread of the disease¹⁰. There are 5 main pillars for devising a strategy that fits a residency program’s demands while preserving resident education as follows: (1) patient and provider safety^{9,11}, (2) ongoing provision of necessary care, (3) system sustainability, (4) system tolerance of uncertainty^{11,12} and flexibility as circumstances evolve, and (5) preservation of command and control. The first requirement, safety, advocates for minimal, well-protected face-to-face contact with patients and colleagues to avoid disease transmission. The second pillar, duty, speaks to the unique and obligate role that orthopaedic residents play in the diagnosis and treatment of the skeletally injured patient and those with

urgent conditions such as infection. Third, a strategy must be sustainable to outlast the uncertain duration and magnitude of the impact of a pandemic on the residency program, the department, and the general population; this is analogous to the organization of a fire department that uses the minimum number of skilled technicians to resolve a relatively unpredictable event while anticipating the future need for service. Fourth, and closely related to sustainability, is flexibility¹². We are facing an evolving situation, and the implemented strategy must be adaptable¹³. The fifth and the final pillar is the preservation of command and control. Although traditional leadership in surgical disciplines is often from the top, and by example, this classical structure clearly poses disproportionate risk to those most experienced and relied on to guide the program through the short-, mid-, and long-term timelines of the pandemic. As such, program and departmental leaders should serve an atypical role that more closely resembles military hierarchy, where asymmetric emphasis is placed on protecting thought leaders and decision makers.

Implementation of a System: Our Approach

In order to provide sustainable, high-quality patient care in a rapidly evolving situation, we departed from the normal operating procedures. We divided residents into 2 teams (more teams could be created, if needed, depending on each department’s structure). These teams are structured as “active-duty inpatient” and “remotely-working.” Team size will depend on each program’s requirements but is defined by the minimum number of residents needed to cover all clinical arenas. Team size should ensure continued adherence to the Accreditation Council of Graduate Medical Education (ACGME) requirements and should not be so small that individual residents are overburdened. Each active duty resident has a reserve counterpart resident. The 2 teams remain completely distinct to minimize the potential for program-wide disease transmission; each team contains substitutes for potential resident illness. The remotely working resident participates in maximal isolation to support the active duty resident with team-wide substitution at predetermined time intervals to reverse roles and allow for rest and seclusion from exposure¹⁴. In parallel, a similar “platooning” system is in place for both faculty and administrators to safeguard a healthy network of indispensable leaders and decision makers. We propose 2-week cycles to observe the incubation period for potential infection so that a reserve resident can return to the active duty role with confidence that they do not have impending symptoms with the potential for viral transmission, reducing the chance of infection of other members of that team or patients^{15,16}. Although much of

orthopaedic care is elective, the current stage of the pandemic in the United States calls for postponement of all nonessential orthopaedic care¹⁷, a lesson learned from previous viral epidemics^{18,19}. Limiting clinical and surgical encounters to urgent and critical cases not only limits interpersonal exposures but also reduces workloads to make the care team model viable. When possible, care is limited to the faculty only to diminish resident exposure and preserve their role in other duties and keep them healthy, given their front-line role in care. This practice helps mitigate strains on duty hour regulations.

While the structure and clinical demands of orthopaedic departments varies, our strategy is widely generalizable to deliver care in a dense, urban environment with a diverse population and a broad catchment area for high-and low-energy trauma, including several institutions that have heterogeneous healthcare models. Our department treats patients at a tertiary and pan-specialty university hospital, an orthopaedic specialty hospital, an American College of Surgeons (ACS) level 1 trauma pediatric hospital, a government-funded safety-net ACS level 1 adult trauma center, and a Veterans' Affairs hospital. We continue to provide 24-hour resident coverage of emergency department consultations and inpatient care through small sub-teams of residents on truncated cycles, with 2-week active duty-remote teams. This strategy could serve as a blueprint for other residency programs while allowing for flexibility to accommodate unique needs within their system.

Resident Education—The Show Must Go On

Didactic Education

While patient care is prioritized during this unprecedented time in modern medicine, resident education—especially in the setting of decreased clinical volumes—continues. In the setting of “social distancing,”^{20,21} education is best achieved virtually. Multiple videoconferencing applications are commercially available that are user friendly and allow for an entire residency to simultaneously log on to a shared videoconference remotely. A faculty leader can then enable interactive engagement with lecture presentations, case conferences, or interactive questions and answer sessions. The use of videoconferencing is strongly recommended to help counteract the stress of social isolation that such a crisis can produce because of social distancing recommendations.

The ACGME mandates that the residents be provided with protected time to participate in core didactic activities²². Although it is recognized that this may not be possible under certain circumstances, if possible, resident education should continue. As education proceeds, a system that continues to address ACGME core competencies should be emphasized. The following is one possible approach, understanding that each institution may need to addend the process to match institutional situations or needs.

1. Daily one-and-a-half-hour collaborative, faculty-led interactive learning sessions on a predetermined and scheduled topic. These are conducted virtually so that all parties can maintain isolation. This equates to 7.5 hours of didactic time weekly. Given the reduction in clinical

volume with elective cases canceled, this is attainable and exceeds ACGME minima²³. The schedule is published at least 1 week in advance so that the residents can properly prepare to participate in each session.

2. Interactive, question-based learning comprises at least some portion of each session so that the remote nature of the didactics does not result in disengagement of participants. This can be accomplished with the traditional Socratic method style teaching or with an interactive multimedia platform. We have found success using an audience response system from an online orthopaedic curriculum/question bank, followed by the faculty-led discussion of each question. Often, the questions will serve as the impetus for a meaningful topic debate.
3. Self-guided learning has also been prescribed. Again, using an online orthopaedic curriculum system, residents are assigned questions to complete each week.

Surgical Education

Beyond didactic education, which will play a pivotal role in resident education during this pandemic, surgical education must also continue where possible. In the setting of deferred elective cases and decreased surgical volumes, essential cases now present an ideal opportunity for education because the time constraints of a busy elective practice are removed. We recommend that residents produce thorough operative preoperative plans to discuss with the attending before the case. Operative execution should continue to be practiced in a graduated manner that protects the patient but also promotes skill progression. Postoperatively, faculty and residents should discuss the case in relation to the preoperative plan to glean knowledge from the procedure's intricacies. Although these are cornerstones of traditional surgical education, decreased operative volume reinvigorates enthusiasm for each facet of surgical education. In addition, during this time, there may be a role for technological supplementation of surgical education in the form of virtual reality or simulation training^{24,25}. We expect that because the healthcare system emerges from this crisis, surgeons may creatively work extra hours (evenings/weekends) to catch up on pent-up surgical demand from patients whose elective procedures were delayed because of the crisis.

Clinical Education

In order to maintain a healthy, unexposed resident population, faculty members cover their clinics without resident assistance when possible. This is made possible by the skeletonization of the clinic to a need-to-see basis. Clearly, there is some loss in educational value here, which can be addressed by a postclinic virtual conference between attendings and on-service residents to discuss patient presentations and radiographic correlations to simulate the ambulatory clinic setting. Most of the musculoskeletal subspecialty visits can be performed via video-enabled telemedicine. Learners can be part of these virtual clinic visits in real time performing the history and video examination before the attending, just as in a nonvirtual clinic visit. All members of

the care team and learners should become certified and familiar with the telemedicine rules and procedures, especially given the recent modifications to Health Insurance Portability and Accountability Act of 1996 (HIPAA)²⁶.

Academic Endeavors

Lastly, the system we have recommended offers an unprecedented amount of time to the orthopaedic surgical resident who is on the remote-working team. This is an opportunity that should be recognized and taken advantage of. In addition to supporting clinical duties and virtual clinic learning opportunities from home, we recommend the utilization of this time for studying and board preparation as well as for execution and completion of clinical research projects, grant writing, quality improvement ventures, and other academic endeavors. Productivity in this regard should accelerate, given the circumstances. Video-enabled virtual research meetings can be conducted between senior authors and residents to ensure that progress is maintained and enhanced by unparalleled time availability.

Future Planning—Planning for the Unknown

At the current time, it remains unclear for how long orthopaedic clinical care and, as a result, resident education will remain influenced by the current pandemic. The 2-team system outlined above allows for a sustainable solution that maintains a healthy workforce and addresses the needs of orthopaedic patients for evaluation and treatment. Disease spread to healthcare workers has already occurred and continuing transmission may be inevitable, despite aggressive institution of classic public health measures^{8,27}. The team system allows for the isolation of a resident who acquires Coronavirus Disease 2019 (COVID-19), allowing them time

for recovery while diminishing the risk of rapid, residency-wide disease transmission.

The situation and challenges we face as an academic orthopaedic community change daily. The system here allows for flexibility to meet the patient needs while also sustaining a commitment to resident education and academic investigation. Adherence to governing recommendations (CDC; World Health Organization, etc.) will continue to be paramount. Providers may need to sacrifice their personal preferences to optimize their ability to provide patient care. Strong leadership during this time is crucial and with unanimous resident and faculty commitment to an organized disaster-mitigation plan, we feel that it is possible to provide excellent care for patients while continuing to train competent orthopaedic surgeons. ■

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References

1. CDC. How to Protect Yourself. Atlanta, GA; 2020. Available at: <https://www.cdc.gov/coronavirus/2019-ncov/prepare/prevention.html>. Accessed March 20, 2020.
2. Riou J, Althaus CL. Pattern of early human-to-human transmission of Wuhan 2019 novel coronavirus (2019-nCoV), December 2019 to January 2020. *Euro Surveill.* 2020;25(4). [Epub ahead of print Jan 30, 2020].
3. Meo SA, Alhowikan AM, Al-Khlaiwi T, Meo IM, Halepoto DM, Iqbal M, Usmani AM, Hajjar W, Ahmed N. Novel coronavirus 2019-nCoV: prevalence, biological and clinical characteristics comparison with SARS-CoV and MERS-CoV. *Eur Rev Med Pharmacol Sci.* 2020;24(4):2012-9.
4. Liu Y, Gayle AA, Wilder-Smith A, Rocklöv J. The reproductive number of COVID-19 is higher compared to SARS coronavirus. *J Trav Med.* 2020;27(2):taaa021.
5. Zhao S, Zhuang Z, Cao P, Ran J, Gao D, Lou Y, Yang L, Cai Y, Wang W, He D, Wang MH. Quantifying the association between domestic travel and the exportation of novel coronavirus (2019-nCoV) cases from Wuhan, China in 2020: a correlational analysis. *J Trav Med.* 2020;27(2):taaa022.
6. Velavan TP, Meyer CG. The COVID-19 epidemic. *Trop Med Int Health.* 2020;25(3):278-80.
7. Li JY, You Z, Wang Q, Zhou ZJ, Qiu Y, Luo R, Ge XY. The epidemic of 2019-novel-coronavirus (2019-nCoV) pneumonia and insights for emerging infectious diseases in the future. *Microbes Infect.* 2020;22(2):80-5.
8. MacIntyre CR. On a knife's edge of a COVID-19 pandemic: is containment still possible? *Public Health Res Pract.* 2020;30(1):3012000.
9. Koh D. Occupational risks for COVID-19 infection. *Occup Med (Lond).* 2020;70(1):3-5.
10. Hellewell J, Abbott S, Gimma A, Bosse NI, Jarvis CI, Russell TW, Munday JD, Kucharski AJ, Edmunds WJ; Centre for the Mathematical Modelling of Infectious Diseases COVID-19 Working Group, Funk S, Eggo RM. Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. *Lancet Glob Health.* 2020;8:e488-96.
11. Chopra V, Toner E, Waldhorn R, Washer L. How should U.S. hospitals prepare for coronavirus disease 2019 (COVID-19)? *Ann Intern Med.* 2020. [Epub ahead of print March 11, 2020].
12. Sambala EZ, Manderson L. Anticipation and response: pandemic influenza in Malawi, 2009. *Glob Health Action.* 2017;10(1):1341225.
13. Stratton SJ. COVID-19: not a simple public health emergency. *Prehosp Disaster Med.* 2020;35(2):119.
14. Guo YR, Cao QD, Hong ZS, Tan YY, Chen SD, Jin HJ, Tan KS, Wang DY, Yan Y. The origin, transmission and clinical therapies on coronavirus disease 2019 (COVID-19) outbreak—an update on the status. *Mil Med Res.* 2020;7(1):11.
15. Backer JA, Klinkenberg D, Wallinga J. Incubation period of 2019 novel coronavirus (2019-nCoV) infections among travellers from Wuhan, China, 20-28 January 2020. *Euro Surveill.* 2020;25(5). [Epub ahead of print Feb 06, 2020].
16. Cascella M, Rajnik M, Cuomo A, Dulebohn SC, Di Napoli R. Features, Evaluation and Treatment Coronavirus (COVID-19). In: *StatPearls*. Treasure Island, FL: Stat Pearls Publishing: StatPearls Publishing LLC; 2020.
17. Iacobucci G. Covid-19: all non-urgent elective surgery is suspended for at least three months in England. *BMJ.* 2020;368:m1106.
18. Schull MJ, Stukel TA, Vermeulen MJ, Zwarenstein M, Alter DA, Manuel DG, Guttman A, Laupacis A, Schwartz B. Effect of widespread restrictions on the use of hospital services during an outbreak of severe acute respiratory syndrome. *CMAJ.* 2007;176(13):1827-32.
19. Schull MJ, Stukel TA, Vermeulen MJ, Guttman A, Zwarenstein M. Surge capacity associated with restrictions on nonurgent hospital utilization and expected admissions during an influenza pandemic: lessons from the Toronto severe acute respiratory syndrome outbreak. *Acad Emerg Med.* 2006;13(11):1228-31.

- 20.** Stein R. COVID-19 and rationally layered social distancing. *Int J Clin Pract.* 2020:e13501. [Epub ahead of print March 2020].
- 21.** Thomson G. COVID-19: social distancing, ACE 2 receptors, protease inhibitors and beyond? *Int J Clin Pract.* 2020:e13503. [Epub ahead of print March 2020].
- 22.** EducationACFGM. ACGME Program Requirements for Graduate Medical Education in Orthopedic Surgery; 2019. Available at: https://www.acgme.org/Portals/0/PFAssets/ProgramRequirements/260_OrthopaedicSurgery_2019_TCC.pdf?ver=2019-06-13-075738-923. Accessed March 20, 2020.
- 23.** Stella JJ, Lamb DL, Stain SC, Termuhlen PM. Understanding ACGME scholarly activity requirements for general surgery programs in the era of single accreditation and the next accreditation system. *Am Surg.* 2018;84(2):e40-3.
- 24.** Logishetty K, Gofton WT, Rudran B, Beaulé PE, Cobb JP. Fully immersive virtual reality for total hip arthroplasty: objective measurement of skills and transfer of visuospatial performance after a competency-based simulation curriculum. *J Bone Joint Surg Am.* 2020;102(6):e27.
- 25.** Logishetty K, Rudran B, Cobb JP. Virtual reality training improves trainee performance in total hip arthroplasty: a randomized controlled trial. *Bone Joint J.* 2019;101-B(12):1585-92.
- 26.** Services UDoHH. Notification of Enforcement Discretion for Telehealth Remote Communications During the COVID-19 Nationwide Public Health Emergency. Washington, DC. 2020. Available at: <https://www.hhs.gov/hipaa/for-professionals/special-topics/emergency-preparedness/notification-enforcement-discretion-telehealth/index.html>. Accessed March 22, 2020.
- 27.** 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 Trav Med.* 2020;27(2).