

## Virtually Possible

### Medical Student Rehabilitation Rotations During a Pandemic

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**Abstract:** The novel coronavirus 2019 pandemic has led to new dilemmas in medical education because of an initial shortage of personal protective equipment, uncertainty regarding disease transmission and treatments, travel restrictions, and social distancing guidelines. These new problems further compound the already existing problem of limited medical student exposure to the field of physical medicine and rehabilitation, particularly for students in medical schools lacking a department of physical medicine and rehabilitation, approximately 50% of medical schools. A virtual medical student physical medicine and rehabilitation rotation was created to mitigate coronavirus 2019–related limitations and impact on medical education. Using audiovisual technology, students had the opportunity to participate in clinical inpatient and outpatient care, live-streamed procedures, and virtual didactics, develop and showcase their clinical knowledge and reasoning skills, and become familiar with the culture of the physical medicine and rehabilitation residency program. Adaptive educational approaches, including integration of the flipped classroom model, success, pitfalls, and areas for improvement will be described and discussed. Providing nontraditional methods for physical medicine and rehabilitation education and exposure to medical students is crucial to maintain and promote growth of the field in this unprecedented and increasingly virtual era.

**Key Words:** COVID-19, Medical Education, Medical Students, Physical and Medical Rehabilitation

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The COVID-19 pandemic has accelerated adaptation in an already evolving medical education landscape to protect the future physician work force and ensure adequate training. Medical education is facing a unique dilemma because of uncertainty regarding the spread and severity of COVID-19, social distancing, and limited supplies of personal protective equipment, affecting students in both preclerkship and clerkship settings.<sup>1</sup> As the pandemic continues to wax and wane

in different areas of the nation and globe, medical students find themselves learning much of their foundational and clinical medicine remotely.<sup>1</sup> Medical students who once were seeing patients face to face, performing foundational physical examinations, and learning from each patient that they interacted with are no longer granted that privilege, but rather are gaining their education in other settings.

In response, the Association of American Medical Colleges created a COVID-19 resource hub to provide guidance to medical schools as well as medical students.<sup>2</sup> Multiple guidelines were put in place to help medical students and schools provide a sustainable and safe return to education as well as the continued protection of both patients and students. Some of the initial changes included canceled rotations and limited exposures to patient care in all fields. These reductions may have a disproportionate effect on smaller specialties, such as physical medicine and rehabilitation (PM&R or physiatry). Other specialties, such as otolaryngology, radiation oncology, radiology, and neuro-ophthalmology, have created virtual experiences in response to the pandemic to continue both medical education and the ability for students to get to know programs outside of their institution, in their respective fields.<sup>3–6</sup> For those students seeking a career in PM&R, access to rotations is imperative to verify their career path, learn the different aspects of PM&R, and to obtain letters of recommendation for application to residency. There are currently 95 PM&R residencies in the United States, and only 49.74% of US medical schools are associated with a PM&R department.<sup>7–9</sup> Students in a school without PM&R departments or divisions are required to seek outside elective rotations to obtain this experience. In a recent assessment of the impact of COVID-19 on fourth-year medical students interested in PM&R, 94% had elective scheduling impacted and 60.4% had graduation dates affected.<sup>10</sup> Lack of away rotations also limits students' and programs' capacity to evaluate whether they are a good fit.

In an effort to adapt to new COVID-19 related limitations affecting medical students interested in physiatry, we developed a virtual rotation, incorporating both clinical inpatient, outpatient, electrodiagnostic and musculoskeletal ultrasound experiences, and flipped classroom (FC) style case-based learning. We describe our experience with this medium and discuss advantages, pitfalls, and improvements for the future.

## METHODS AND MATERIALS

### Design

This is a quality improvement initiative, and therefore exempt from the institutional review board process. Off-site students were offered a 2-wk virtual rotation. Department-funded

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audiovisual equipment (iPads) mounted to mobile stands and video conferencing enabled student participation in patient care and interaction with residents and attending physicians. Secure virtual conferences were generated via the Zoom application using institutional professional accounts. The mobility of the platform provided a novel way for the student to experience hospital and clinical settings from their remote location. Rotation design was tailored to the capacity of our faculty. A sample student schedule is provided in Table 1. In their first week, students were assigned to an inpatient medically complex rehabilitation service. During their second week, students participated in outpatient clinics and were assigned a different attending physician each day to increase their exposure to the breadth of the program. To avoid screen fatigue, students were not assigned more than 5 hrs of video conferencing per day. During the nonclinical portion of the day, the student completed an assigned reading and associated case that correlated with the respective attending’s area of specialization. More detailed aspects of our curriculum are described in further detail hereinafter. During both weeks, students participated in resident didactics and any journal club, grand rounds, or mortality and morbidity conference that were scheduled. Students were asked to give a 10-min virtual presentation to residents and available faculty at the conclusion of their rotation. Grading was pass/fail. Of note, students routinely provide course feedback as part of an ongoing quality assurance program; therefore, this study was considered a quality improvement project, and institutional review board approval was waived. Consent was considered implied, as students sought and signed up for the virtual rotation in the same manner they would sign up for an onsite visiting student rotation.

### Virtual Outpatient Clinic and Inpatient Rounds Experience

During the inpatient week, students participated in daily morning rounds, interviews with the patients, and weekly multidisciplinary team rounds, with focus on diagnosis and medical management discussions. In the outpatient setting, students participated in video-assisted virtual history taking, physical examination instruction and observation, and discussion of

the differential diagnosis and the patient management with both residents and the attending physician.

### Virtual Electrodiagnostic Experience

The student was able to participate with two views. The room set up is shown in Figure 1, and the student computer view is shown in Figure 2. The first view included a shared screen of the electrodiagnostic software screen so that waveforms and sounds were visible and audible. The second view was angled toward the physician and patient and allowed the student to observe the technical skills used to perform the study. Students’ participation occurred through history gathering, selection of physical examination maneuvers, and review of key neuromuscular anatomy needed to perform testing with the faculty and resident.

### Virtual Ultrasound Experience

Two views were used, shown in Figure 3. The first view allowed the student to see the patient, probe, and physician positioning for procedures. The second camera showed the ultrasound screen. This setup enabled the student to observe proper technique for performing ultrasound procedures without compromising the ability to see the ultrasound image. In addition, the microphone on the camera facing the physician was used to transmit audio to optimize audio quality.

### Virtual Education

In addition to the virtual clinical components of the rotation, medical students were provided with learner centric educational sessions, using the FC model to optimize active learning. As prework in our curriculum, students were given an article and case on a specific topic. Upon completion of the prework, the student would engage in case and topic discussion with the respective faculty member. The topics chosen for the curriculum included commonly seen diagnoses in PM&R, upper limb entrapment neuropathies, calcific tendinopathy of the shoulder, chronic regional pain syndrome, lumbar stenosis, and cerebral palsy. Each case was designed in a progressive fashion that required the student to identify key elements and develop differential diagnoses, which they were expected to refine as more information was subsequently provided. Using their

**TABLE 1.** Sample medical student rotation schedule

	Mon	Tues	Wed	Thurs	Fri
Week 1	Inpatient rounds and SCI lecture series	Inpatient rounds and interdisciplinary team rounds	Inpatient rounds	Inpatient rounds	Didactics and journal club or grand rounds (if available)
	Time designated to work on presentation	Assigned journal article and case with questions and faculty review	Time designated to work on presentation	Time designated to work on presentation	Inpatient rounds
Week 2	Electrodiagnostic medicine clinic	Pain clinic	Musculoskeletal medicine and ultrasound clinic	Musculoskeletal medicine and spine clinic student presentation	Didactics and M&M conference (if available)
	Assigned journal article and case with questions and faculty review	Assigned journal article and case with questions and faculty review	Assigned journal article and case with questions and faculty review	Assigned journal article and case with questions and faculty review	

M&M, morbidity and mortality conference; SCI, spinal cord injury.



**FIGURE 1.** The virtual student is present via an electronic tablet and has auditory and visual of the physician and patient interaction and the electrodiagnostic procedure.

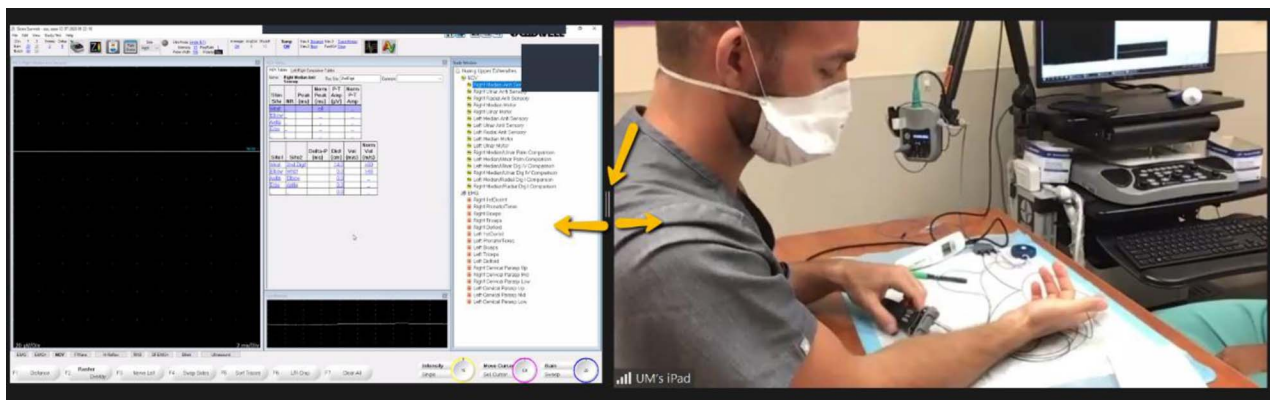
differential diagnoses as justification, students were asked to order a diagnostic workup. Once results were revealed, the students had the opportunity to determine the final diagnosis. To reinforce key learning objectives, each case concluded with fourth-year medical student level questions regarding the specific topic. Independent search and usage of supplemental articles and/or medical reference information were encouraged.

**RESULTS**

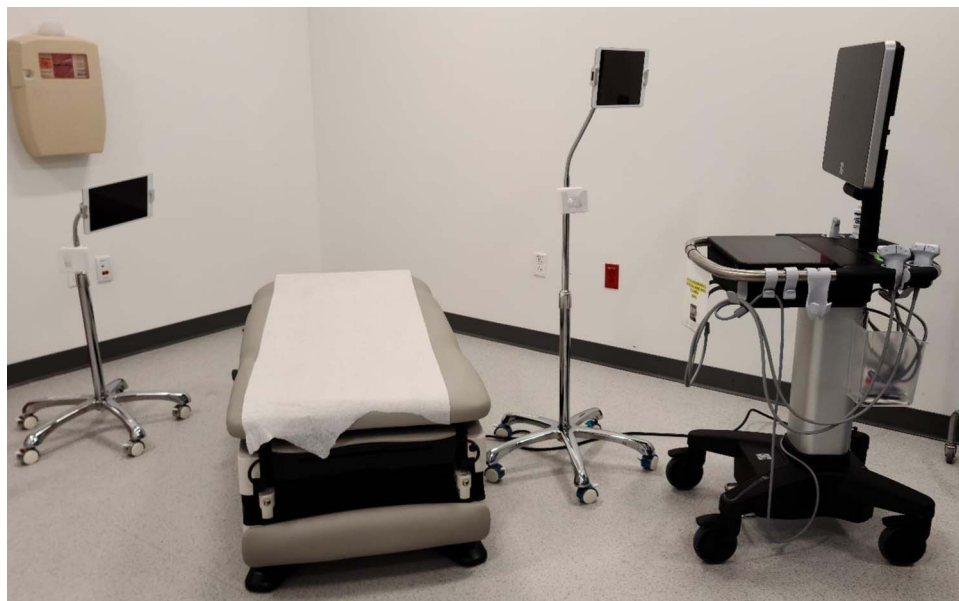
Eight students completed the virtual elective. In total, seven faculty members served as preceptors. Two faculty members supervised the inpatient week on a rotating basis, one faculty member precepted the case-based learning during the inpatient weeks, and four faculty served as preceptors during

the outpatient week. Written feedback regarding the rotation was obtained from students in a written questionnaire. Verbal feedback and written feedback were provided to students using their respective medical school evaluation forms. Faculty provided both written and verbal feedback regarding the rotation. Attendings reported the ability to discern the differential qualities of students, including each students’ knowledge base, and clinical reasoning ability, and to a lesser but equally relevant degree, their interpersonal and professional skills. In addition, the faculty reported that tablet-enabled learners were well received by patients.

Of the students who rotated, all reported that they were able to get a general sense of the culture of the program. However, several students noted the lack of opportunities for new collegial relationships, friendships, and networking that



**FIGURE 2.** The virtual student’s dual view of both the nerve conduction and electromyography potentials and physician-patient interaction.



**FIGURE 3.** Dual-view setup of ultrasound-guided procedures allows the virtual student to see both the physician-patient interaction and ultrasound images.

typically occur during onsite rotations. All students reported high satisfaction with the case-based FC model of learning. All students reported that 2 wks was sufficient, and all would repeat a virtual rotation but would prefer in person, if available. Various technical challenges arose, including limitations in maximum volume, field of view, battery life, and issues with Internet connectivity. Of those challenges, the most limiting was the sound quality and volume during inpatient rounds.

## DISCUSSION

Virtual clerkships are part of a nationwide trend toward more customizable and independent medical education. Learner-centered asynchronous instruction has been recognized formally by the Accreditation Council for Graduate Medical Education.<sup>11</sup> In addition, many medical schools before the pandemic had already begun shifting toward online, electronic-based curricula that reward independent learning and group application and discussion.<sup>12</sup> The COVID-19 pandemic and restrictions on in-person clinical rotations for medical students accelerated this interest. The availability of high-quality virtual rotations has the potential to revolutionize many aspects of medical school clerkships, including expanded access for medical students in different geographical locations. One investigation of medical student career perceptions after COVID-19 showed that many medical students believe the pandemic will influence their choice of specialty, most commonly citing the inability to explore their specialty of interest.<sup>13</sup> Psychiatry is one field in particular that most preclinical medical students have limited exposure.<sup>14</sup> Access to rotations is key to growing psychiatry as a field and especially important for those interested students without a home program. Lack of access to these rotations potentially disadvantages students who may have limited psychiatric clinical and research exposures and an inability to obtain a letter of recommendation from a psychiatrist. In the pre-pandemic

era, students still faced challenges securing away rotations, including scheduling difficulties, the burden of financial costs, and institutional requirements. Virtual rotations can more flexibly offer learning opportunities to a greater variety of medical students with fewer barriers to entry.

A strength of our curriculum was the utilization of FC and case-based learning to maximize learner engagement. The FC model has gained momentum in recent years and is being applied among a variety of professional educational programs, medical schools, and residency programs of varying specialties.<sup>15–18</sup> Furthermore, the FC model has been found to be an effective tool in many virtual curricula.<sup>12,19–21</sup> Although more research is needed to evaluate the long-term efficacy of the FC model compared with the traditional lecture approach, a 2017 systematic review of 46 articles found that the FC approach was perceived favorably by students and is a promising tool to increase students' motivation, task value, and engagement.<sup>22</sup> Designating time for students to review common diagnoses, as in our FC case model, from start to finish is an experience not often received during in-person clinical rotations because of other responsibilities and obligations. Moreover, having the opportunity to think through the cases themselves from beginning to end with one-on-one assistance from attendings is an invaluable experience, allowing them the opportunity to expand their knowledge base and apply this newly acquired information through clinical reasoning discussion. In addition, choosing a variety of topics may have secondary impact in promoting different aspects of PM&R that medical students often do not realize exist.

Many of the models being tested in medical education incorporate innovative methods of replicating the experience of in-person learning and, in some cases arguably, improve upon it. Surgical trainees in one program were treated to real-time video and interactive discussion via a head-mounted camera worn by the attending during the operation, thereby improving student participation with a better view.<sup>3</sup> A radiology department found that after switching to a virtual lecture format and permitting open participation of remote medical students, overall participation

within their own department increased drastically, and the total number of rotating students increased by approximately 350%.<sup>11</sup> Student test scores during virtual rotations were also shown to be comparable with those of in-person clerkships and lend credence to the equitability of overall education.<sup>5</sup> Innovative future designs will refine the use of elements of in-person learning, virtual seminars, simulations, live-streamed procedures, flipped-classroom models, and evidence-based medical education. Our curriculum design experience demonstrates that elective experiences can be delivered in a virtual environment. Students have opportunities to develop and showcase virtual skills, such as teleconferencing, communication, knowledge, presentation, and data gathering, through case-based discussion with faculty, participation in didactics, and a presentation to the residency program. Virtual students can also make real contributions to their clinical teams through real-time data gathering to aid evidence-based practice. The trends in electronic education and healthcare delivery, which have blossomed during the pandemic, are likely to persist. Developing the capability to work with mixed physical and virtual team members is a skill, which will grow in importance for clinicians and educators.

To our knowledge, this is the first time that virtual instruction of electrodiagnosis has been implemented or reported. Although a virtual electrodiagnostic medicine experience may be an adequate introduction to the field, we hypothesize that virtual training would be insufficient for residency level learners. Further investigation is needed to assess for effectiveness. Conversely, remote, or teleultrasound, has been demonstrated to be a feasible option in both educational and clinical settings, including in real time.<sup>23-28</sup> The Society for Academic Emergency Medicine recommends that ultrasound should continue to be used as an educational strategy within existing medical school curricula,<sup>29</sup> but recommendations focus on in-person training. Although no studies have specifically look at Zoom as a platform for remote ultrasound, FaceTime has been shown to be noninferior as a mode of image transmission when compared with viewing images directly obtained from the ultrasound machine itself.<sup>30</sup> Opportunities for hands-on procedure training, including ultrasound, a required component of PM&R residency training,<sup>31</sup> were the second highest overall factor that potential trainees considered when ranking programs for the residency match.<sup>32</sup> Although virtual ultrasound education is an insufficient replacement for in person training, it is still a feasible supplemental tool to bolster learning opportunities.

To address the technical challenges that we encountered, innovation and investment are needed to optimize the audio/visual equipment used in virtual education. In the future, strategic use of screen time, scheduled recharging times, or pairing of virtual and in-person students to assist one another may help improve the student experience.

A limitation of the virtual rotation is the loss of intangibles. The lack of a physical presence in the room contributed to limitations of social engagement with residents, faculty, and patients and affected the student's ability to network and build camaraderie. Students observe skills, habits, strategies, and interprofessional behaviors from those around them as part of the "hidden curriculum" of medical education. This essential education becomes even more important when a student is a potential applicant with an eye toward residency applications and beyond. Social engagement is an area for further

refinement and may benefit from inclusion of dedicated and more structured social activities and resident introductions.

From the patient perspective, there is some novelty and challenge to establishing an engaging patient-student relationship. Having virtual students conduct interviews and virtual physical examinations was suitably rigorous and thorough, particularly if the physician instructor was experienced with telehealth and could offer guidance for strategic physical examination techniques. One survey of attending psychiatrists found that although a small proportion practiced telehealth before the pandemic, that percentage increased to 86.5% after the outbreak of COVID-19.<sup>10</sup> These virtual skills are increasingly critical for learners' future success as physicians, as telemedicine becomes more prevalent in the delivery of health care.

The inability to practice in-person physical examination clinical skills is another major limitation of a virtual rotation. Although a physical assessment can be performed well by a clever virtual examiner, this requires tutelage from physicians experienced in telehealth and does not account for the absence of hands-on clinical skills practice. Assessments may also be limited by patients with communication impairments, which might otherwise be overcome by sensing body language. In psychiatry, where the physical examination is essential for patient evaluation and determination of functional impairments, dedicated material for teaching both in-person and virtual examinations is an area for focused improvement.

Another shortcoming of the curriculum design was the inability of virtual students to independently access the electronic medical record and therefore limited their potential contributions during rounds or in the outpatient clinic. Access could not be granted through our institution, given the remote nature. Secure and practical ways for students to access the electronic medical record during virtual rotations to create more engaging educational experiences are a potential area of collaboration between institutional information technology professionals, security professionals, and educators.

## CONCLUSIONS

The COVID-19 pandemic has accelerated a paradigm shift in medical education, spurring many teaching centers to assemble virtual curricula quickly, connecting students with faculty and patients, despite distant locations. Psychiatrists must continue to embrace new technological developments to adapt to this new world of virtual learning in the wake of COVID-19. Not all aspects of a classical clerkship are easy to replicate in a virtual format, and the limitations discussed represent challenges and opportunities for growth. Newly created virtual clinical rotations have the potential for a lasting effect on the accessibility and exposure for physicians in training. This is particularly relevant in specialties where limitations already exist regarding exposure, including psychiatry. As leaders in adaptation, psychiatry as a field must continue to be a leader in educational innovations. Whether for PM&R applicants or other students, developing an engaging and rewarding curriculum for virtual rotations will enhance both clinical practice and the training of future physicians. This innovative virtual PM&R elective provides a strong foundation for continued psychiatric education both during the pandemic and beyond and will help grow the specialty's presence in an increasingly virtual world.

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