

Innovation in Response to the COVID-19 Pandemic Crisis

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Abstract

The COVID-19 pandemic has disrupted all aspects of academic medical center missions. The number and rapidity of innovative responses to the crisis are extraordinary. When the pandemic has subsided, the world of academic

medicine will have changed. The author of this Invited Commentary anticipates that at least some of these innovations will become part of academic medicine's everyday clinical and educational operations. Here, he considers the

implications of exemplary innovations—virtual care, hospital at home, advances in diagnosis and therapy, virtual learning, and virtual clinical learning—for regulators, academic medical centers, faculty, and students.

The demands on clinical care systems, disruptions to educational institutions, economic chaos, and societal upheaval that the COVID-19 pandemic has brought on are unprecedented in our collective memories. To call this an existential crisis for academic medical centers (AMCs) may be hyperbole, but at a minimum it has wrought a defining moment. The rapidity and breadth of creative innovations developed in response to the crisis and implemented across AMCs and their missions are also unprecedented. When the pandemic has subsided, the world will have changed. What will the legacy of the 2020 COVID-19 pandemic be for medical educators and U.S. AMCs?

For years, commentators have noted that education and clinical care are 2 areas relatively unaffected by the disruptive changes that have transformed other sectors, ranging from banking to retail to manufacturing. Not because the need for transformational (not simply incremental) change was not identified, not because there were no innovative options available, not because leaders ignored the need,¹ but because a host of barriers, ranging from payment

to regulatory to the natural human inclination to resist change, all impeded the implementation of many innovations.

Ironically, now a biologic agent, the COVID-19 virus, seems to be the catalyst for disruption in educational and clinical care systems to an extent and at a pace unimaginable only a few weeks ago. While abstract tabletop exercises and apocalyptic works may have presaged our current reality, who among us thought a pandemic was a near-term possibility? Innovations that have been available for years or decades but not widely implemented have suddenly become the norm. But the COVID-19 pandemic has also exposed deficiencies within the U.S. clinical care system and highlighted the need for additional innovation. In this Invited Commentary, I briefly consider a few examples of innovative responses; the directionality of needed future innovations; and their current and future implications for AMCs, faculty, and educational programs.

Virtual Care

The utility and value of technology-enabled, asynchronous in space and/or time virtual care—termed *telemedicine*—have been written about and studied for decades but not universally implemented. While payment, licensure, and privacy issues were major impediments, some clinical systems, such as Kaiser Permanente, embraced virtual visits for a majority of their ambulatory patient interactions long before COVID-19.² But Kaiser and others like it were the exception. The pandemic has changed this. Clinical care systems across the United States have markedly

expanded their virtual visit capabilities and converted in-person clinical visits to virtual visits for the full spectrum of problems ranging from chronic disease follow-up to acute care triaging. Notably, public service announcements have urged individuals who are concerned about potential COVID-19 infection to call their physician's office rather than to present to a clinic or emergency room for evaluation.

As with many innovations, virtual visits have advantages and disadvantages. For the patient, advantages include convenience and access without the risk of further exposure. For the clinician, the ability to care for patients with acute and chronic diseases while allowing patients to observe shelter-in-place requirements and minimizing health care worker exposures are advantages. Virtual visits also maximize the availability of clinical resources for face-to-face visits with patients who have been virtually screened, termed "forward triage," and determined to need in-person visits.³

Likely the relaxation of payment, regulatory, and privacy standards that have facilitated the innovative use of virtual visits will remain in place once the pandemic abates. What does the ongoing presence of telemedicine as a standard-of-care provision mean for faculty, students, and AMCs? Video visits, through a multitude of platforms, will be commonplace. While these represent an improvement over audio-only conversations or email exchanges, the information conveyed nonverbally is still minimal, the flow of conversation remains somewhat stilted, the social value of in-person interactions is absent,

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obviously the opportunity for physical examination (unless the patient has been provided specialized equipment) is absent, and of course the “healing touch” is impossible. Further, there is a learning curve for clinicians to master the optimal use of video-based virtual communication tools and to develop a “webside manner.”

For AMCs, virtual patient visits will necessitate revisions to relative value unit–based clinical faculty productivity and compensation models. For students and residents, telemedicine will require education and training in the nuances of virtual visits and the development of “webside manner” equal to education and training in traditional in-person patient communication. Although some medical schools have developed virtual communication exercises, this is an area in need of further development. Potentially much could be gained through partnerships with faculty from theater, media arts, and broadcasting programs.

Hospital at Home

Not only has the pandemic led to widespread virtual visits and to public education to first call rather than “see” your physician, but it also has resulted in recommendations that people with COVID-19 symptoms self-quarantine and treat themselves at home unless seriously ill. While the concept of the “hospital at home” has been studied and demonstrated to be equivalent or superior to inpatient hospitalizations for a number of conditions, it generally has not been a first choice or option despite concerns about the increasing incidence of nosocomial infections and medical care expenses. Might the pandemic serve as a crash course for clinicians and patients alike in the value of care, even acute care, in the home? While not yet widely available outside of the hospital setting, sensors for a multitude of physiologic variables with remote monitoring capabilities have been developed. Might the necessity of using alternative care settings due to hospital bed limitations lead to innovations that make hospital-at-home care the preferred option for all patients except those who are critically ill and require intensive care?

While many patients would welcome such an innovation, it represents significant financial risks for AMCs

many of which are dependent on inpatient clinical revenues. For many faculty, hospital-at-home care would require the development of new skills and the adoption of new roles. For students and faculty alike, such care would require not only virtual communication skills but also the development of the knowledge and skills to be sophisticated consumers of remote sensor data. Importantly, physicians and physicians-in-training would need to learn how to detect spurious or compromised signals. Clinicians are very familiar with the output of monitoring equipment; the machines in modern intensive care units and operating rooms generate copious amounts of sensor data. If an unusual electrocardiogram recording occurs in the hospital, it is easy to go to the patient’s bedside and determine if a lead has been misplaced or fallen off. However, caring for patients remotely would necessitate alternative means to check the veracity of abnormal signals that would require intervention if confirmed. Do medical educators need to partner with engineering faculty and develop innovative courses and simulations to educate future physicians as to the strengths and weakness of the technology that will enable care of patients in their homes and other remote locations?

Advances in Diagnosis and Therapy

Viewed by historical standards, the rapidity with which the COVID-19 genome was mapped, diagnostic tests developed and implemented, and therapeutic clinical trials initiated was remarkable. The speed of these advances exemplifies the transformative effect that a multitude of scientific and technologic innovations may have on clinical medicine. The COVID-19 experience also provides medical educators multiple teaching options that are broadly applicable. While the genomic-based tests seem highly accurate, they reflect only the presence or absence of detectable virus in the sample. Their sensitivity and specificity depends on a multitude of factors ranging from the adequacy of sampling to transport media to the technical limits of the assay. Clinicians still must make judgments based on their patients’ presentations. The press has reported on individuals who initially tested negative and then were found to

be positive after potentially exposing multitudes of other individuals—as well as people who tested positive but were clinically essentially well. While physicians welcome the additive value of technology to facilitate diagnosis, the COVID-19 example aptly illustrates that even sophisticated diagnostic tests must be coupled with clinical judgment. The identification of the virus in apparently healthy individuals exemplifies the decisions and questions that clinicians will face with the increasing availability of genomic screening: Of what significance is a finding to the individual? Further confounding the picture will be the proliferation of microbiome analyses. Additionally, the current pandemic exemplifies the ethical and professional conundrums facing clinicians when an apparently healthy individual tests positive for something—in this situation an infectious agent—that may result in harm to others. What are the clinician’s responsibilities to that individual vis-a-vis protecting the public’s well-being? This conundrum is a modern instance of a long-standing problem as exemplified by the celebrated case of “Typhoid Mary.”⁴

Virtual Learning

While I have touched on the implications of just a few of the innovations that have emerged from the clinical exigencies of the COVID-19 pandemic, as noted earlier, education has also been disrupted. Faculty are converting their in-person courses to virtual courses. Medical students have been removed from clinical rotations. The clinical responsibilities and educational opportunities of residents have been altered. The whole fabric of medical education has been ripped apart. This turmoil has also led to widespread innovation—albeit not as visible to the public and the media. As with telemedicine, the potential of web-based education has been touted for years, but uptake among educational institutions has widely varied. Some massive open online courses or MOOCs, the Khan Academy, and the Human Diagnosis Project are successful examples of web-based educational programs with global impact. These exemplars represent proof of concept and now, out of necessity, medical school faculties are being required to rapidly convert their in-person instruction to virtual courses. Such innovations

present an opportunity for medical educators to leverage technology to develop courseware that incorporates empirically derived insights into how adults learn. Frequent testing (i.e., the retrieval practice effect) with feedback, spaced learning and interleaving, a focus on threshold concepts, scaffolding, minimization of cognitive overload, and self-paced learning are all among the potential advantages presented by electronic educational materials and virtual courses. However, this technology-mediated teaching requires new skills and institutional infrastructure, and it is time and labor intensive, requiring more than simply recording a lecture and posting slides. Might medical educators benefit from TED (Technology, Entertainment, and Design) talk experts? From marketing professionals? From developers of serious games?

Again, although these educational innovations—like other advances—hold great promise, potential drawbacks must be considered. How important are the social interactions that occur in medical school classrooms and laboratories to professionalization? Will we sacrifice the opportunity to develop mentoring relationships between faculty and students? And very importantly, the potential negative impact on faculty cannot be ignored. Many of the foundational courses in the medical curriculum are similar from school to school. A logical extension of the development of virtual courses is the emergence of a handful of national or international “superstar virtual educators,” which could, in turn, eliminate or greatly modify the educational responsibilities of many current faculty. Still, technology-enabled virtual learning may be essentially a logical progression of the flipped classroom and hybrid classroom initiatives that already exist in many schools, and there would still be a need for faculty to serve as coaches, to host and moderate online discussions, and to provide feedback. The need for faculty members continues, but their roles may evolve dramatically.

Virtual Clinical Learning

The removal of medical students from their clinical rotations is a profound disruptor. The implications for their ethical and professional development as physicians are numerous. Now is the time for medical educators to act—not simply to discuss implications—but to rapidly innovate and develop alternatives to fill the void. Indeed, the Association of American Medical Colleges has already responded⁵ to the outpouring of innovative ideas emanating from AMC faculty by creating “a new free and open resource repository that will allow for the agile sharing and disseminating of these educational approaches.”⁶

Simulated patients and simulation technology are already a standard part of the medical education experience. Communication and physical examination skills are developed with simulated patients, and students and residents are required to demonstrate a level of proficiency with simulated procedures before performing them on patients. Augmented and virtual reality are the next frontier in educational program development. Already available for teaching anatomy and surgical procedures, might this technology be leveraged to replace, at least in part, what heretofore trainees learned on clinical rotations? Problem-specific patient interviewing, disease presentations, and team training are but a few of the potential applications of augmented and virtual reality educational programs. To fully capitalize on these, medical educators need to partner with video game developers, the military, and others who are working at the forefront of augmented and virtual reality. Importantly, while the new technology is promising, simulations can supplement but will never fully replace actual patient encounters in the medical education curriculum. Medical educators must focus on applying these innovative technologies where they add value.

Critical Choices

The COVID-19 pandemic has changed the world. Academic medicine and the

roles of faculty, administrators, and students will also change. Collectively, we face a decision. Will the faculties and leaders of AMCs and of regulatory and accrediting agencies embrace the innovations that this crisis necessitates? Will we make them permanent, accepting changes that in some cases, I would argue, are long overdue, or will we simply endure for now and then return to the pre-COVID-19 status quo? While recognizing that we will grieve the loss of what was, I urge all of us to continue to unleash the innovative power of our faculties and transform our AMCs for the good of our students, patients, and society.

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