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Unveiling the Uncertainty-Revolutionizing Medical Education in COVID-19 Era

Rabeeya Saeed, Salman Sharif and Faridah Amin

Abstract

The beginning of the year 2020 marked the biggest pandemic of the twenty-first century. COVID-19 not only jeopardized the global health care system but also led to unprecedented effects on every aspect of life. The tragedy evoked by the virus, resulted in disruption of face-to-face learning across the globe. The aftermath of this pandemic on medical education will be enormous and long-lasting. Therefore, it is of utmost importance to identify the challenges and threats facing medical education, both at undergraduate and postgraduate level. Comparative analysis of the innovative models adapted globally in post-COVID era will help countries learn from success stories. Amidst the uncertainty posed by the pandemic, there is a special prospect for medical education. Medical educationist and health policy makers may convert this crisis into opportunity through innovative strategies maximizing the outcome of e-learning. This is the time to relook medical curricula, redesign assessment, focus on standardization of e-learning and upgrade faculty development programs to produce doctors equipped and prepared to serve in the new era.

Keywords: COVID-19, medical education, virtual learning, E-learning, training during COVID, undergraduate, postgraduate

1. Introduction

The beginning of the year 2020 marked the biggest pandemic of twenty-first century. COVID-19 not only jeopardized the global health care system but also led to unprecedented effects on every aspect of human life. The tragedy evoked by the virus, resulted in disruption of the face-to-face learning across the globe. Amidst the uncertainty, fear and crisis situation faced by the world the whole learning cycle came to a halt, till the stakeholders proposed innovative strategies of online learning in medical education. Though blended learning was in vogue in pre COVID times, but the sole dependence on online learning in the “New normal” phase has raised questions. Clinical and soft skills teaching is widely accepted to be best taught through physical interaction with patients. Even for undergraduate pre-clinical years, teaching of basic sciences requires performing procedures and demonstration in the skill laboratory, which was also disrupted due to social restriction.

This chapter gives an in-depth understanding of the impact of the COVID-19 pandemic on transforming medical education and the challenges faced by medical education, both at undergraduate and postgraduate level. It also elaborates how

countries all over the world embraced this challenge, recognized the opportunities and responded to the crisis by ongoing waves and variants of COVID-19. Amidst the uncertainty posed by the pandemic there is still hope. The tremendous opportunity of innovative advancement in technology along with sensible decisions to adopt learning, need to be aligned to survive in the “new normal” world.

2. The knee-jerk response to pandemic

The COVID-19 pandemic that has affected almost 221,134,742 people around the world and has claimed 4,574,089 lives, evoked huge fear and uncertainty among people all over the world [1].

The novelty of the situation, uncertainty and limited research on the clinical course of the virus forced policy makers to rush towards difficult decisions. This led to stopping or slowing down academic and nonacademic activities until the world started adopting the best evidence-based recommendations to deal with the catastrophe.

2.1 A hiatus in medical education

Soon after official declaration of pandemic by World health organization (WHO), almost 182 countries in the world closed their educational institutions in response to the regulatory bodies' decision on social distancing and lockdown [2, 3]. Medical schools and universities faced dual challenges; first to respond to the clinical and administrative demands, in order to prevent the health care system from collapsing; second was to maintain an effective educational system in order to produce doctors with strong foundation of patient care. In March 2020, the Association of American Medical Colleges (AAMC), released their guidelines for immediate disruption of all clinical rotations till they get further enlightenment and preparedness to handle the situation [4]. Italy has faced the worst situation of COVID-19, with almost 4,574,787 cases reported till September 2021 [5]. At the onset of pandemic, their government responded by immediate suspension of all in-campus learning at medical schools [6]. The example of US, UK, Italy and China was followed by developing countries. Though the numbers of cases affected by the virus were comparatively lower in these countries; however, considering the dreadful situation of the developed world, the underprivileged nations were not ready to risk testing their health care system. In India, Pakistan and Bangladesh, all face-to-face educational activities and clinical rotations were suspended after implementation of a nationwide lockdown [7]. The rationale behind these decisions was to conserve the resources including personal protective equipment for front line workers; minimize exposure of health care professionals, protect well-being of students and their families and prevent the already fragile health care system from further declining.

2.2 Fast tracking medical graduates into health care system

Uncertainty lead to halting of the education system in early 2020, hence there was an urgent need to develop an alternative system to enhance capacity. With a case fatality rate of 12.6% and total reported fatalities of 17, 600, Italian government responded in the most urgent manner by taking tough decisions regarding Medical education [8]. The 'Cura Italia' decree passed on 17th March 2020, revolutionized the rules of Italian Medical board examination [8]. According to this decree almost 10,000 medical graduates were given license to practice without taking post

graduate examination at the end of their practical training. In other words, this change lead to graduates joining the health care system almost nine months earlier than they would otherwise have done in the pre-COVID era. A 10.3% increase in hospital doctors, was anticipated through its implementation to provide services and support departments or intensive care units (ICUs) dedicated to COVID-19 Care [8]. Exemption from medical licensing exam puts an additional bar on the system to evaluate their medical practices, the impact of which is yet to be seen in the coming years.

This practice of introducing young medical graduates in clinical practice, was followed by other countries including US, Ireland and UK, where health care system needed a boost [9].

3. Lack of pandemic preparedness: an identified gap in medical education

While pushing fresh medical graduates to enter into health care system may be beneficial to handle the pandemic, the risks needs to be recognized.

Due to uncertainty and the absence of defined roles in this calamity, the role of students varied across different institutions around the world. While some universities did not allow contact with patients, others deployed final year students or fresh graduates as frontline workers in COVID ICUs and emergencies [10, 11]. In a conventional medical education system, the graduates are gradually introduced to clinical practice in a controlled and supervised learning environment. During clinical rotations their work is mostly passive, shadowing consultants during ward rounds, taking history and observation of clinical procedures. This structure creates a stable learning environment, but it does not necessarily prepare students to function with appropriate level of confidence and skills in a system under crisis. A study conducted among medical students in Ireland found that majority of students (75%) were not confident about their skills for working in an emergency setting [12]. Pre-assessment for an elective on disaster preparedness found 70% participants unprepared to work in an emergency however, this number reduced to 11% after training [13].

Inclusion of students in the health care system without necessary preparation or training can be a serious risk for patients, other colleagues and for themselves. This has been explored in various researches in which students did not have sufficient information to make appropriate clinical decisions in their work setting [14].

The presence of such student volunteers or physician assistants can actually overburden the system capacity and compromise quality of patient care. They can act as vector for virus transmission, deplete resources like personal protective equipment and overstrain teaching faculty or clinicians whose resilience was already at stake in this extraordinary situation [15]. However the balance would still be fluctuating between the duality of providing adequate manpower to the health care system and risk of managing the system with unprepared workforce. A careful and ongoing risk benefit analysis as per situation country wise would lead to practical solutions to overcome this challenge.

4. Vulnerability of medical students and trainees to mental health problems

Implementation of unaccustomed public health interventions like social distancing and lockdown, fear and stigma due to COVID-19, closures of medical colleges, anxiety

from suspension of clinical training and rotations, apprehension about well-being of older relatives and the abrupt switch to the 'New normal' life had a negative impact on psychological health of medical students [16].

The complexity of this challenge is thoroughly evaluated by researchers all over the world. Available evidence suggest that even in pre-COVID times, the mental health of medical students was at a greater risk as compared to the general population [17]. Moreover, graduates and medical students are recognized as vulnerable strata with a high frequency of suicidal ideation and death by suicide. The results of a recent meta-analysis found suicidal ideation to be more prevalent among medical students as compared to qualified doctors [18].

Data from Turkey, Iran, India and European countries like Malta suggest a high prevalence of depression and anxiety in medical students during COVID-19 pandemic [19–23]. However prevalence of anxiety in medical students is found to be similar to pre-pandemic era according to the results of a recent meta-analysis. Sleep deterioration and decreased appetite was commonly reported symptoms [22, 23].

In contrast to stay at home orders, rapid inclusion of recent graduates or final year students in health care system put an additional challenge, the effect of which is yet to be evaluated [24]. Though many students showed great motivation to volunteer their services, however for many the experience was dreadful and altruism alone cannot justify this rapid transition to work. A recent research conducted on post-graduate trainees identified anxiety, stress and feeling of helplessness while working in a pandemic [25]. Moreover, disruption of training caused by cancelation of elective rotations, procedures or teaching sessions by supervising faculty could be strong predictors of evoking uncertainty regarding their future career.

5. Impact on postgraduate clinical training

Transition to post graduate medical education has been a real challenge for young graduates in COVID era. The suspension of clinical rotations, cancelation of distant electives, travel restriction in between countries pose a serious challenge for students to explore their areas of interest [25]. Moreover, cancelation of elective procedures and disruption of outpatient clinics resulted in patchy clinical exposure with patients [26]. Adequate clinical exposure to the specialty of interest at undergraduate level is vital for future career selection [27]. Restrictions on clinical rotation reduced students' physical interaction with mentors who could have positively influenced their choice of career [28].

Fewer opportunities and lack of meaningful recommendations due to cancelation of distant rotation may create negative influence on student's morale affecting their progress. This can also make the selection process challenging for program directors relying on less reliable characteristics, such as medical school reputation [29].

5.1 Uncertain competence level of postgraduate medical trainees

This evolving setting does not only create more uncertainty among medical students about their future career but also generates doubts among post graduate trainees regarding their competence at the end of a compromised training tenure. As the pendulum of health care shifted towards addressing a crisis situation, limited attention was given to other non COVID health conditions resulting in reduced patient volume in elective clinic setting [30], thus minimizing the necessary exposure required for training.

6. Emergence of technology enhanced medical education (TEME)

As the pandemic unfolded, academic leaders came under immense pressure to adapt and bring innovation in curriculum, learning strategies and assessments [31]. Though technology enhanced medical education or the concept of e-learning was not a novel concept even in pre-COVID era [32], however as an immediate response to the national lockdown, the teaching pivot shifted to online delivery. An abrupt transition from face-to-face learning to online pedagogy challenged principles of integrity, fairness and equity in medical education. Yet, considering safety of medical students and faculty as the priority, the new change was unanimously accepted around the world [31, 33].

6.1 Medical education with no geographical restriction

During COVID pandemic TEME was adopted as a learning process for both pre-clinical and clinical sciences. With social distancing as a new norm, the concept of traditional class room now seemed like a fairy tale (**Figure 1**).

For basic sciences subject, lectures were delivered through communication softwares like Zoom and Google meet up for synchronous meeting. Online demonstration of procedures was also implemented through virtual labs [35–38].

For discussion on clinical cases and interpretation of diagnostic tests, hybrid models employing asynchronous and synchronous sessions were used [39, 40]. Many schools used to broad cast their study reading material before the flipped class online sessions, making students learn through interactive exercises on virtual patients [41]. Few medical school in Italy utilized video tele-consultation with simulated patients to mimic the clinical experience [6].

6.2 Hurdles on the road to innovation

The paradigm shift to virtual learning brought many impediments. The world was not ready for this unprecedented intervention in medical education. Various studies conducted globally identified numerous challenges [6, 42–46] as depicted in **Table 1**. These are particularly exaggerated in developing countries, where barriers including lack of infrastructure, technological resources, financial constraints and

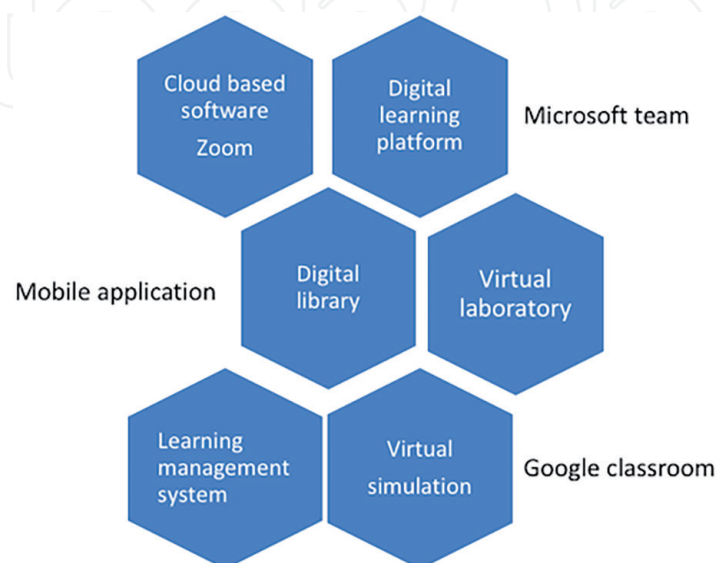


Figure 1.
E-resources used for medical education during COVID-19 pandemic [34].

| | Factors | Challenges |
|-----|--|--|
| 1. | Time management | <ul style="list-style-type: none"> • Time consuming content preparation • Short notice transition to online pedagogy • Time allocation for learning software |
| 2. | Infrastructure defects and problems | <ul style="list-style-type: none"> • Internet connectivity issues • Lack of availability of compatible software • Non-availability of hardware resources • Problems with uploading contents • Problems with downloading information |
| 3. | Inadequate student teacher interaction | <ul style="list-style-type: none"> • Passive participation by students • Compromised clinical teaching due to no patient interaction • Risk of one sided discussion |
| 4. | Noncompliance with virtual class room etiquettes | <ul style="list-style-type: none"> • Informal attire and attitude of students towards teaching • Disturbance in home environment • Lack of students' commitment to punctuality and attendance • Unfamiliarity with virtual class room rules |
| 5. | Technophobia | <ul style="list-style-type: none"> • Fear and resistance to use technological tools by experienced and senior teaching faculty and staff |
| 6. | Electronic literacy of teaching faculty | <ul style="list-style-type: none"> • Teaching faculty with low level of virtual literacy • Need of assistance by the administration for installing and running soft ware |
| 7. | Students adaptability | <ul style="list-style-type: none"> • Lack of preparedness by students to adapt to this rapid change • Lack of familiarity with software • Doubts regarding effectiveness of online learning model |
| 8. | Lack of human interaction | <ul style="list-style-type: none"> • Less patient interaction • Lack of social interaction with friends, colleagues and teachers |
| 9. | Ergonomics | <ul style="list-style-type: none"> • Neck and back problems due to inappropriate posture • Excessive strain on eyes due to prolonged screen time |
| 10. | Formative and summative assessments | <ul style="list-style-type: none"> • Designing high taxonomy level questions for open book exam • Need to rethink distant mechanisms of individual assessment • Thinking alternative method for OSCE/practical exam |
| 11. | Learning by role modeling | <ul style="list-style-type: none"> • Lack of interaction with mentors and faculty • Reduce chances of learning professionalism, ethics and communications skills through role models |

Table 1.
Challenges of technology enhanced medical education (TEME) in COVID pandemic [6, 47–49].

a fragile health care system imposed friction towards smooth transition to a digital system for medical education [7].

6.2.1 Challenges faced by medical teachers and staff

Developing online lectures is more time consuming as compared to face-to-face sessions. Faculty with limited or a complete lack of digital-learning skills, faced immense stress during this rapid transition phase [45, 50].

In their struggle to adapt to the new system, most of the medical faculty overlooked the fact that virtual learning material is different from face-to-face sessions. In the

absence of well-established guidelines and standardization procedure for e-learning, the outcome was dubious [47].

6.2.2 Availability of infrastructure for e-learning

Lack of reliable infrastructure for delivery of online education was one of the widely reported challenges especially in developing countries. Various studies reported lack of compatible software, hardware and internet connectivity issues as major barriers towards e-learning [51].

6.2.3 Lack of social interaction

The new learning model demanded an unlimited duration of time spent in front of computers. Lack of personal touch and real life interaction may promote a passive learning style, the impact of which is yet to be explored [51]. Online teaching can also compromise one to one interaction with mentors. Yet, it is too early to extrapolate outcomes till we get sufficient evidence.

Various studies reported isolation, stress, lack of concentration and disturbance by domestic affairs as major factors, compromising online learning in home environment [47].

6.2.4 Adaptability by students to new learning environment

For students of basic sciences, transition to online learning would mean confinement to home. Modifying this new learning environment to make it conducive for e-learning was a real challenge [51].

6.2.5 Dependency of medical education on clinical facilities and clinical educators

The concept of online learning cannot replace real-time patient interaction and clinical experience which are deeply ingrained, foundation and unique attributes of medical curriculum. Limited (and in some cases none) exposure to clinical teaching raised concerns regarding the competence and skills of final year students, interns and post-graduate trainees who could not get the required clinical experience. Real-life counseling, history taking and examination skills cannot be performed online. Moreover ethics, professionalism and other soft skills are learnt through role modeling for which physical interaction is essential. Though opportunities to provide clinical clerkship through virtual experience were being explored, the idea was not sufficiently imbibed by medical students. In Libya, a study showed 53% of the students expressed their disagreement for this approach.

6.2.6 Virtual assessments

Just like getting clinical experience online is difficult, assessment of psychomotor and affective domain through clinical examinations or objective structured clinical examination (OSCE) is challenging. Almost 25% medical schools in UK canceled clinical examinations [48]. This led to a negative impact on preparedness of medical students, as depicted in the survey conducted in UK [52]. While online synchronous and asynchronous methods were widely practiced for teaching and learning, however academic leaders started to brainstorm on the modalities that can be adapted for online assessment. Yet, it is an exhausting task to reinvent assessment modalities, reliable enough to safeguard against the use of unfair means, yet valid enough to produce safe doctors.

7. The silver lining in pandemic- success stories

As quoted by Albert Einstein “In the midst of every crises, lies great opportunity”. COVID-19 pandemic is not an exception. It has brought immense opportunities for medical educators and leaders to explore innovative strategies and drive advancement into the new model of medical education and training (**Figure 2**).

7.1 Revamping medical curricula

This pandemic identified huge gaps in medical education driving rapid modifications in the existing curricula. Some schools realized the importance to expand their courses of community medicine, digital and public health [6]. Schools in Italy, UK, US organized webinars on resilience, self-regulation, disaster preparedness and mental wellbeing [6, 7]. All such efforts would prepare future doctors to develop necessary soft skills and core competence to face the world which was on its knees in response to this disaster.

7.2 Rethinking assessments in medical education

7.2.1 Open book examination

Due to inadequate capacity to organize in-person examinations with social distancing protocols, open book examination (OBE) emerged as an assessment tool in medical education during the pandemic. First successful model of distant online assessment was pioneered by Imperial college of London [53]. Medical students were given 150 scenario based questions with findings from history and examination in which they had to answer regarding diagnosis and management. Randomizing the question order for each student was used as an effective tool to safeguard against cheating. Exposing them to time pressure (approximately 60 seconds per question), minimized chances to search intensively for the answer [54]. OBEs in contrast to conventional examination discourage rote and knowledge recall during assessments. These exams closely mimic actual clinical practice where such information can easily be retrieved from available resources in hospital. OBEs have therefore emerged as a practical assessment modality during the pandemic. As assessment drives learning, this kind of assessment will allow students to study in

| Pre COVID era | Post COVID-19 era |
|--|--|
| Lectures Small group discussion | Online synchronous/asynchronous session Video clips, breakout rooms |
| Basic sciences practical labs(anatomy, Biochemistry) | Online Virtual labs Dividing students into small groups, using PPEs |
| Soft skills and medical humanity | Live online group discussion Video clips |
| Clinical training | Tele medicine with simulated real life patient Short time exposure in wards with PPEs Virtual rounds |

Figure 2. Transformation of learning strategies in medical education during COVID-19 pandemic [49].

a way more aligned to real life clinical practice. Written OBE will allow more analytical thinking, evidence based practice and application of knowledge using multiple resources promoting students to be self-directed learners. This type of assessment also minimized anxiety among medical students taking exam while sitting in a home environment [55, 56].

7.2.2 Online proctoring

Another success story of conducting successful online examination was from a developing country in which they designed an online proctored approach to monitor a group of students at their home by teaching assistants and faculty [57]. The structure of questions and allocation of time were specifically designed in a way to encourage students to utilize their problem solving abilities rather than copy pasting the answers.

7.2.3 Online OSCE, quiz and viva

Another example of accelerated innovation likely to be introduced soon for final year assessments by Imperial College of London is remote OSCE. This will include history taking of a real or simulated patient through video conferencing and display of examination findings on screen to have a complete clinical picture [53].

7.2.4 Establishing continuum of assessment

More focus is now being given to develop an assessment process comprising of ongoing formative rather than summative evaluation at the end of academic year. Assignments which need to be submitted within a stipulated time period; e-log books, portfolios, reflective diaries are being considered both for formative and summative assessment [58, 59].

7.3 Can clinical posting be done virtually?

An important aspect of medical education is patient interaction through clinical postings. At the beginning of the pandemic, this was considered non-resolving challenge, since clinical rotations cannot be replaced by distant virtual learning. However with the threat of second, third and fourth wave and emergence of various variants, much has been done to address this issue as well. Imperial College London created an online bank of patient interviews and interactive cases to supplement clinical study. Many university hospitals are piloting the concept of virtual bedside teaching to avoid overcrowding of clinical areas. Clinicians through the use of specially designed headsets provide feedback to students regarding patient examination findings. However, its feasibility on a larger scale across countries still needs to be explored further [53].

Mayo clinic used the tele-consultation through zoom meetings or video conferences to allow direct patient interaction with students [60]. Such adaptation can be fruitful to cover short term disruption of clinical teaching during peak of COVID waves, however it is hard to believe that it is as effective as learning through physical interaction.

A study conducted in US reported positive feedback of medical students doing clerkship in Emergency Medicine [61]. The students were involved in follow-up care of patients through zoom meetings, conducted under direct supervision of faculty preceptors. They felt more involved and valued the opportunity of engaging with the faculty for critical thinking.

7.4 Positive perception of online teaching by medical students

Overall, a positive perception of online learning has been reported by medical students. Some studies show that these remote sessions lead to better attendance as compared to in-person. This could be due to the ease and convenience to access online classes at home, minimizing the traveling time. Another reason could be the close monitoring through digital tracking of the attendance which would otherwise be difficult in large physical sessions. Various studies found online medical education as effective or in some cases more effective than conventional learning [62]. Some of the factors reported in the literature include flexibility and convenience of online teaching, students more in control of their own learning, availability of recorded lectures, opportunities to reflect through the given material and reproducibility of educational material or sessions [3]. Even if they miss face-to-face session they can later catch up by accessing the material online. Nonetheless, students see online teaching complementing rather than complete replacement of medical education, perhaps as part of flipped or blended learning approach.

7.5 Empowering teachers for a digital world

With the dynamic circumstances emerging due to the crisis, it is of utmost importance for the faculty to upgrade their digital skills. Special training courses are being organized to empower teaching faculty and staff to use innovative learning and assessment tools in medical education.

A major barrier to adopt innovative methods of teaching was a natural preference and comfort level regarding face-to-face learning. However COVID-19 served as a fuel to drive this transformation, bringing a positive inclination towards e-learning [63].

7.6 Road to collaborative and inter-professional learning

With the online education system crossing boundaries of location and geographical constraints, new horizons for collaborative learning are arising. Global conferences, webinars and other asynchronous sessions facilitating a wider group of students, allowing students from different classes, universities or countries to get benefit from subject experts [30]. Moreover, a dire need for inter-professional education (IPE) and collaborative approach has been recognized globally, due to unequal distribution of teaching resources in developed and developing countries. Available evidence suggests that knowledge-sharing among the different professionals can lead to better patient outcomes and effective utilization of health care and learning resources [64]. Tremendous work is already underway and new avenues are being explored to deliver online IPE programs [53, 65].

7.7 Development of best practice models

As pedagogy transformed, the impact of different online teaching methodologies were studied and reported. This led to development of learning models and various frameworks were proposed to structure meaningful online interactions. One such example is the “Community of Inquiry” model which is based on the interplay of teaching, social, and cognitive presence in an online environment, for an effective learning experience [66]. Based on experience, educationists also proposed solutions and recommendations for synchronous virtual learning sessions and strategies to optimize transition from face-to-face to online medical education [67, 68]. Moreover, as online medical education evolved, based on need, prediction models

for effectiveness of online clinical clerkship curricula were also developed [69]. The experience and insight of health profession education experts therefore promoted best practices in e-learning, improving the quality of online medical education and clerkship.

8. Conclusion

The noise created by COVID-19 pandemic has produced a resonating impact on medical education which will last forever. The urgency and necessity of situation acted as a catalyst, driving a rapid transformation of learning pedagogy; a change that was bound to happen and predicted in pre-COVID era.

The global adversity stimulated academic leaders to relook medical curricula, redesign assessment, standardize e-learning and upgrade faculty development programs, producing doctors ready to serve in the modern era. This is time to convert this crisis into opportunity through innovation, maximizing the outcome of e-learning programs. The term “new normal” has been nailed in the human history making it impossible for medical education to go back to pre-COVID learning strategies. The importance of clinical clerkship, social and physical interaction still pose an ongoing challenge. Though novel teaching and learning strategies complement the conventional curriculum, medical educationists and faculty are skeptical as outcomes may make a life and death difference for the patient. Therefore, a total transformation to virtual environment for the time being seems impossible.

As the world is still recovering from the depredation of COVID-19; many will remember this contagion as a driving spur for revolutionizing medical education that was already on the road to evolution for many years.

Conflict of interest

The authors declare no conflict of interest.

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