

Original Article

Challenges of the Sudden Shift to Asynchronous Virtual Education in Nursing Education During the COVID-19 Pandemic: A Qualitative Study

Yaser Moradi, Rahim Baghaei, Aram Feizi, Reza HajiAliBeigloo

Patient Safety Research Center, Clinical Research Institute, School of Nursing and Midwifery, Urmia University of Medical Sciences, Urmia, Iran

ORCID:

Yaser Moradi:
0000-0001-9331-7573
Rahim Baghaei:
0000-0002-8172-7994
Aram Feizi:
0000-0002-2260-1451
Reza HajiAlibeigloo:
0000-0002-0679-8362

ABSTRACT **Background:** The global health crisis caused by the COVID-19 pandemic has led many institutions and universities around the world to bring about a sudden shift to virtual education to continue their educational activities. **Objectives:** This study aimed to explain the challenges of the sudden shift to asynchronous virtual education in nursing education throughout the COVID-19 pandemic. **Methods:** A qualitative study was conducted during 2020, on nursing faculty members and undergraduate nursing students in the Urmia School of Nursing and Midwifery, Iran. A total of 12 faculty members and 8 students were enrolled in the study using purposive sampling. Data were collected using semi-structured face-to-face interviews and then analyzed through the content analysis method. **Results:** Participants identified “inappropriate groundwork” and “low inclination to virtual education” as the main challenges of the sudden shift to asynchronous e-learning in nursing education during the COVID-19 pandemic. **Conclusion:** The authorities of nursing schools should provide the appropriate groundwork for virtual education by the provision and upgrading of the required hardware and software, teaching how to use the facilities, and developing standard protocols for virtual education.

KEYWORDS: COVID-19, education, nursing, pandemic, qualitative research, students, virtual

INTRODUCTION

On December 31, 2020, an outbreak of atypical pneumonia due to a novel coronavirus was reported in Wuhan, China.^[1] The threat posed by the novel coronavirus disease (COVID-19) has severely damaged the education systems worldwide.^[2] As a result, schools, universities, and educational institutions were closed to reduce the rapid spread of the disease.^[3] Then, countries replaced face-to-face education with e-learning to ensure the continuity of education.^[3,4] Although the nursing education system was not an exception, however, nursing education faced more challenges because of the impacts of the outbreak on clinical education. The nursing education system faces a paradoxical situation. On the one hand, there are limited opportunities for the nursing students to attend clinical internships and gain clinical experience, and on the other hand, the nursing education system is under great pressure to train and prepare the required nursing workforce in the current crisis.^[5] Such a situation and the need for timely

graduation of nursing students forced officials and nursing educators to make extensive use of virtual education.^[5,6] While helping to continue teaching and learning activities, e-learning helps maintain social distance and prevents the development of COVID-19.^[7,8]

E-learning can be provided synchronously or asynchronously. Synchronous e-learning allows teachers and learners to have “live” interaction, whereas asynchronous e-learning causes significant delays between training time and receiving it. Both synchronous and asynchronous e-learning may benefit information

Address for correspondence: Reza HajiAliBeigloo, Patient Safety Research Center, Clinical Research Institute, School of Nursing and Midwifery, Urmia University of Medical Sciences, Urmia, Iran. E-mail: hajialibegloo.r@umsu.ac.ir

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

Submitted: 23-Aug-2021 **Revised:** 25-Nov-2021 **Accepted:** 15-Dec-2021
Published: 23-Mar-2022

How to cite this article: Moradi Y, Baghaei R, Feizi A, HajiAliBeigloo R. Challenges of the sudden shift to asynchronous virtual education in nursing education during the COVID-19 pandemic: A qualitative study. *Nurs Midwifery Stud* 2022;11:44-50.

Access this article online	
Quick Response Code: 	Website: www.nmsjournal.com
	DOI: 10.4103/nms.nms_82_21

technology.^[9] Over the past few years, many faculties have sought to develop methods and guidelines for asynchronous learning so that learners can participate in learning activities anytime and anywhere.^[10] Many academic institutions including medical sciences universities that were previously reluctant to change their traditional approaches education had also no choice but to change their education system to online education during the COVID-19 pandemic.^[11] However, they faced many challenges in clinical courses. Many academic centers did not have sufficient preparation and infrastructure for e-learning. There were also many concerns about the quality of virtual clinical training, especially when used on a large scale.^[11] Therefore, many courses were postponed.^[8] However, attempts have been made to adopt appropriate strategies. However, despite the ongoing COVID-19 pandemic, serious research is needed to ensure the quality of education, reduce the challenges of clinical education, and increase the effectiveness of current and future e-learning.

In a study of the effect of e-learning on Nepalese nursing students and teachers during the COVID-19 pandemic, a majority of the students and teachers were satisfied with the updates to the digital technology used for taking the class. However, almost half of the nurse educators and students experienced difficulties in their online classes because of the electricity and internet problems. Only 64% of the students had internet access for their online courses and about half used mobile phones to attend online sessions. The authors conclude that e-learning is a good option for

continuing education, but it is not fully effective due to the lack of infrastructure in developing countries such as Nepal.^[12]

Despite the fundamental changes in the nursing education system during the COVID-19 pandemic, the challenges arising from these changes have not been studied in the context of Iran. So, the question is what are the challenges of the sudden changes in teaching–learning strategies (especially asynchronous e-learning) during the COVID-19 pandemic? What experiences do nursing instructors have in this area? Addressing the experiences of those involved in nursing education during this period can help clarify the sudden and widespread changes in educational approaches, especially the overt and covert challenges that arise from the use of asynchronous e-learning in nursing.

Objectives

This study was conducted to explain the challenges experienced by nurse educators and undergraduate nursing students in the sudden shift to asynchronous e-learning during the COVID-19 pandemic.

METHODS

Study design and participants

A qualitative study was conducted on 12 nursing faculty members and eight undergraduate nursing students in the Urmia School of Nursing and Midwifery, in northwestern Iran [Table 1]. The consolidated criteria for reporting qualitative studies (COREQ) were applied to describe the design and results.

Table 1: Demographic characteristics of the study participants

Participant no.	Age (years)	Gender	Position	Educational level	Academic degree	Semester
P1	59	Male	Faculty member	PhD	Associate Professor	
P2	42	Male	Faculty member	MSc	Lecturer	
P3	32	Male	Faculty member	PhD	Assistant Professor	
P4	61	Male	Faculty member	MSc	Lecturer	
P5	46	Female	Faculty member	PhD	Assistant Professor	
P6	39	Female	Faculty member	MSc	Lecturer	
P7	38	Female	Faculty member	MSc	Lecturer	
P8	40	Female	Faculty member	MSc	Lecturer	
P9	52	Male	Faculty member	PhD	Assistant Professor	
P10	39	Male	Faculty member	PhD	Assistant Professor	
P11	31	Female	Faculty member	MSc	Lecturer	
P12	28	Male	Faculty member	MSc	Lecturer	
P13	19	Male	Nursing student			Second
P14	19	Female	Nursing student			Third
P15	20	Male	Nursing student			Third
P16	20	Male	Nursing student			Fourth
P17	21	Female	Nursing student			Fifth
P18	21	Male	Nursing student			Sixth
P19	21	Female	Nursing student			Sixth
P20	22	Male	Nursing student			Seventh

The Urmia School of Nursing and Midwifery offers bachelor's and master's degrees in both nursing and midwifery, a doctoral program in nursing, and an associate degree in emergency medicine. Since the outbreak of COVID-19, all theoretical and some practical courses have been conducted virtually and asynchronously through the Learning Management System. Participants were selected purposively. The inclusion criterion for faculty members was the experience of running an online theory course, and that for the undergraduate nursing students was the experience of attending an online course. Moreover, willingness to participate in the study was considered as an inclusion criterion for both groups.

Data collection

Data were collected through semi-structured, face-to-face, individual interviews, taking social distance into account. All interviews were conducted from September to November 2020, when the first semester of the academic year had been held virtually after the beginning of the COVID-19 pandemic. Participants were asked to describe the challenges they experienced following the sudden shift to asynchronous e-learning.

The main interview question was as follows: *“What challenges did you experience as a nursing faculty member/student due to the sudden shift to asynchronous e-learning during the COVID-19 pandemic?”* Probing questions were asked based on the participants' responses. The questions included *“What do you mean?”*, *“Can you please explain more?”*, *“Can you please clarify what you mean?”*, *“Why?”*, and *“How?”*

All interviews were conducted in a comfortable atmosphere and in accordance with the principles of

personal protection. Interviews with faculty members were conducted in their offices at the School of Nursing and Midwifery, and students were interviewed in classrooms in clinical settings. The researcher recorded all interviews with the consent of the participants. Each interview lasted about 40 min. Interviewing continued until data saturation was achieved.

Data analysis

Qualitative content analysis was performed according to the approach proposed by Graneheim and Lundman.^[13] Initially, each interview was carefully listened to by two authors (YM and RH). The interviews were then transcribed and typed up verbatim in Microsoft Word. Then, the researcher read each interview several times to become acquainted with and immersed in the data and grasp the main themes of the text. Then the data were managed using the MAXQDA software (version 10; VERBI, Berlin, Germany). The researcher then read the text line by line, identified the meaning units (i.e., sentences and/or paragraphs expressing the participants' experiences or certain meanings), and converted them to codes. The codes were then compared for similarities and differences and were categorized in themes and subthemes [Table 2]. Finally, the researcher labeled and refined the themes and subthemes and described them in text.

Trustworthiness

The four criteria of credibility, confirmability, dependability, and transferability were utilized to ensure the rigor of the findings.^[14] To achieve credibility, the researcher had a long-term engagement with the data.

Table 2: Examples of themes, subthemes, and codes obtained during data analysis

Theme	Subtheme	Code
Inappropriate groundwork	Lack of facilities and equipment	Low access to the appropriate software
		Having no smartphone or computer
		Bandwidth limitation on file uploading
Economic hardship	Economic hardship	Defective system
		Defect in hardware infrastructure
		Slow internet speed
		Lack of internet access
		Economic pressure caused by the purchase of equipment
Lecturers' lack of preparedness to enter virtual education	Lecturers' lack of preparedness to enter virtual education	High cost of internet
		Lack of lecturers' familiarity with the method of creating e-learning content
Low inclination to virtual education	Students' low adherence to e-learning	Forced and sudden shifts to e-learning
		Students' low interest in e-learning
	Lecturers' low adherence to e-learning	Students' low participation in e-learning
		Disarray in content uploading
		Resistance of some lecturers to virtual education
		A tendency toward traditional teaching methods

This was achieved by repeatedly reading the transcripts of interviews and continued throughout the data analysis process. The interview process and the data analysis were supervised by an expert supervisor. Disagreements were resolved by discussion and consensus. An attempt was made to consider the diversity and therefore both nursing faculty members and students were considered as participants. For confirmability, a complete description of the research process including data collection and analysis was provided to facilitate the auditability of the research. For dependability, the external audit was used to assess similarities and differences between the participants' and the researchers' understanding of the issues. For transferability, the researcher tried to fully describe the setting in which the research was conducted, through the accurate description of the participants, sampling method, and time and place of data collection.

Ethical considerations

Ethical approval for this study was obtained from the Regional Committee for Medical Research Ethics (Ethics No. IR.UMSU.REC.1399.194). The researcher introduced himself and explained the study objectives to the participants. Written informed consent was obtained from all participants. They were also assured that the personal data would be remained as strictly confidential, and all recorded interviews would be deleted after complete transcription of the content.

RESULTS

Two themes, including a total of five subthemes, were emerged from the data. According to the participants' experiences, "inappropriate groundwork" and "low inclination to virtual education" were identified as the main challenges of the sudden shift to asynchronous e-learning in nursing education throughout the COVID-19 pandemic [Table 2].

Inappropriate groundwork

According to the participants, inappropriate groundwork refers to the lack of infrastructure needed for e-learning. This theme included three sub-themes: "lack of facilities and equipment," "financial problems," and "lecturers' lack of preparedness for using virtual education."

Lack of facilities and equipment

Faculty members frequently referred to the lack of access to the appropriate software, defects in hardware infrastructure required for e-learning, low bandwidth, and slow internet speed that caused limitations in uploading the educational material.

"My laptop was so old that I couldn't install the required software. An IT specialist said that my version of Windows

was old. My laptop's microphone could not record high-quality sound. I spent a month or two on providing required accessories for virtual education" (Faculty member, P6).

"We had a lot of infrastructure issues. It was difficult to upload files to the e-learning system due to limited bandwidth. Sometimes the system server filled up and we couldn't upload more. The speed of the internet was also low and it was disconnected repeatedly" (Faculty member, P9).

In addition to the lack of access to the internet and slow internet speed, a number of the students had more fundamental challenges such as the lack of smartphones or computers.

"I live in a village, where there is no access to virtual education. In our village, there is no telecommunication antenna at all, let alone the internet. What should I do? Besides, some of us do not have a computer, laptop, or smartphone to meet our needs" (Student, P17).

Financial problems

Financial problems, high equipment costs, and high internet costs were among the challenges that made the e-learning system hard to use for both faculty members and students. These challenges were especially evident for students whose family income was affected by the COVID-19 pandemic.

"It's been a few months that I want to buy a laptop for myself, but I can't. Prices are rising every day. In this economic downturn where the students' families are under financial pressure, it is really difficult for them to pay the costs of internet and necessary equipment" (Faculty member, P11).

"We all use personal internet. Some files were up to 80 MB in size. These are not just one or two files. Just imagine! 20 large files for only one lesson. The cost of the Internet has grown up. I wish they could provide at least a free internet package for students" (Student, P20).

Lecturers' lack of preparedness to use virtual education

The lack of lecturers' familiarity with the methods of creating e-learning content and the forced and sudden shift to e-learning were among the other challenges experienced by the faculty members.

"The sudden shift to virtual education was difficult for us. We entered virtual education without any preparation. We had got used to face-to-face training. We were not familiar with the software used in virtual education. I didn't even know how to add simple audio narrations to PowerPoint" (Faculty member, P9).

Low inclination to virtual education

Participants' experiences showed that both faculty members and students had a low inclination to virtual education. Such a low inclination resulted in low adherence to the principles of virtual education and e-learning. This theme included two sub-themes of "students' low inclination to virtual education" and "lecturers' low adherence to virtual education."

Students' low inclination to virtual education

Based on the participants' experiences, the students' low interest and participation in virtual education were important barriers to the success of this educational strategy. Faculty members repeatedly complained about students' reluctance and tricks.

"I was posting content through the Storyline, but this content couldn't be uploaded to in the virtual education system. Students had to refer to the system to see the content, read it there, and take notes. Besides, if they had questions, they'd ask through the system. However, they were sending the message: 'Sir, just send us a PowerPoint file, that's enough. They were little inclined to this type of training. All in all, they did not do well in this system'" (Faculty member, P3).

"Students were reluctant toward virtual education. When I uploaded a course, I send a text message to them via WhatsApp. But finally, a maximum of 5 students checked it" (Faculty member, P7).

The students also acknowledged their reluctance and tricks and were upset by the negative impact of virtual education on their motivation and interest in studying.

"Interruption of face-to-face training has had a profound effect on our morale. We used to study by being in the classroom, but this is not the case now. Many of us check the option of study confirmation without downloading or studying the virtual content just to convince the teacher that we have received the file and studied it" (Student, P15).

Lecturers' low adherence to virtual education

Based on the participants' experiences, the resistance of some faculty members to virtual education and the tendency toward traditional teaching methods had caused them to show low adherence to the principles of virtual education.

"There was resistance from some faculty members who were not familiar with modern technology. One of my colleagues refused to use online education till the last minute. He believed that classes should be held face-to-face" (Faculty member, P2).

The poor adherence of the lecturers caused delays and irregularities in the production and uploading of e-learning content, and students complained about this.

"Our online classes were not held in an appointed time frame. Some lecturers uploaded six or seven files a week before the exams. It was really hard to study them all in one week. One of the lecturers just uploaded the PowerPoint files of the course without any audio narration; another uploaded a 400-page book and just identified the chapters we should study every week!" (Student, P14).

DISCUSSION

Based on the experiences of nursing faculty members and students, inappropriate groundwork and low inclination to virtual education were the two main challenges arising from the sudden shift to asynchronous virtual education in the early COVID-19 pandemic. The inappropriate groundwork was reflected in the lack of facilities and equipment, financial problems, and the lecturers' lack of preparedness for using virtual education. Studies have shown that the effectiveness of virtual education largely depends on the accessibility and reliability of the required software and hardware.^[15,16] Therefore, providing the necessary funds and setting up the e-learning facilities and equipment are basic prerequisites for the application and development of virtual education in higher education.^[15] Nonetheless, some studies have cited the lack of required hardware and software as the most important challenges in developing e-learning.^[15,17] Evidence shows that e-learning will not work and does not achieve its goals if the required infrastructure and the appropriate groundwork are neglected.^[18] It has also been found that the costs associated with accessing the e-learning system create significant stress for faculty members and students. Therefore, universities need to take steps to reduce the concerns associated with these financial pressures.^[5,16]

In the present study, the lecturers' unfamiliarity with e-learning methods, programs, and software was described as another challenge in the sudden shift to virtual education. Effective use of virtual education requires certain knowledge and technical skills. However, our participants had not received the required training on virtual education before the current crisis.^[6] Similar findings are reported in a previous study examining the effectiveness and barriers to implementing interactive learning in Saudi Arabia.^[19]

The low inclination to e-learning among lecturers and students was described as another challenge of asynchronous virtual education. It was found that compared to face-to-face teaching, students had little interest in virtual learning. In addition to financial problems, there might be several reasons behind this issue.

Some students may lack experience in using computers and the internet. Then, they may feel less positive about the usefulness of the technology.^[20] Some others may also suffer from computer anxiety.^[21] In addition, asynchronous virtual education discourages students from participating because there is no active interaction between students and teachers.^[3,22] Previous studies have also shown that students' inclination and effective use of e-learning systems are associated with their self-motivation, self-regulation, time management and technical skills, and the software's ease of use.^[16,23,24] Therefore, educational administrators should focus on students' perceptions of actual and potential barriers and take appropriate steps to successfully implement e-learning.

The experiences of the participants in this study showed that the lectures also had a low inclination and adherence to asynchronous virtual education. On the one hand, structural deficiencies can negatively affect faculty members' experiences with virtual education. On the other hand, this issue may be rooted in due to poor teacher preparation and disruption of their traditional role, which has been challenged in the digital era of higher education. These findings are congruent with what has been reported in former studies.^[6,18,25] Throughout the transition from traditional education to virtual education, universities should try to reduce the problems faced by faculty members and students by preparing them and providing the most convenient and appropriate method of e-learning. However, the optimal e-learning method is not yet known, and there is a strong desire to return to the traditional teaching method.^[6]

This study investigated only the experiences of Iranian nursing faculty members and nursing students in the area of asynchronous e-learning. Although the qualitative researchers are not concerned with the generalization of the results, it is recommended to conduct similar studies in other contexts.

CONCLUSION

The present study provided an overview of the challenges of the abrupt shift to asynchronous e-learning in nursing education during the COVID-19 pandemic. Our findings revealed that inappropriate groundwork and low inclination to virtual education are the most important challenges of asynchronous e-learning. Given the crucial role of the nursing education system in preparing the workforce needed to combat COVID-19, it is important to recognize and alleviate or overcome existing obstacles and challenges. Hence, the management systems of nursing schools must adopt effective solutions and measures to upgrade hardware and software facilities and equipment and provide the appropriate groundwork for e-learning. Furthermore, running additional training courses on how

to use e-learning software and hardware for lecturers and students, developing standard protocols for implementing e-learning, and creating an attractive user interface for the e-learning system can improve the students' and lecturers' inclination to e-learning.

Financial support and sponsorship

This study was supported by the Vice-Chancellor of Research and Technology of Urmia University of Medical Sciences under contract number 10342. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Conflicts of interest

We declare that there is no conflict of interest between the authors.

Acknowledgements

The researchers would like to thank all participants in this study.

REFERENCES

1. Wong LP, Alias H, Danaee M, Ziaee M, Abedi F, Ziaee A, *et al.* Uncovering psychobehavioural implications of SARS-CoV-2 infection in Iran. *Transbound Emerg Dis* 2020;67:2892-900.
2. Alvarez A Jr. The phenomenon of learning at a distance through emergency remote teaching amidst the pandemic crisis. *Asian J Dist Educ* 2020;15:144-53.
3. Elhadary T, Elhaty IA, Mohamed AA, Alawna M. Evaluation of academic performance of science and social science students in Turkish Universities during Covid-19 crisis. *J Crit Rev* 2020;7:1740-51.
4. Al Lily AE, Ismail AF, Abunasser FM, Alhajhoj Alqahtani RH. Distance education as a response to pandemics: Coronavirus and Arab culture. *Technol Soc* 2020;63:101317.
5. Gaur R, Mudgal SK, Dharni I, Sharma R, Suyal N. Barriers encountered during online classes among undergraduate nursing students during COVID-19 pandemic in India. *Int J Res Med Sci* 2020;8:3687-93.
6. Cutri RM, Mena J. A critical reconceptualization of faculty readiness for online teaching. *Distance Educ* 2020;41:361-80.
7. Arora AK, Srinivasan R. Impact of pandemic COVID-19 on the teaching-learning process: A study of higher education teachers. *Prabandhan: Ind J Manage* 2020;13:43-56.
8. Rose S. Medical student education in the time of COVID-19. *J Am Med Assoc* 2020;323:2131-2.
9. Rehman R, Fatima SS. An innovation in flipped class room: A teaching model to facilitate synchronous and asynchronous learning during a pandemic. *Pak J Med Sci* 2021;37:131-6.
10. Iancu AM, Kemp MT, Alam HB. Unmuting medical students' education: Utilizing telemedicine during the COVID-19 pandemic and beyond. *J Med Internet Res* 2020;22:e19667.
11. Dhawan S. Online learning: A panacea in the time of COVID-19 crisis. *J Educ Tech Sys* 2020;49:5-22.
12. Subedi S, Nayaju S, Subedi S, Shah SK, Shah JM. Impact of E-learning during COVID-19 pandemic among nursing students and teachers of Nepal. *Inter J Sci Healthcare Res* 2020;5:68-76.

13. Graneheim UH, Lundman B. Qualitative content analysis in nursing research: Concepts, procedures and measures to achieve trustworthiness. *Nurse Educ Today* 2004;24:105-12.
14. Guba EG. Criteria for assessing the trustworthiness of naturalistic inquiries. *ECTJ* 1981;29:75-91.
15. Almaiah MA, Al-Khasawneh A, Althunibat A. Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic. *Educ Inform Technol* 2020;25:5261-80.
16. Alanazi AA, Alshaalan ZM. Views of faculty members on the use of e-learning in Saudi medical and health colleges during COVID-19 pandemic. *J Nat Sci Med* 2020;3:308-17.
17. Shafiei Sarvestani M, Mohammadi M, Afshin J, Raehy L. Students' experiences of e-Learning challenges: A phenomenological study. *Interdiscip J Virtual Learn Med Sci* 2019;10:1-10.
18. Al-Balas M, Al-Balas HI, Jaber HM, Obeidat K, Al-Balas H, Aborajoo EA, *et al.* Distance learning in clinical medical education amid COVID-19 pandemic in Jordan: Current situation, challenges, and perspectives. *BMC Med Educ* 2020;20:1-7.
19. Khyzer E, Aftab T. Students' perceptions about current use, effectiveness and barriers in implementation of interactive learning at College of Medicine, Northern Border University, Arar. *Int J Med Res Health Sci* 2019;8:12-6.
20. Azizi Shamami M, Jafari Karafestani Z, Abedini Baltork M. The study of relationship between attitude to e-learning and self-regulation with academic achievement of students in Babol University of Medical Sciences. *J Med Educ Develop* 2017;12:114-27.
21. Oyadeyi JB. An assessment of computer anxiety among distance learning freshmen in South Western Nigeria. *KIU J Soc Sci* 2018;4:151-9.
22. Kian M. Challenges of virtual education: A report of what are not learned. *Interdiscip J Virtual Learn Med Sci* 2014;5:11-21.
23. Sekhon MSK, Patil S. Student engagement in traditional learning vs online learning—A comparative study. *PalArch's J Archaeol Egypt* 2021;18:2134-47.
24. Lu H. Online learning: The meanings of student engagement. *Educ J* 2020;9:73-9.
25. O'Doherty D, Dromey M, Loughheed J, Hannigan A, Last J, McGrath D. Barriers and solutions to online learning in medical education—An integrative review. *BMC Med Educ* 2018;18:130.