



Faculty perceptions regarding an individually tailored, flexible length, outcomes-based curriculum for undergraduate medical students

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Purpose: The perception of faculty members about an individually tailored, flexible-length, outcomes-based curriculum for undergraduate medical students was studied. Their opinion about the advantages, disadvantages, and challenges was also noted. This study was done to help educational institutions identify academic and social support and resources required to ensure that graduate competencies are not compromised by a flexible education pathway.

Methods: The study was done at the International Medical University, Malaysia, and the University of Lahore, Pakistan. Semi-structured interviews were conducted from 1st August 2021 to 17th March 2022. Demographic information was noted. Themes were identified, and a summary of the information under each theme was created.

Results: A total of 24 (14 from Malaysia and 10 from Pakistan) faculty participated. Most agreed that undergraduate medical students can progress (at a differential rate) if they attain the required competencies. Among the major advantages mentioned were that students may graduate faster, learn at a pace comfortable to them, and develop an individualized learning pathway. Several logistical challenges must be overcome. Providing assessments on demand will be difficult. Significant regulatory hurdles were anticipated. Artificial intelligence (AI) can play an important role in creating an individualized learning pathway and supporting time-independent progression. The course may be (slightly) cheaper than a traditional one.

Conclusion: This study provides a foundation to further develop and strengthen flexible-length competency-based medical education modules. Further studies are required among educators at other medical schools and in other countries. Online learning and AI will play an important role.

Key Words: Faculty, Curriculum, Medical students, Artificial intelligence

Introduction

Four overarching themes underpin competency-based

medical education (CBME). These are outcome-focused, with an emphasis on abilities, a shift of emphasis from course duration, and promoting greater learner-centeredness [1]. In medical education, time plays an

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important role, and the duration of the course is determined by regulatory and licensing bodies. Some are of the opinion that a reduced emphasis on course duration may be detrimental to the education of doctors [2]. The proponents of CBME posit that learning experiences can be provided within a more flexible time frame, emphasizing the learner's progress and achievement of learning outcomes [3].

The time-independent promise of CBME has not been fulfilled due to several constraints. Among these is the fact that competencies in the health professions require a combination of knowledge, procedural and affective skills and are difficult to assess and quantify. However, entrustable professional activities (EPAs) can be adopted to guide the shift to outcomes. EPAs are units of professional practice that are observable, measurable, and suitable for entrustment [4].

Allowing each student, the freedom to progress at their own pace according to their attainment of competencies places logistical challenges. The increasing use of artificial intelligence (AI) and blended learning may offer support for competency-based progression. A recent integrative review mentions that the major use of AI in education has primarily been to support student learning due to its ability to provide individualized feedback in real-time [5].

1. Shortening the undergraduate medical program

In North America, there has been increasing interest in 3-year undergraduate medical programs. Eight North American medical schools offered an accelerated pathway mainly to cater to the need for doctors for underserved areas [6]. In developed nations, students graduated a few months early to meet the demand for physicians during the coronavirus disease 2019 pandemic as described in a public medical school in Massachusetts, United States [7]. The final year of medical school in the United States

focuses mainly on elective rotations and involves a lot of traveling and expenses and can be shortened [8]. Medical education may evolve to shorter training for some physicians via flexible pathways and "fast tracks" at different phases of training for flexible training over a lifetime [9].

In the United States, the Penn State-Jefferson accelerated BS (Bachelor of Science)-MD (Doctor of Medicine) program enables students to complete both degrees in a 5-year period and a study found that accelerated program students earned their degrees quicker and had careers comparable to students in a matched control who were in a regular MD program [10]. The authors concluded shortening the length of medical education does not compromise educational and professional outcomes.

Malaysia faces the challenge of decreased availability of doctors in rural areas and in the states of Sabah and Sarawak compared to peninsular Malaysia [11]. Several medical schools have opened recently, especially in the private sector. However, the medical course is long and tuition fees are high. In Pakistan, there is one doctor for every 877 people and the ratio is lower in the provinces of Balochistan and Khyber Pakhtunkhwa where the ratio is one doctor for 1,794 people and 1,064 people respectively [12]. Early graduation of doctors should be useful for both countries.

The emphasis in the previous paragraph has been on shortening the curriculum. However, the perspective of students who may require more time to complete the program due to different reasons like the need to work, family commitments, illness, and emotional problems should also be considered. These students may benefit from a flexible-length curriculum that allows them to take more time to graduate if required.

2. Individualized learning pathways

Creating individualized learning pathways has received significant attention globally. The American Medical Association provided grants of \$1 million each to 11 medical schools for the purpose of redesigning curricula for flexible, individualized learning pathways, measuring the achievement of competencies, developing new assessment tools to test readiness for postgraduate training, and implementing new models of providing clinical experiences within health care systems [13]. Implementing AI and learning analytics in developing nations faces greater challenges including financial constraints, less collaboration with data scientists, problems with the information technology infrastructure, and a lack of emphasis on AI. AI can inform experts and designers regarding the pedagogies to be adopted and it can also analyze the behaviors exhibited by teachers and students to create appropriate pedagogies and adjust the virtual learning environment [14].

We were not able to find descriptions of an individually tailored flexible-length outcomes-based medical curriculum in the literature prompting us to study the perceptions of faculty members on this important topic. We wanted to obtain faculty members' perceptions of this curriculum. Faculty members will play an important role in designing and implementing the curriculum. They also can provide evidence to the other stakeholders involved and develop a strong case for the curriculum to be implemented. The present study obtained the perception of faculty members at two universities in Malaysia and Pakistan on this topic. Universities in two countries with different sociocultural settings and per-capita income were chosen to obtain a wider perspective. There are several issues with healthcare and medical education globally including maldistribution of doctors, high cost of medical education, high medical student debt, stress and

burnout, and inequitable access to healthcare for patients and to medical education for aspiring doctors. Respondents' opinion about the advantages, disadvantages, and challenges was studied. This study is important for different countries and regions due to differences in the socio-cultural context, availability of economic resources, and differences in public expectations of doctors and their roles and responsibilities. As mentioned, this issue has not been previously studied and details about the areas to be addressed were not readily available. The authors were not able to find questionnaires that measured faculty perceptions regarding a flexible-length undergraduate medical curriculum in the literature. Hence, the authors believed a preliminary qualitative study will provide important information regarding this topic.

Methods

The study was conducted among faculty members at the International Medical University and the University College of Medicine and Dentistry, University of Lahore. A list of possible interviewees was developed through consensus among the authors. Individuals on the list were approached through email to participate. The study information sheet and the semi-structured interview guide were shared with potential participants.

Those agreeing were approached for a convenient date for the interview. These were conducted from 1st August 2021 to 17th March 2022. Written informed consent was obtained from all respondents. The interviews were conducted online via Microsoft Teams (Microsoft Corp., Redmond, USA) or Zoom (Zoom Video Communications, San Jose, USA) in the English language, were recorded and a transcript was generated. Each interview lasted between 30 to 40 minutes. These were conducted by the first two authors and followed the sequence of the

questions in the interview guide. The transcript was generated using online transcription programs and was cross-checked with the recording by the researchers, required corrections were carried out, and were shared with the respondents. Further corrections or modifications, if any, were done based on the interviewees' feedback. The interview guide is shown in the Appendix 1. Data saturation was attained after the 12th interview in Malaysia and the 8th interview in Pakistan. Two further interviews were carried out in each location to confirm data saturation and see if any additional themes emerged.

The interviews were carried out by medical educators with additional training in qualitative research. The researchers approached 38 faculty members for participation and 24 interviews were conducted. No reasons for non-participation were requested from those who did not consent to participate. They knew most of the interviewees personally before the start of the interview. The participants were selected based on the personal contacts of the researchers and considering the need to achieve a diverse representation of faculty. The interview guide was pilot-tested, and notes were taken immediately after each interview.

The transcripts were read through repeatedly by the first two authors. They were also shared with the other authors for their input. The transcripts were also shared with the interviewees for member checking. A predominantly deductive approach to thematic analysis was utilized. The codes were identified, and it was noted if they were fitting into the themes identified prior to the interview using the questions in the interview guide by the first two authors. If information was not fitting within a particular theme, then a new theme was considered. The codes and the themes were carefully examined by all authors and a consensus was obtained. Demographic information was noted. A summary of the information under each theme was created and representative open comments were noted.

The study was approved by the ethical review board of the University College of Medicine and Dentistry, University of Lahore (number 46/06/21 dated 7th June 2021) and the International Medical University with ID number 532/2021 on 7th July 2021.

Results

A total of 24 respondents participated. Table 1 shows their demographic characteristics. Table 2 provides a summary of important issues explored under each theme.

1. Flexible-length outcomes-based medical curriculum

Participants mentioned competency-based curricula as flexible, and non-time bound. They mentioned the duration could be shortened for students who are doing well academically but can be lengthened for students who are facing academic difficulties and/or must balance their studies with other responsibilities. This would enable academically stronger students to complete their course within a shorter duration while students requiring extra time due to their other responsibilities, weaker academic performance or other reasons can take more time. A few

Table 1. Demographic Characteristics of the Respondents

Characteristic	No. (%)
Gender	
Male	8 (33.3)
Female	16 (66.6)
Country of work	
Malaysia	14 (58.3)
Pakistan	10 (41.7)
Faculty workplace	
Basic Science non-medical	3 (12.5)
Basic Science medical	9 (37.5)
Clinical	12 (50)
Having higher qualifications in medical education	
Yes	16 (66.6)
No	8 (33.3)

Table 2. Major Themes and Outline of Issues Addressed under Each

Theme	Issues addressed
Flexible-length outcome-based curricula	Conceptually sound and in line with learning theories The knowledge component of the basic sciences can be shortened. Experiential learning should stay the same More flexibility based on personal interest
Advantages of flexible-length curricula	Certain students can graduate faster depending on their performance. Assessment according to competency can improve the quality of doctors. More mature and married students may be able to enrol in a decelerated curriculum.
Challenges	Conducting multiple sessions and assessments Specifications of the number of teaching-learning hours by agencies Competencies to be assessed and acceptable level of performance Students may not be mature at the time of graduation.
Regulatory and accreditation challenges	People are used to the traditional time-bound curriculum. These bodies are usually conservative and may not be in favour of new ideas.
Addressing the challenges noted	Courses with interactive quizzes and activities can be uploaded online. Virtual patients and virtual skills centres can be created. AI can support the development of an individualized learning pathway. Providing information about different aspects of the course and the assessment to agencies can make the case stronger.

respondents (especially faculty from the clinical sciences) mentioned that the duration of the basic sciences could be shortened. They had reservations about shortening the clinical component. Basic science faculty stated that modules could be offered online and students progress through these at a pace comfortable to them. The quality of doctors produced may improve due to competency-based assessment.

The following quotes are representative of the participants' views.

"I mean, theoretically speaking, it is actually a very good idea that the students move on based on their competency. If they attain their competency early, they move on early. If it is late, then it moves on late." (P5)

"So, this differential rate-dependent will give some more time to the students who are like slow learners, or maybe who require more time to acquire that competency. According to our circumstances, maybe it would be difficult if you do not have the infrastructure, or the student may take too long to graduate." (P16)

2. Advantages of flexible-length curricula

Participants described the advantages as being in tune with current learning theories, being more student-centered, and promoting self-directed learning. Students take increasing responsibility for their own learning. They can progress through the course at a pace comfortable for them. Greater flexibility may also allow them to focus on areas of greater interest to them after completing the core courses/areas required. Academically stronger students can complete the undergraduate course quickly and may have more time to focus on postgraduation and specialization. This may result in a reduction in fees and an earlier entry into the workforce.

The following quotes mention the views of the participants.

"(Students can) exit earlier compared to the rest of the cohort and very mature and adult way of learning. So, they themselves take the opportunities and they can ... Or they would be much more in control of their learning path of how they wanted to go about. I think it is a very good

way of learning.” (P1)

“So, these things will help to individualize the learning pathways and are required to be individualized. I cannot move forward without attaining those or without taking those assessments. I can take it on my preference at any time in any part of the world and you can take it on your own.” (P18)

“I think the biggest advantage would be that students would really take responsibility for their own learning. Once they know that they can proceed at a pace of their own choice, or on their own feet well I think they would be more involved in their learning.” (P24)

3. Challenges

There will be logistical challenges in conducting sessions for multiple cohorts of students and in organizing assessments. The fees to be charged for the accelerated and decelerated programs were also discussed. Respondents highlighted that the fees charged should compensate for the increased resources to be deployed by the institution. The issue of which competencies are to be assessed and what would be an acceptable level of performance was also mentioned. As progression is based on the attainment of competencies defining these objectively and training faculty on assessing the attainment of the competencies is important. Certain “soft skills” and nice-to-know areas may receive less attention. Representative comments were:

“Do they have the mental or psychological maturity to manage a patient? Some sort of assessment on maturity may need to be in place for those who are graduating, like. Specific mentors to look after these ones on the alternative or differential pathways.” (P6)

“When you talk about fees you must include marketing. And then it is not about fixing it as to a particular price. There are usually in any economic project you must look

at the return on investment. The fees will change. The fees certainly must become competitive. So, the initial investment will be there and subsequently become cheaper for you to rerun.” (P9)

“And this will come with a very huge setback of psychological depression and dilemmas that the students will face who is still struggling to achieve a particular skill by, say for example a student is taking 4 weeks to achieve a skill, while the sharp student took that only 2 days to achieve that skill you would be sitting in the first-year curriculum while the bright student will be sitting in the fourth-year curriculum.” (P15)

4. Regulatory and accreditation challenges

Many accrediting and regulatory agencies have specified the number of hours of clinical training required and the duration of the MBBS (Bachelor of Medicine, Bachelor of Surgery) program. Many respondents mentioned that this may among the most difficult challenge and will require support from the regulatory and possibly, the political leadership. Respondents believed these agencies will require strong evidence of the effectiveness of flexible-length curricula before they consider it for possible implementation. A shortage of supporting evidence from other regions and countries can make the task more difficult.

“I think it would be hard to accept. At first, because, you know, the whole concept of being a doctor is, like, in our country. It is like a 5- or 5-year course culturally or the opinion of the people is that if you study for 5 to 6 years you become a good doctor.” (P23)

5. Addressing the challenges noted

AI and creating an individualized learning pathway will be important. Considering the large student body and limitations on the availability of faculty, AI can support

faculty in individualizing learning pathways for students. AI can help students practice their knowledge and skills in a non-threatening environment obtaining feedback for continuous improvement.

“If the student is well prepared with artificial intelligence with simulation with appropriate time given to achieve competencies. They must be able to achieve what we expect our graduates to achieve within a shorter time.” (P1)
 “I think artificial intelligence would allow them (students) to learn more because they can assess and evaluate themselves through artificial intelligence, ... if you incorporate artificial intelligence in it (assessment) I think they can assess themselves beforehand, before reaching the final assessment.” (P15)

Ensuring high standards of assessment and inviting regulators and accreditors to the examinations can create a favorable climate. Creating a body of evidence to support the effectiveness of the flexible-length curriculum is important. A few respondents felt that the total duration should not be reduced but more freedom should be offered within the course for students to pursue specialties and other courses based on their interests. Learning can occur in manageable chunks with interactive quizzes and activities to enable students to check their understanding. The issue of selecting students for the accelerated program was also discussed. The fees to be charged were also debated. Respondents felt that while it should be less than that charged for the regular duration the investment in more faculty, learning resources, AI systems, student support, and assessment requires resources, and students can be charged for the additional resources required.

“Very work intensive. It first would need the faculty to get trained. Lot of feedback that has to be given, the whole assessment is different where it’s more formative than

summative, so we need a larger workforce, multiple assessments and you know from many sources and many, many times along the way.” (P13)

Another respondent stated, “You need a very sophisticated bank of virtual patients, develop a comprehensive Virtual Patient (that according to) to me takes at least 3 or 4 days for an expert. The student is being exposed to every kind of case including the trivial problems which come in outpatient department, then the complex ones, and then he can he or she can have the mastery.” (P17)

Discussion

Most respondents agreed that an individually tailored, flexible, outcomes-based curriculum was feasible for undergraduate medical students provided they attain the required competencies. Both advantages and challenges were highlighted. We examined a self-paced curriculum under the subheading of technology-enhanced learning (a major supporting factor), an accelerated program of study, students’ emotional maturity, challenges of CBME, accreditation and regulatory challenges, challenges of an accelerated program, broader implications of this study, and future developments.

1. Technology-enhanced learning

There is an increasing interest in using technology to enhance student learning. A study published in 2018 mentioned that very few institutions in Pakistan were using Moodle and blended learning in medical education [15]. The situation may have changed due to the wide-spread adoption of online learning by necessity during the pandemic. In a study conducted among medical schools in Punjab, Pakistan, participants mentioned factors that may influence the adoption of technology-enhanced

learning (TEL) as self-effort, motivation, a positive approach at the personal level, and departmental policy. At the national level, governing bodies can provide definite policies and guidelines for TEL implementation [16]. Faculty in a Malaysian university provides five tips to maintain student engagement during online learning [17]. Among these were understanding the use of online platforms, and multiple communication channels and conducting online formative assessments. Member schools of the American Medical Association Accelerating Change in Medical Education Consortium have tried to implement individualized learning pathways for undergraduate students [18]. Promotion of self-regulated learning, longitudinal learning pathways, and robust data management that can provide data access on demand to students, coaches, mentors, and program leaders is required. Our respondents believed TEL will play a vital role in supporting an individually tailored flexible-length curriculum. Technology will also play an important role in collecting, storing, analyzing, and providing data. There were concerns about the cost, but they mentioned that locally designed solutions will be more affordable.

2. An accelerated program of study

There have been some studies regarding an accelerated curriculum. These are not individually tailored curricula but ones where the overall program was shortened. In Chile, a university shortened its program from 7 to 6 years. The authors mention that the quality of applicants, the number of students accepted, the training of teachers, and the presence of adequate campus space should be considered while making the change [19]. A study published in 2016 explored the perceptions of deans and program directors about the accelerated 3-year program in North America [20]. Reduction of medical student debt was regarded as an important advantage while concerns were raised regarding reduced readiness for independent

practice, earlier commitment to a specialty, level of maturity, and the increased possibility of burnout. Some of these issues were also mentioned by respondents in our study.

3. Students' emotional maturity

The emotional maturity of students was highlighted as a possible concern. In Malaysia, a significant positive correlation was noted between emotional maturity and academic performance [21]. The authors concluded that medical school faculty should strengthen the emotional maturity of their students to ensure better performance. In the United Kingdom, it was shown that older, more mature students transitioned easily to clinical learning and experienced lesser problems than their younger compatriots [22]. Respondents in this study believed that as students enter medical school earlier in Malaysia and Pakistan compared to other regions, they may not be emotionally mature and fully equipped to handle an accelerated curriculum and patients may regard them as too young to handle their problems.

4. CBME

CBME is less established in many countries. In India, a high student-to-faculty ratio, poorly developed infrastructure, and challenges in the assessment were hurdles to implementing CBME. The solutions suggested were to increase faculty strength, improve infrastructure, extra remuneration and increase administrative support. The opinions of the teaching faculty of government and private-sector medical colleges were significantly different [23]. CBME requires more effective assessment and feedback by faculty. Faculty may lack expertise and skills in this task across different domains and international faculty development may be required [24]. This was highlighted as a major concern in the current study. Educating both faculty and students regarding the com-

petencies may be important. Also, mechanisms may need to be developed and resources allocated to offer assessments multiple times during the course.

5. Accreditation and regulatory issues

Pakistan Medical & Dental Council accredits, regulates, and ensures the quality of medical education in Pakistan [25]. The perceptions of health professions educators regarding the appropriateness of the World Federation for Medical Education basic medical education standards for Pakistan were explored [26]. Most areas, subareas, and standards were mentioned as appropriate. In Malaysia, medical schools are accredited by the Malaysian Qualifications Agency and the Malaysian Medical Council, requiring all academic programs to be outcomes-based. There are six areas of focus including educational mission and leadership, curriculum content and delivery, assessment, learning resources, quality assurance, student support, and faculty. Acceptance by regulators and accreditors was mentioned as a very important challenge by the respondents and probably highlighted as among the most difficult to address.

6. Challenges of accelerated medical programs

A 3-year undergraduate medical program has been offered by a few medical colleges in North America. The authors of a recent article mention schools offering these programs should choose their matriculants wisely and seek student input to optimize these programs. Robust support systems for students should be provided. Strong faculty support and faculty development programs to address faculty fatigue should be in place. The schools should also offer transition or deceleration pathways for students who are not able to complete the accelerated curriculum [27]. Schools planning for an accelerated program should define their admission process, develop policies and processes for

student acceleration and deceleration, develop a customized remediation program for students, create a mentoring program, develop systems for program evaluation, ensure sufficient resources in terms of personnel, infrastructure, and money are in place, innovate and get buy-in from stakeholders [28].

7. Broader implications of the present study

Globally there is a move toward CBME, and time-independent individualized progression can result in students graduating quicker and being able to meet the health manpower requirements of their region and country. Students requiring more time to complete the course can do so, reducing stress and promoting mental well-being. The cost of education and living expenses can be reduced resulting in savings for families, governments, and society. The rapid development of technology, specifically AI, and the known strengths of many developing nations in computer technology and software may lead to the development of cost-effective AI programs to support institutions and faculty in offering differential progression and support the creation of individualized learning pathways.

Respondents mentioned that though there are several challenges there are also significant advantages associated with a self-paced medical curriculum and the developments in technology make it feasible for implementation.

8. Future developments

An integrative review mentioned four important developments in medical education. These were (1) strengthening patient safety through encouraging humanistic doctors and facilitating collaboration; (2) early clinical exposure and longitudinal integrated clerkships; (3) responding to changing community needs and showing respect for diversity; and (4) technology-enhanced

student-driven learning with individualization, social interaction, and access to resources [29]. Self-directed lifelong learning is vital, and technology can help learners develop their individual learning pathways and become effective self-directed learners [30].

We were not able to find other studies exploring the impact of an individually tailored flexible-length curriculum though it has been mentioned as an innovation/advance in manuscripts. The study was conducted in two institutions in two nations. The study has limitations. The faculty interviewed were from institutions in urban centers with active faculty medical education programs and substantial investment in online learning resources. These institutions may not be representative of other medical schools in the countries studied.

9. Conclusion

The study provided information on faculty perception regarding the differential progression of undergraduate medical students. Respondents believed that it was feasible to offer a flexible-length individually tailored outcomes-based undergraduate medical curriculum at the two institutions and this can also be considered in the two nations though there may be challenges in certain regions and institutions. Future studies in other institutions and countries are required. Findings provide a foundation to further the design and further develop CBME. Respondents agreed that this is an important concept but mentioned there were significant challenges. Online learning and AI are constantly progressing and can better support the creation of individualized student learning pathways. Students can study at a pace comfortable for them while developing the competencies required of a physician.

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References

1. Frank JR, Snell LS, Cate OT, et al. Competency-based medical education: theory to practice. *Med Teach*. 2010; 32(8):638-645.
2. Harris P, Snell L, Talbot M, Harden RM. Competency-based medical education: implications for undergraduate programs. *Med Teach*. 2010;32(8):646-650.
3. Carraccio C, Wolfsthal SD, Englander R, Ferentz K, Martin

- C. Shifting paradigms: from Flexner to competencies. *Acad Med.* 2002;77(5):361-367.
4. Orgill BD, Simpson D. Toward a glossary of competency-based medical education terms. *J Grad Med Educ.* 2014;6(2):203-206.
 5. Chan KS, Zary N. Applications and challenges of implementing artificial intelligence in medical education: integrative review. *JMIR Med Educ.* 2019;5(1):e13930.
 6. Cangiarella J, Fancher T, Jones B, et al. Three-year MD programs: perspectives from the Consortium of Accelerated Medical Pathway Programs (CAMPP). *Acad Med.* 2017;92(4):483-490.
 7. Flotte TR, Larkin AC, Fischer MA, et al. Accelerated graduation and the deployment of new physicians during the COVID-19 pandemic. *Acad Med.* 2020;95(10):1492-1494.
 8. Rao RC, Dlouhy BJ. Shortening medical education. *JAMA.* 2012;308(2):133-134.
 9. Pershing S, Fuchs VR. Restructuring medical education to meet current and future health care needs. *Acad Med.* 2013;88(12):1798-1801.
 10. Gonnella JS, Callahan CA, Erdmann JB, et al. Preparing for the MD: how long, at what cost, and with what outcomes? *Acad Med.* 2021;96(1):101-107.
 11. Falcon DJ. The health care gap in rural Malaysia. *New Malays.* 2019;37(6):28-36.
 12. Ullah M. One doctor for 877 persons in Pakistan. <https://dnd.com.pk/one-doctor-for-877-persons-in-pakistan/263421>. Published February 2022. Accessed April 8, 2023.
 13. Skochelak SE, Stack SJ. Creating the medical schools of the future. *Acad Med.* 2017;92(1):16-19.
 14. Colchester K, Hagrais H, Alghazzawi D, Aldabbagh G. A survey of artificial intelligence techniques employed for adaptive educational systems within e-learning platforms. *J Artif Intell Soft Comput Res.* 2017;7(1):47-64.
 15. Memon AR, Rathore FA. Moodle and online learning in Pakistani medical universities: an opportunity worth exploring in higher education and research. *J Pak Med Assoc.* 2018;68(7):1076-1078.
 16. Iqbal S, Ahmad S, Willis I. Influencing factors for adopting technology enhanced learning in the medical schools of Punjab, Pakistan. *Int J Inf Commun Technol Educ.* 2017;13(3):27-39.
 17. Ganeson M, Amirthalingam SD, Kim KS. Five tips for teaching and learning during the COVID-19 movement control order era: a family medicine perspective. *Malays J Med Sci.* 2020;27(6):183-186.
 18. Lomis KD, Mejicano GC, Caverzagie KJ, Monrad SU, Pusic M, Hauer KE. The critical role of infrastructure and organizational culture in implementing competency-based education and individualized pathways in undergraduate medical education. *Med Teach.* 2021;43(sup2):S7-S16.
 19. Reyes BH. Shortening undergraduate medical training: now and for all medical schools in Chile? *Rev Med Chil.* 2016;144(1):7-10.
 20. Cangiarella J, Gillespie C, Shea JA, Morrison G, Abramson SB. Accelerating medical education: a survey of deans and program directors. *Med Educ Online.* 2016;21:31794.
 21. Bhagat V, Haque M, Bin Abu Bakar YI, Husain R, Khairi CM. Emotional maturity of medical students impacting their adult learning skills in a newly established public medical school at the east coast of Malaysian Peninsula. *Adv Med Educ Pract.* 2016;7:575-584.
 22. Shacklady J, Holmes E, Mason G, Davies I, Dorman T. Maturity and medical students' ease of transition into the clinical environment. *Med Teach.* 2009;31(7):621-626.
 23. Kandasamy S, Catherine AP, Gopalakrishnan S. Challenges in implementation of competency based medical education: a cross sectional survey among medical faculty in India. *Res Sq [Preprint].* 2021 Jul 28. <https://doi.org/10.21203/rs.3.rs-753685/v2>
 24. Holmboe ES, Ward DS, Reznick RK, et al. Faculty development in assessment: the missing link in competency-

- based medical education. *Acad Med.* 2011;86(4):460-467.
25. Sethi A, Javaid A. Accreditation system and standards for medical education in Pakistan: it's time we raise the bar. *Pak J Med Sci.* 2017;33(6):1299-1300.
26. Wajid G, Sethi A, Khan RA, Aamir HS. World Federation for Medical Education: appropriateness of basic medical education standards in Pakistan. *Pak J Med Sci.* 2019; 35(5):1185-1191.
27. Raymond JR Sr, Kerschner JE, Hueston WJ, Maurana CA. The merits and challenges of three-year medical school curricula: time for an evidence-based discussion. *Acad Med.* 2015;90(10):1318-1323.
28. Leong SL, Cangiarella J, Fancher T, et al. Roadmap for creating an accelerated three-year medical education program. *Med Educ Online.* 2017;22(1):1396172.
29. Han ER, Yeo S, Kim MJ, Lee YH, Park KH, Roh H. Medical education trends for future physicians in the era of advanced technology and artificial intelligence: an integrative review. *BMC Med Educ.* 2019;19(1):460.
30. Singaravelu SL, Nair AS. Technology deployment in self-directed learning: a guide for new path in medical education. *SBV J Basic Clin Appl Health Sci.* 2021;4(2): 51-53.

Appendix 1. Semi-structured Interview Guide

Kindly introduce yourself.

What is your perception about undergraduate medical students progressing at a differential rate dependent on their attaining the required competencies?

What are the advantages of adopting this system?

What challenges are associated? How can these be addressed?

What is your level of familiarity with online learning in medical education? How familiar are you with the application of artificial intelligence in medical education? What is your self-rated level of competence in these areas?

Do you believe online learning and artificial intelligence can support the creation of an individualized learning pathway for students?

Do you believe we are able to offer assessments on demand to students?

How can we best determine whether a student has attained the required competencies?

Should we charge more for a student who wants to progress faster through the course?

What accreditation and regulatory hurdles do you foresee?

Any other comments?