Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

clinicians, health systems, and payers to encourage the best possible outcomes for patients.

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Challenges to medical education at a time of physical distancing

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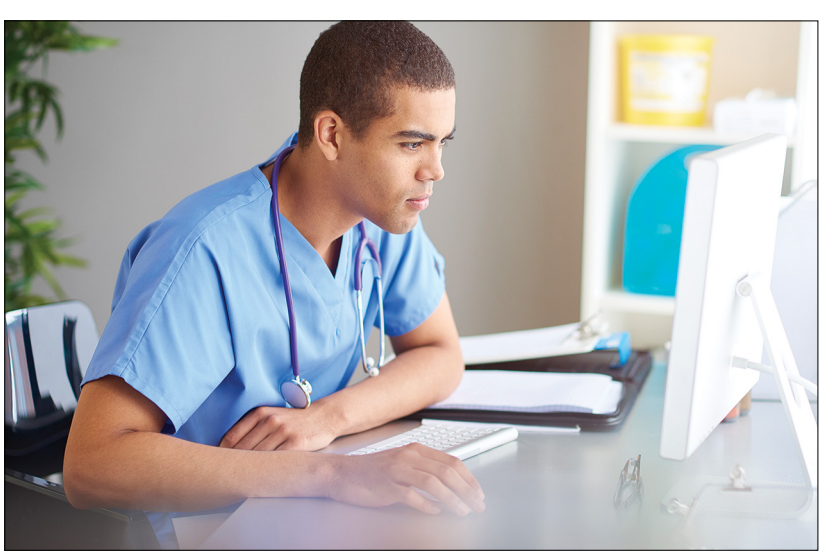
Practice-based learning is the backbone of the education of physicians. Hospitals, clinics, and community services are where future doctors learn, forge professional identities, and develop an orientation to patient-focused care that shape their practice.[1] The COVID-19 pandemic has had profound impacts on medical education globally. For almost all medical students clinical placements stopped as health-care settings focused on the care of patients with COVID-19 and teaching in classrooms and laboratories was cancelled, leaving students to continue their studies remotely.[2] Across Europe and parts of North America, thousands of senior medical students have been graduated early to provide a vital extra resource to health-care teams as part of the response to COVID-19.[3] Globally, doctors in training have had rotations modified or cancelled to maximise the capacity of health-care systems to cope with pressures from cases of COVID-19.[2,4,5] As a result, entire cohorts of students and doctors in training have missed months of educational experiences that would normally be considered fundamental in their education, training, and progression.[6,7]

As we move forwards, a "COVID-19 generation" of students and doctors must continue their education in health-care settings that are continuously adapting and responding to virus management in a world transformed by physical distancing. Although not the first infectious diseases outbreak to disrupt health-care education,



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or likely the last,[8] the global scale of the COVID-19 pandemic means there are many shared implications across the global medical education community.

Education has been affected in different ways for medical students during the pandemic. For example, in the UK and parts of Canada, there has been a coordinated effort to mobilise senior students in the workforce as paid practitioners or volunteers.[2,9] Yet most students worldwide have been confined to their homes, where they are away from university learning resources, educators, and peers and are attempting to learn medicine remotely through textbooks or online resources. Although some educators believe this removal of potentially useful contributors from clinical settings is counterintuitive, particularly in low-income and middle-income countries (LMICs), concerns for the safety of students and their potential role as vectors in the transmission of the virus have generally shaped decision making.[7,10]

Many clinical teachers have been diverted to clinical services for months and as they return to their teaching roles are faced with changing and unfamiliar requirements, such as learning to incorporate unfamiliar e-learning or virtual classrooms into their teaching and attempting to instruct in clinics and wards transformed by new infectious disease control measures.[11] As medical schools carefully reconfigure teaching, educators will need to find creative ways to deal with the challenges of missed learning and ongoing disruption while addressing the myriad issues of delivering effective education safely.[2,6] Some activities will need to be stopped or adapted, for example, lecture theatres and other crowded settings are sources of unnecessary risk and most medical schools, including our own at University College London, UK, the University of Toronto, Canada, and Addis Ababa University, Ethiopia, are switching to remote delivery of most of the large class teaching in the next academic year. However, replacing these activities with remote alternatives relies on digital resources and accessibility. In resource-poor settings and in low-income households in high-income countries (HICs), this approach could prove to be a barrier for learners and concerted efforts will be needed to ensure parity of learning opportunities for all medical students. The success of these hastily assembled and converted alternative learning activities remains to be seen.[2,11]

Beyond the university, placement-based activities will need to be adapted. In the UK, Australia, and North America, there is the growing realisation that short clerkships, joining work groups for single events, frequent movements between different health-care settings, and undertaking multiple group tasks will need to be replaced with learning in much smaller and stable social bubbles.[2,11] Longer attachments to smaller groups of health-care teams may reduce both the infection risk to, and the vector risk of, learners in the workplace. Hospital-based teaching in small, stable teams of consultants and students—what was traditionally known as "firms" in the UK—and longitudinal clerkships models may need to replace the constant rotation and movement of students through services in the pursuit of varied experiences until COVID-19 is under control.[12]

While there will be pressure to keep students away from unnecessary exposure to patients with COVID-19 and consideration will be needed about use of precious personal protective equipment, the care of these patients will probably be an important part of more senior medical students' early months and years of work. Global pandemics also remind medical schools of the importance of infectious diseases, epidemiology, public health, and health promotion in the curriculum in both HIC and LMIC settings where there has been an increasing focus on non-communicable diseases.[13] With more limited opportunities to travel and engage with educators through courses and conferences, e-learning resources and learning opportunities are currently being shared nationally and internationally in ways never previously imagined and, provided learners have sufficient internet access, this sort of engagement could have an beneficial impact on learning opportunities, particularly in low-income countries.[5]

Doctors in training have experienced a different sort of disruption to their educational opportunities, with a near total focus on service rather than learning during the peak of the pandemic. A halt to rotations and the consequent difficulties and losses for learning, career progression, and home life have been felt across all continents and will have a lasting impact on this cohort of doctors. Although involvement in caring for COVID-19 patients will have created many beneficial learning opportunities, there will also be missed learning opportunities for trainees in their chosen specialty that will need to be addressed

during what will probably be a considerable period of ongoing disruption to workplaces where that learning happens.[4,5,7]

Consideration must also be given to how risk of physical harm at work through potential exposure to the virus has been, and continues to be, a daily lived reality and that psychological distress and moral injury are likely consequences of caring for patients during the pandemic[14]—perhaps more likely for doctors still in training than for more experienced and seasoned colleagues. Interventions such as debriefing, supportive counselling, and a focus on self-care aimed at working through the consequences of these experiences and making meaning from them are being discussed and planned in Europe, North America, and Australia and could prove more important to the long-term ability and sustainability of the medical workforce than looking for opportunities to catch up on learning.[15]

For medical students and doctors in training the pandemic has exposed some learners to unplanned learning opportunities and a greater sense of purpose within health-care teams. Where volunteering has been possible, some medical students have become embedded and welcomed participants in health-care settings.[16] However, the premature interruption of training experienced by the majority has conversely deprived medical students of the opportunity to become embedded in service teams tackling the crisis, with health-care institutions losing necessary human resources they might need as the pandemic advances, particularly in LMICs. Moving forwards, students could be part of the solution in these settings when COVID-19 vaccines become available and testing and contact tracing increases and by serving as a vital public health education resource.

Importantly, the COVID-19 pandemic has shone a spotlight on health inequities and how systemic issues of access and resources in health care impact patient outcomes.[17] There is no doubt that the senior doctors of tomorrow will be more mindful of the interplay of medicine and politics and see their role extend to more assertive health advocacy. Exposure to infectious disease management, intensive care medicine, and a growing awareness of public health and the consequences of health inequities could also alter the career trajectory of a generation of new doctors. As COVID-19 continues to impact on the way we live, work, and learn, it is becoming increasingly clear that medical schools and postgraduate training organisations will need to be flexible, responsive, and creative in how they adapt to educating this next generation of doctors at a time of physical distancing.

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