



Challenges and Opportunities of Preclinical Medical Education: COVID-19 Crisis and Beyond

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Abstract

COVID-19 pandemic has disrupted face-to-face teaching in medical schools globally. The use of remote learning as an emergency measure has affected students, faculty, support staff, and administrators. The aim of this narrative review paper is to examine the challenges and opportunities faced by medical schools in implementing remote learning for basic science teaching in response to the COVID-19 crisis. We searched relevant literature in PubMed, Scopus, and Google Scholar using specific keywords, e.g., “COVID-19 pandemic,” “preclinical medical education,” “online learning,” “remote learning,” “challenges,” and “opportunities.” The pandemic has posed several challenges to premedical education (e.g., suspension of face-to-face teaching, lack of cadaveric dissections, and practical/laboratory sessions) but has provided many opportunities as well, such as the incorporation of online learning in the curriculum and upskilling and reskilling in new technologies. To date, many medical schools have successfully transitioned their educational environment to emergency remote teaching and assessments. During COVID-19 crisis, the preclinical phase of medical curricula has successfully introduced the novel culture of “online home learning” using technology-oriented innovations, which may extend to post-COVID era to maintain teaching and learning in medical education. However, the lack of hands-on training in the preclinical years may have serious implications on the training of the current cohort of students, and they may struggle later in the clinical years. The use of emergent technology (e.g., artificial intelligence for adaptive learning, virtual simulation, and telehealth) for education is most likely to be indispensable components of the transformative change and post-COVID medical education.

Keywords COVID-19 pandemic · Preclinical medical education · Online learning · Remote learning · Challenges · Opportunities

Introduction

The COVID-19 pandemic required a massive and rapid change in the way we deliver medical education, particularly to the junior years of the medical program. [1]

The global COVID-19 pandemic impacted every sphere of human life including medical education, resulting in the suspension of face-to-face teaching in medical schools across the world [2, 3]. Medical schools have adopted several innovative strategies in response to the crisis, with shift to online learning and assessment [4]. However, medical schools are currently facing the biggest challenge, “training medical students within limitations of social distancing” especially in the preclinical phase due to suspension of practical/lab sessions. The British model of MBBS curriculum is split into preclinical and clinical phases; the initial 3 years are preclinical years dealing with basic science subjects, i.e., anatomy, physiology, biochemistry, pharmacology, microbiology, and pathology. Preclinical phase plays a very crucial role in shaping up scientifically grounded and clinically competent physicians [5, 6].

Before the outbreak of COVID-19, blended learning was highly recommended for preclinical years using active learning strategies which were found to be more effective learning

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experiences [1, 5, 6]. Online learning emerged as a sole option to continue the semester during lockdown and social distancing era. Implementation of a well-structured “blended” pre-clinical curriculum with integration of knowledge and skills to prepare a better trained doctor is highly recommended.

We searched relevant literature in PubMed, Scopus, and Google Scholar using specific keywords, e.g., “COVID-19 pandemic,” “preclinical medical education,” “online learning,” “remote learning,” “challenges,” and “opportunities.” Original studies, reviews, editorials, commentaries, perspectives, short or special communications, and policy papers on COVID-19 pandemic were reviewed. Information from websites of different medical schools, universities, professional associations, and international or national organizations were extracted. Reference lists from retrieved articles were also examined manually for relevant information.

Preclinical curriculum is considered the “foundation” and “core component” for clinical education and allows students to learn basic sciences. Learning in-depth mastery of the pre-clinical knowledge is necessary to prepare tomorrow’s doctors for the scientific advances that are rapidly changing the perspective of medical practice. Preclinical curriculum utilizes didactic lectures with practical-oriented, laboratory-based hands-on training [5–7]. However, in recent years, preclinical faculty has been facing the reduction of contact hours with the introduction of integrated curriculum and limited resources [5–8]. To accommodate the transition from regional to systemic integration in anatomy, preclinical education in the last few decades observed a slow transition from didactic, lecture-based classroom teaching to small group sessions, problem-based learning, team-based learning, and flipped lectures [5–9]. Introduction of these new teaching strategies makes learning more active, student-centered, engaging, creative, effective, and enjoyable [8]. New strategies are emerging in the preclinical phase that integrates technology to make learning effective and appealing to students, [7–9], making them more relevant and applicable for remote learning during the current COVID-19 pandemic. These strategies proved very useful in the current COVID-19 crisis, and medical students appreciated synchronized online learning, especially preclinical students [10].

Medical education in the last two decades has seen the extensive implementation of evidence-based teaching with the adaptation of new learning strategies supported by digital technology [7–11]. Technology-based medical curriculum was found to be more effective than the traditional approach and was well-received by medical fraternities [7–12]. Digital approaches transformed medical education to achieve higher levels of knowledge and skills through competency-based education with the application of adult learning theory [7–9, 12]. In this unprecedented and unforeseen circumstance raised by COVID-19, online learning may be the only way to continue teaching basic sciences during post-COVID-19.

Impact, Challenges, and Opportunities of COVID-19 on Preclinical Medical Education

We will need to develop new and enduring ways to support medical students who may be scarred by this pandemic. [13]

The effect of current pandemic has an enduring transformation on medical education and is likely to have long-lasting repercussions on student learning. The academic leadership has been placed under tremendous pressure in terms of delivery, access, and assessment of courses; [1–4, 11–17] while simultaneously preserving the principles of integrity, equity and inclusiveness, fairness, ethics, and safety [18]. The unprecedented use of online pedagogy as an emergency measure during COVID-19 period, with an adaptation to the “new normal” to deliver preclinical medical education, has brought both challenges and opportunities to medical education [16, 19–22]. The main impediments to providing online learning include lack of reliable network infrastructure (hardware and software, network bandwidth) and compatible online platforms that work with existing learning management system (LMS) [1, 2, 4, 13–16]. Other challenges included shortage of competent IT personnel to extend technical support, zoom-bombing/cyberattacks on online platforms, increased cost (schools, students, and faculty), time constraints, poor computer technical skills of faculty and students, inadequate infrastructure and resources, and absence of institutional policies, which will pose real challenges for low- and middle-income countries [1, 2, 4, 13–16].

The transition from on-campus medical school settings to home environments results in isolation, stress, lack of concentration, reduced interaction with peers, and disturbance caused by family affairs [1, 2, 4, 13, 14]. Sudden transition from classroom to home learning affected the performance of students and faculty. Adaptability to home learning would be a challenging task [4, 13, 14, 16]. Moreover, students would lose access to dissection rooms and practical labs, prosections, models, pathology specimens, skeletons, and other lab- or practical-based materials and equipment [1, 13, 16, 19–21]. This is worrying because the medical curriculum has already shortened the basic medical sciences teaching time and limited students’ exposure to anatomy and other important foundation subjects of the medical program [7–9].

Very short notice transitioning of the teaching community from face-to-face to online teaching with limited and in some cases no prior exposure has been a real challenge for preclinical faculty. This resulted in a struggle to find “a best-suited medium” for teaching anatomy and other basic sciences [1, 2, 4, 13–17]. The current situation also raised concerns regarding unlimited amount of time spent in front of the computer

screen, lack of social interaction, and lack of real-life verbal and nonverbal communication which could result in a passive form of learning [3, 14, 16, 19–22]. Moreover, facial expression and voice would be compromised in online teaching to some extent. Online learning will minimize the chances of building a better mentoring relationship between faculty and students as well. The lack of hands-on training in the preclinical years may have serious implications on the training of the current cohort of preclinical students, and they may struggle later in the clinical years [4, 19–22]. It is well established that clerking patients cannot be replaced by online learning as “clinical experience and human interaction are extremely important for the practice of medicine” and online learning cannot completely replace in-person live sessions [10]. Clinical students can be benefited when teaching is supplemented by virtual simulations and computer-based models [10, 23].

To create a conducive learning environment (Internet access, dedicated space) to deliver a “forced home learning” has also been a challenge for both staff and students [1, 11, 13–15]. Physical (e.g., lack of social interaction and outdoor activity) and psychological wellbeing of both students and staff is of great concern [13–15, 24]. The preparation of online assessments and training for various online platforms has been a struggle for faculty as well as students [1, 16, 17, 24]. Furthermore, unproctored online assessments may encourage students towards academic misconduct or dishonesty, i.e., plagiarism and cheating, [25, 26] which may “severely affect the knowledge and conduct of future doctors and therefore the quality of healthcare” [27].

While COVID-19 has thrown many challenges for preclinical medical education, it has also created opportunities—academic leaders with servant leadership, distribution of leadership responsibilities, and clear lines of communication dealt with the situation aptly [1, 16–19]. During this challenging time, the academic leadership presented guidelines/protocols to conduct course delivery and assessment in a remote environment which were found to be helpful for students and staff [16–19]. Medical schools and faculty utilized novel methods of delivering education, which need to be adopted much earlier to teach “adult learners” [28, 29]. Online delivery of courses has the potential to enhance student engagement, geographical accessibility, and synchronous/asynchronous learning and assessment [12, 18, 19, 24, 29].

Medical educators worldwide are trying to learn from experiences of innovative schools and developing survival packages for their medical schools. Many medical schools have worked to transform pedagogy by increasing online lectures of basic medical sciences, using technology to replace and enhance basic sciences and laboratory teaching, and implementing online formative and summative assessments [14–16, 18–22]. Online lectures, flipped

lectures, videos, virtual simulators, webcasting, online chatrooms, and other technologies and simulation-based teaching modalities have been used to teach preclinical courses [18–22, 25, 28]. Small group teaching in virtual team settings are found to be effective, even for some laboratory science and practical training contents [22, 28]. For example, a recent study showed that fourteen medical schools in the UK and Republic of Ireland used technology to teach and assess anatomy in medical students (Table 1) [16]. Medical schools in Australia and New Zealand used diverse platforms/policies for the delivery of online lectures and active learning (asynchronous/synchronous, discussion boards, prerecorded lectures, and feedback), practical sessions (asynchronous/synchronous), and online assessments (random Q&A, modified weighting, pass/fail, and team exams) [19]. Imperial College London’s first-ever online exam by open-book examination (OBE) approach, for final years, has proven successful [30, 31]. Many medical schools have adopted similar approaches to engage students with their studies. All these positive impacts will certainly provide “an initial insight into new and innovative ways of delivering medical education,” especially in preclinical phase during the post-COVID era [19–22, 28].

The pandemic has provided opportunities for staff to acquire skills in online pedagogy and digital media production while developing alternative modes of assessments and transferring principles of learning [16–18, 21, 24, 25]. Online learning during COVID-19 received positive students’ feedback with “an extremely high level of satisfaction and engagement with online learning activities”¹ and brought a psychological resilience among staff and students [1, 32, 33]. This is an opportunity for the academic sector to converge, strengthen connections across countries and continents, and collaborate.

Medical schools, regulatory bodies, and other stakeholders have a responsibility to ensure that tomorrow’s doctors are “sufficiently trained and supported to deliver essential patient care, even in crises” [34]. Medical educators should “learn from this experience and prioritize a forward-thinking and scholarly approach” to implement best practices and flexible approaches adopted in medical education around the world for an effective transition to online learning and assessment [14]. As pandemic exposed the “flaws” in medical education and healthcare, medical educators should review curriculum using the “bioscientific model of health” and widen the educational approach by incorporating determinants of health (behavioral, social, and environmental factors) [35]. Medical curriculum should include “surveillance for disease, investment in disease and injury prevention, and disaster planning” as core components [35]. We must remain optimistic as the medical education fraternity has accepted that “transition is inevitable” and has already started preparing to ensure that “transition can be smooth through resilient educational systems” [36].

Table 1 Emergency online anatomy learning and assessment in the UK and Republic of Ireland in response to the COVID-19 pandemic [16]

Lectures	Practical	Assessment
<ul style="list-style-type: none"> •Virtual learning environment: recorded presentations and accompanying audio •Live sessions and tutorials via platforms (Zoom, Collaborate Ultra, BigBlueButton) 	<ul style="list-style-type: none"> •Digitized cadaveric resource only •3D virtual resource only •Both cadaveric and 3D virtual resources 	<ul style="list-style-type: none"> •Practical summative <ul style="list-style-type: none"> - Digital spotter •Written summative <ul style="list-style-type: none"> - Online MCQ, EMQ, SAQ, SBA - Online open book

MCQs multiple-choice questions, *EMQs* extending matching questions, *SAQs* single-answer questions, *SBA*s single-best-answers

Conclusion

We are waiting to see what ingenuities for medical education will emerge in the face of the COVID-19 pandemic [37].

Basic or preclinical sciences are considered the foundation of medical practice. The COVID-19 pandemic has impacted medical education globally. COVID-19 has disrupted medical education and forced basic science teaching to rapidly adapt to changes which will pose unique challenges to the clerkship training. The preclinical medical curricula have seen the introduction of novel methods of delivering education online, and online classes received positive responses from students and faculty. The use of remote learning as an emergency measure has brought both challenges and opportunities for many medical schools worldwide affecting faculty, students, and administrative and support staff. However, the lack of hands-on training in the preclinical years may have serious implications on the training of the current cohort of students, and they may struggle later in the clinical years. Medical educationists need to adopt a “forward-thinking and scholarly approach” with curricular innovations to train future medical graduates during and after the pandemic [14]. To make an online learning package beneficial, it needs to be “suitably integrated into curriculum design” to “guide students through a learning journey, rather than simply made available as another resource” [20]. Moreover, technology-based teaching modalities must be evaluated for effectiveness and sustainability for application in the preclinical settings. Appropriate attention must be paid to pedagogical requirements of online learning as well as providing face-to-face clinical training so that students can develop required competencies to practice medicine.

Future Directions

If the higher education sector believes that digital education should replace contact teaching and learning, it

runs the risk of producing highly qualified people with severely underdeveloped human or social skills. They will just be robots [38]. (Dr. Sizwe Mabizela, vice-chancellor of Rhodes University in South Africa)

Terry Hartle, Vice-President of the American Council on Education, mentioned the pandemic as an “epochal event” which will “leave a huge impression on the education sector” [39]. McCullough et al. [40] also warned: “The COVID-19 pandemic will not be the last major infectious disease that puts learners at risk.” However, many medical schools have successfully transitioned their teaching and learning environment to emergency remote learning, having monitored and examined student and staff readiness, and completed online formative and summative exams both in preclinical and clinical years. While bringing closure to the turmoil academic year 2019–2020, medical schools are now making final preparations for the start of the new academic year and carefully monitoring national and international COVID-19 environments. Due to the COVID-19 pandemic, online learning has been expanding as a relatively new concept in medical education. Implications for educators now include increased responsibility; a need to alter teaching style, curriculum planning, and assessment strategies; more meaningful and continuous communication; and better preparedness to not only challenge learners of the digital age [1, 2, 14, 33, 34, 41] but also to obtain “deeper learning” and “apply knowledge in the clinical context” [22]. However, due to the “immersive nature of medical education,” medical educators should find innovative ways to have face-to-face teaching alongside online delivery [11]. Novel and authentic assessment strategies are required where students can develop a set of graduate attributes or “soft skills” (e.g., communication skills, reflective practice, group work, and collaboration) and demonstrate understanding and application of the relevant basic science knowledge required for clinical phase [11]. And, further design of quality assurance strategies that will monitor the online delivery of curriculum and assessment is also crucial.

During and after this pandemic, extensive research is required to examine the effectiveness of superimposed online pedagogy and indicators such as students’ academic performance, their mental health, and teaching transferable graduate

skills. The use of emergent technology for education, such as artificial intelligence for adaptive learning, virtual simulation, and telehealth, are most likely to be essential components of the transformative change and the future of medical education, including clinical training [2].

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Compliance with Ethical Standards

Other Disclosures None.

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Abbreviations *COVID 19*, coronavirus disease of 2019; *MBBS*, Bachelor of Medicine Bachelor of Surgery; *LMS*, learning management system; *IT*, Information Technology; *UK*, United Kingdom; *Q&A*, question and answer; *MCQs*, multiple-choice questions; *EMQs*, extending matching questions; *SAQs*, single-answer questions; *SBA*s, single-best-answers

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