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Original Paper

Medical Student Training in eHealth: Scoping Review

Jean-François Echelard[1], MD; François Méthot[1*], BBA; Hue-Anh Nguyen[1*], MD; Marie-Pascale Pomey[2,3,4], MD, PhD

[1]Faculty of Medicine, Université de Montréal, Montréal, QC, Canada

[2]Research Centre, University of Montreal Hospital Center, Montreal, QC, Canada, University of Montreal Hospital Center, Montreal, QC, Canada

[3]Department of Management, Evaluation and Health Policy, School of Public Health, Université de Montréal, Montreal, QC, Canada

[4]Department of Family Medicine and Emergency Medicine, Faculty of Medicine, Université de Montréal, Montreal, QC, Canada

[*]these authors contributed equally

Corresponding Author:
Jean-François Echelard, MD
Faculty of Medicine
Université de Montréal
2900 Edouard Montpetit Blvd
Montréal, QC, H3T 1J4
Canada
Phone: 1 514 343 6111
Email: jfechelard@hotmail.com

Abstract

Background: eHealth is the use of information and communication technologies to enable and improve health and health care services. It is crucial that medical students receive adequate training in eHealth as they will work in clinical environments that are increasingly being enabled by technology. This trend is especially accelerated by the COVID-19 pandemic as it complicates traditional face-to-face medical consultations and highlights the need for innovative approaches in health care.

Objective: This review aims to evaluate the extent and nature of the existing literature on medical student training in eHealth. In detail, it aims to examine what this education consists of, the barriers, enhancing factors, and propositions for improving the medical curriculum. This review focuses primarily on some key technologies such as mobile health (mHealth), the internet of things (IoT), telehealth, and artificial intelligence (AI).

Methods: Searches were performed on 4 databases, and articles were selected based on the eligibility criteria. Studies had to be related to the training of medical students in eHealth. The eligibility criteria were studies published since 2014, from a peer-reviewed journal, and written in either English or French. A grid was used to extract and chart data.

Results: The search resulted in 25 articles. The most studied aspect was mHealth. eHealth as a broad concept, the IoT, AI, and programming were least covered. A total of 52% (13/25) of all studies contained an intervention, mostly regarding mHealth, electronic health records, web-based medical resources, and programming. The findings included various barriers, enhancing factors, and propositions for improving the medical curriculum.

Conclusions: Trends have emerged regarding the suboptimal present state of eHealth training and barriers, enhancing factors, and propositions for optimal training. We recommend that additional studies be conducted on the following themes: barriers, enhancing factors, propositions for optimal training, competencies that medical students should acquire, learning outcomes from eHealth training, and patient care outcomes from this training. Additional studies should be conducted on eHealth and each of its aspects, especially on the IoT, AI, programming, and eHealth as a broad concept. Training in eHealth is critical to medical practice in clinical environments that are increasingly being enabled by technology. The need for innovative approaches in health care during the COVID-19 pandemic further highlights the relevance of this training.

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KEYWORDS

medical education; eHealth; digital health; mHealth; health apps; telehealth; artificial intelligence; electronic health records; programming; internet of things

Introduction

Background

In 2018, a survey by the Canadian Medical Association showed that approximately "75% of Canadians believe new technologies could solve existing issues in [the] health care system" [1]. In reality, such technologies are continually being developed to address health care needs in diverse fields. For instance, remote medical interventions can enable access to health care in rural areas as well as support diabetes management [2,3]. Medical mobile apps can enhance asthma management [4]. Artificial intelligence (AI) can measure cancer risk or predict mental health outcomes [5,6]. The concept that is defined by the use of such technologies in health care is termed *eHealth* [7]. As the COVID-19 pandemic challenges health care systems worldwide, eHealth technologies enable physicians to continue to provide medical consultations while maintaining social distancing. In this context, clinicians must "conduct more virtual consultations than before, while uncertain about how to do so effectively." This crisis also highlights the need for innovative approaches in health care [8]. eHealth encompasses many technologies and is not limited to remote medical interventions.

Defining eHealth

Various definitions of eHealth have been proposed by many authors during the last two decades. The definitions vary in breadth, ranging from being vague to highly specific. According to recent definitions that could be deemed either too broad or too narrow, eHealth is the use of information and communication technologies to enable and improve health and health care services [9]. Various technologies fit into this definition when they are applied to health. This is notably the case for AI, telemedicine, the internet of things (IoT), connected devices, and mobile health (mHealth). Although some may consider the following technologies as part of eHealth, the scope of our definition does not include 3D printing, robotics, blockchain, and nanotechnology. Important terms regarding eHealth are defined in Multimedia Appendix 1.

Strategic Approaches to eHealth

National eHealth strategies have been adopted by various countries, including Australia in 2008 and France in 2016 [10,11]. The World Health Organization also published a *national eHealth strategy toolkit* in 2012 [12]. According to the aforementioned eHealth strategies, adequate workforce education and training are required and may depend upon "development, integration or changes to existing curricula." In the same spirit, in 2014, Canada developed a set of eHealth competencies for undergraduate medical education, acknowledging that medical students have to be better prepared "to practice in modern, technology-enabled, clinical environments" [9]. Although such initiatives clearly indicate that there is a need to train the next generation of physicians for future medical practice, it is relevant to examine the education that medical students are actually getting regarding eHealth and how this training is perceived. The literature on this topic is heterogeneous and has not yet been comprehensively reviewed.

Goal of This Study

This review aims to evaluate the extent and nature of the existing literature on medical student training in eHealth worldwide. More precisely, we approached this study with the following research questions: (1) to what extent and how are medical students being educated about eHealth and (2) what are the barriers, enhancing factors, and propositions regarding this training? This review focuses primarily on some key technologies under the umbrella of eHealth, namely mHealth, the IoT, telehealth, and AI.

Methods

Theoretical Framework

We followed the 5-stage framework by Arksey and O'Malley in conducting this scoping review: identifying the research question, identifying relevant studies, screening studies, charting the data, and collating, summarizing, and reporting the results [13]. We also followed guidelines from the PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews).

Identifying the Research Question

As described earlier, this review's primary focus is to map the literature on medical student training in eHealth, given the continuous development of eHealth technologies in medicine and the importance of adequate education for doctors who will have to work in such an environment. Given the breadth of eHealth, the scope of this review has been narrowed to some key technologies under the umbrella of eHealth; therefore, mHealth, the IoT, telehealth, and AI are the primary focus of this review. However, other technologies directly relevant to the research question are deemed to be of interest for this review.

Identifying Relevant Studies

A systematic literature search was performed in 4 medical databases (Cochrane Library, MEDLINE [Medical Literature Analysis and Retrieval System Online], Web of Sciences, and the *Journal of Medical Internet Research* [JMIR]: *Medical Education*) using keywords developed through a preliminary search on the review topic. The databases were selected based on their broad spectrum of results, specificity for peer-reviewed articles, and relevance for medical topics. The preliminary search on these databases yielded relevant articles, and these databases were therefore deemed adequate. Similarly, no search for gray literature was done because the scope of this review did not extend to articles that had not been peer reviewed. The keywords were selected to gather results about medical student training in eHealth as a broad concept, and some were specifically added to increase sensitivity for articles regarding AI, the IoT, and mobile apps. Increasing sensitivity for these technologies was considered congruent with the primary focus of this review on a subset of key technologies under the umbrella of eHealth. The search terms used in this review are described in Textbox 1.

The search was first performed in June 2019 and included publications from January 2014 to June 2019. Articles that were more than 5 years old were considered less likely to be informative of the present situation as, in general, eHealth and technology are evolving at a rapid pace; this produced an initial publication count of 1624 studies for review. A second iteration of this search was performed in December 2019 to include articles published since June 2019, and this produced 109 additional studies, resulting in an updated initial publication count of 1733 studies. Only articles published in English and French were included in this review.

Textbox 1. Keywords used for database searches.

(santé connectée OR m-santé OR santé numérique OR santé digitale OR e-santé OR internet santé OR digital health OR ehealth OR e-health OR drug reference* OR Medscape OR Epocrates OR UpToDate OR medical domotic* OR mhealth app OR mhealth apps OR mhealth OR mhealth device* OR smart health device* OR connected health device* OR smart health apps OR mobile health app OR mobile health apps OR medical app OR medical apps OR smart medical device* OR connected health OR connected medical apps OR connected medical app OR mobile medical app OR mobile medical apps OR connected health app OR connected health apps OR connected medical device* OR m-health OR m-health app OR m-health apps OR m-health device* OR mobile health device* OR mobile health app OR mobile health apps OR smart apps OR smart app OR internet of things OR iot OR ai OR artificial intelligence OR deep learning OR machine learning OR appjam OR app jam OR ia OR intelligence artificielle OR apprentissage profond OR apprentissage machine OR appli* médicale* OR app* médicale* OR lanthier) AND (medstudent* OR med student* OR medical student* OR future doctor* OR future physician* OR curriculum* OR externe* OR externat OR étudiant* en médecine OR medschool OR medical school OR faculté* de médecine OR programme* de médecine OR étude* en médecine OR formation* médicale* OR formation* en médecine)

Study Selection

Following the removal of duplicates from the initial publication count, inclusion and exclusion criteria (Textbox 2) were applied during the study selection process, which was divided into 2 main phases.

In the first phase, after the removal of duplicates, each of the 1451 remaining articles was reviewed by 1 of the 3 authors (JE, FM, and HN), initially excluding articles if the title and abstract were not related to training in eHealth or to medical students. Full texts were read by JE, FM, or HN when the title and abstract were insufficient to include or exclude a given study. The first author (JE) subsequently screened all studies labeled as *included* using the finalized inclusion and exclusion criteria. This resulted in the selection of 16 studies, including both previously described iterations of the search.

In the second phase, we conducted a backward and forward reference search on the 16 articles selected in the first phase. All 746 newly obtained references were subjected to the same selection process as in the first phase using the same inclusion and exclusion criteria. Nine additional studies were added at the end of this process, including both iterations of the search.

Thus, the final count of studies included in this scoping review was 25. Throughout this whole process, one author (MP) assessed each phase to ensure and verify the accuracy of the work and contributed to the analysis of results.

Textbox 2. Inclusion and exclusion criteria used for study selection.

Inclusion criteria

- Related to training in eHealth
- Related to the training of medical students. When a study population was not limited to medical students, only data exclusive to medical students were included in this review

Exclusion criteria

- Limited to e-learning of subjects other than eHealth
- Not supported by empirical data, obtained either directly or through a literature review
- Interns, residents, and doctors were not considered medical students as they had already obtained their medical degrees and finished most of their curriculum
- Not published in a peer-reviewed journal
- Published in a language other than English or French
- No access to the full article

Charting Data (Data Extraction)

We created and used a data extraction grid on a spreadsheet to chart the data from the included studies into different categories including study characteristics, target population, intervention characteristics, data regarding various aspects of eHealth, and other statements regarding the goal of this review (Multimedia Appendix 2). Throughout the charting process, we iteratively revised the extraction grid to refine its components.

Collating, Summarizing, and Reporting the Results

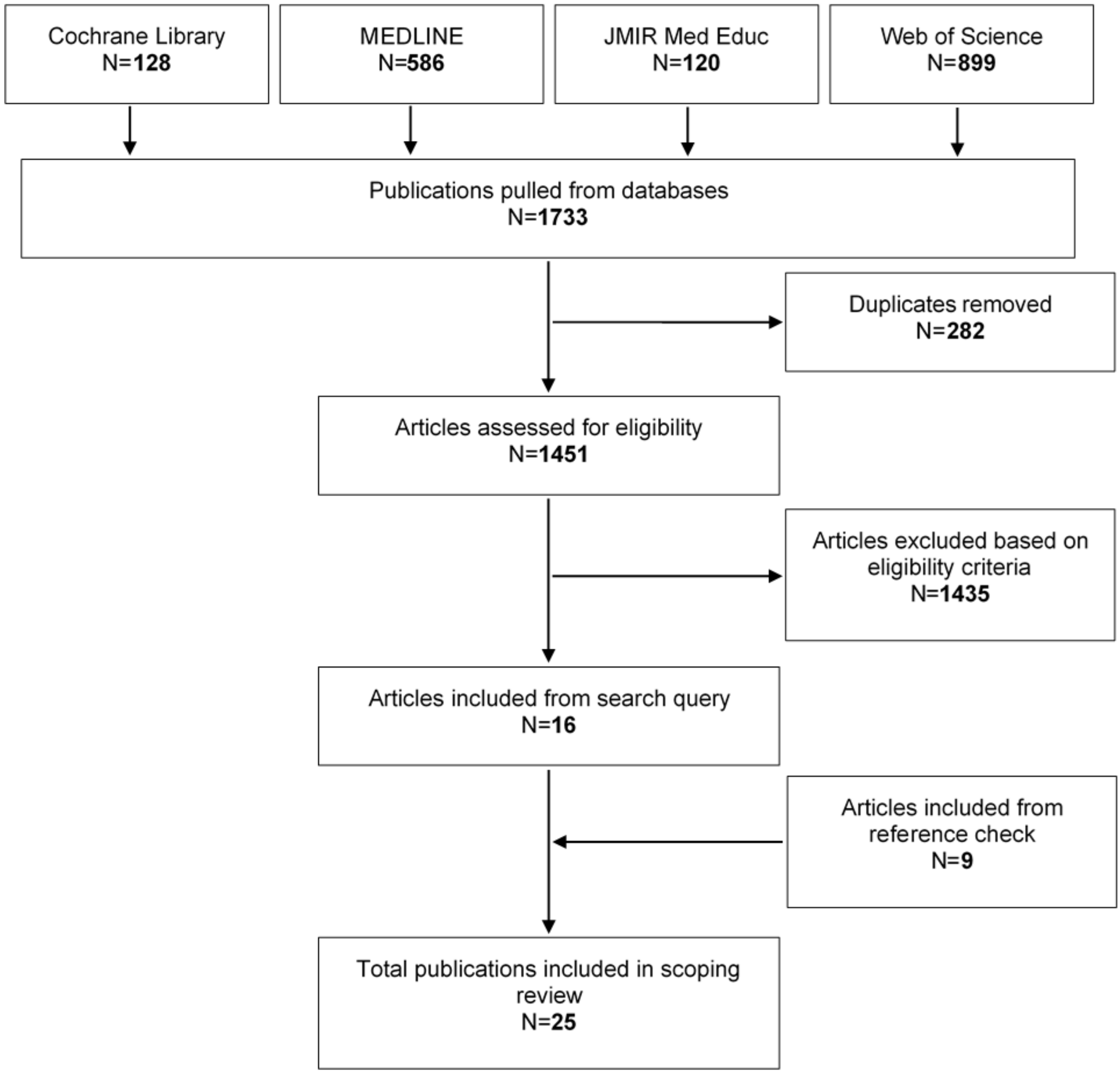
Results regarding the methodology were thematically subdivided into paragraphs supported by tables as well as figures produced using Microsoft Excel. Findings from included articles were deemed relevant in light of the goals of this review. These relevant findings are presented in the form of tables as we aimed to present an overview of the findings without weighing or aggregating these results. Data regarding methodological characteristics and data regarding relevant findings were not aggregated in a single table because the size of such a table would have hindered readability and interpretability. Critical appraisal of included articles and the assessment of the robustness and generalizability of the findings were not performed for this review.

Results

Selection Process

A total of 25 articles were included in this scoping review. The selection process of these articles is detailed in Figure 1, and their characteristics are summarized in Multimedia Appendix 3 [14-38].

Figure 1. Flowchart of the selection process.



Characteristics of Included Studies

Included studies were published every year from 2014 to 2019. Notably, nearly half (12/25, 48%) were published in 2019. Studies were categorized as *Intervention* (13/25, 52%) or *No Intervention* (12/25, 48%) depending on whether they included an experimental component such as a pilot program. This is summarized in Figure 2.

The aspects of eHealth covered by the included studies are summarized in Figure 3. Notably, AI and the IoT were only studied in a *No Intervention* manner, although programming was always studied through interventions.

Figure 2. Number of included articles by year of publication and presence of an intervention.

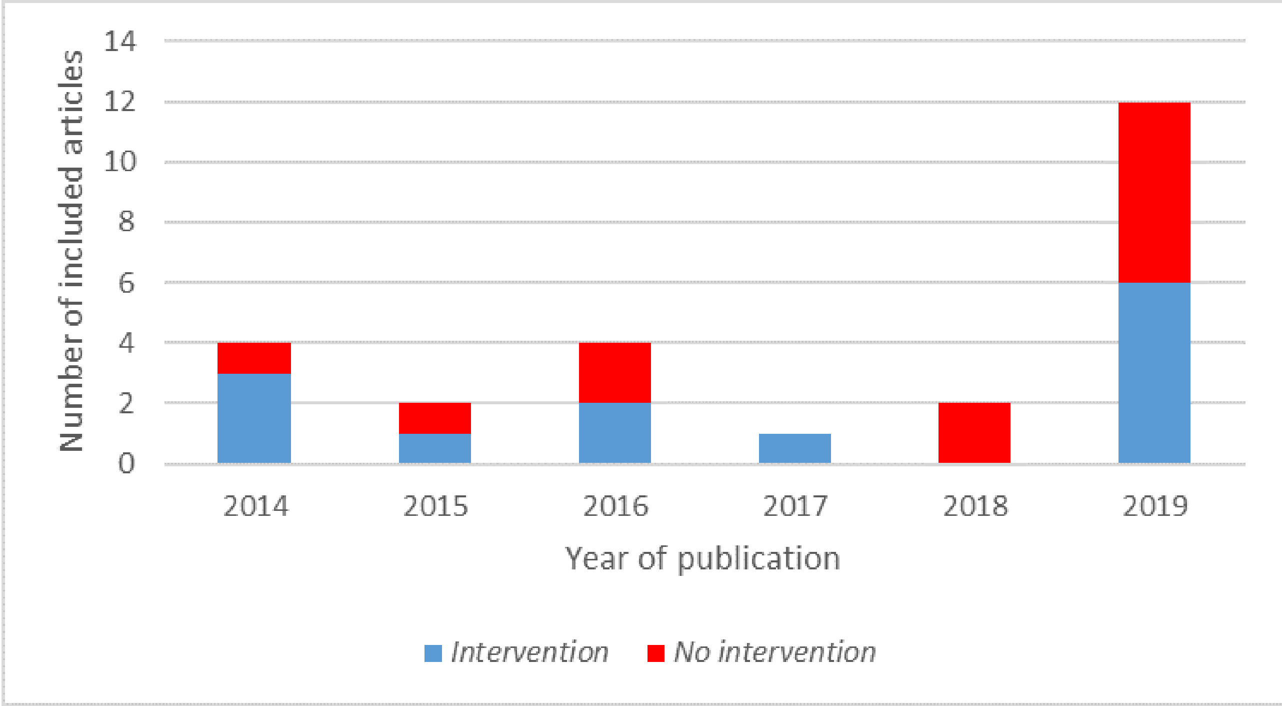
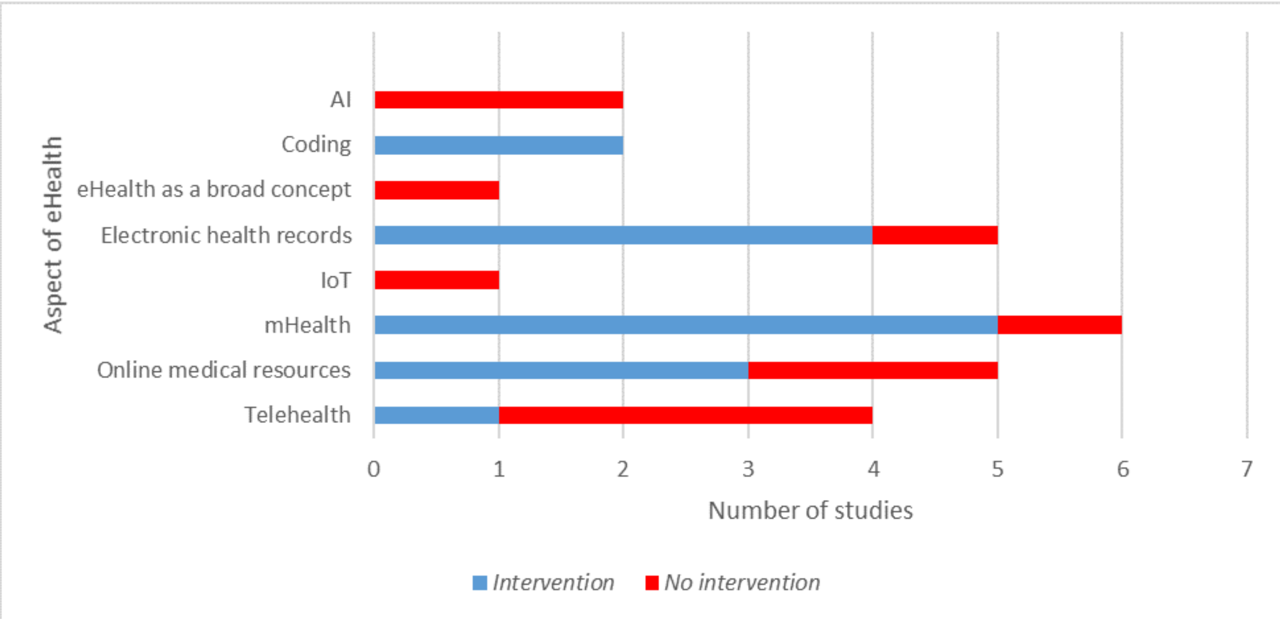


Figure 3. Number of articles discussing each aspect of eHealth. AI: artificial intelligence; IoT: internet of things.



Of the 20 papers that studied a population of medical students, 11 (55%) had a sample size of more than 100. The smallest study had 9 respondents, and the largest had a population of 17,202. Only half of the studies specified the student's gender distribution; overall, 55.82% (623/1116) of students whose gender was specified were female. A total of 4 of the included articles had a study population composed of medical school deans, program directors, faculty members, or similarly involved personnel instead of medical students.

Of the studies that did not include an intervention, most consisted of surveys answered by medical students or faculty members. One study was a mixed methods review that complemented a search of the existing literature with interviews conducted with the administration or faculty members of medical schools that included telemedicine in their curricula. Only 1 *No Intervention* study was a pure literature review. Among all the included articles, a few contained quantitative data only (5/25, 20%) or qualitative data only (6/25, 24%) and the majority were conducted with a mixed methodology with both types of data (14/25, 56%). The included studies were published in 17 different journals, with *JMIR Medical Education* (4/25, 16%), *Academic Medicine* (4/25, 16%), the *Journal of Telemedicine and Telecare* (2/25, 8%), and *Medical Teacher* (2/25, 8%) being represented more than once.

Studies were conducted in 12 different countries, with the United States being the most represented. Multiple studies have also been conducted in Canada, Australia, and Germany. The study locations are displayed in Table 1. No included studies were conducted in South America.

Of the 25 included studies, 10 (40%) did not state their sources of funding, if any. Only 4% (1/25) study was funded by a private company, the Western Connecticut Health Network. Another received free UpToDate subscriptions from Wolters Kluwer, but no monetary funding from the company. Moreover, 32% (8/25) explicitly stated that they were not funded, 12% (3/25) were funded by academic institutions, and 12% (3/25) were financed by public American funding agencies.

Table 1. Number of studies by study location.

Country	Value, n (%)
United States	10 (40)
Canada	3 (12)
Australia	2 (8)
Germany	2 (8)
France	1 (4)
Oman	1 (4)
Russia	1 (4)
Rwanda	1 (4)
Singapore	1 (4)
Turkey	1 (4)
United Kingdom	1 (4)
Zimbabwe	1 (4)

Interventions and Main Findings

Of the studies that described an intervention, most measured its effect by assessing the students' self-reported confidence in using eHealth. Three used more objective methods, either examination results or faculty observation during simulated patient sessions. None of the included articles sought to demonstrate that the eHealth training of medical students objectively influenced care in nonsimulated environments. Most *intervention* studies provided medical students with training and information on eHealth, although only 2 did not. Three studies further provided hardware to medical students, and another provided access to a web-based medical resource. Table 2 contains a summary of all the interventions from the included articles, along with the most relevant findings regarding these interventions. The main findings relevant to this review's research question for all *No Intervention* articles are presented in Table 3. A summary of the characteristics of all included articles is presented in Multimedia Appendix 3 [14-38], including authors, study location, year of publication, and which aspect of eHealth had been studied.

Table 2. Summary of all interventions from the included articles and related findings.

No.	Aspect of eHealth: aim of the study	Intervention and related findings
1	mHealth[a]: to determine whether providing students with preloaded iPad Minis would enhance their experience and increase awareness of and access to mHealth information resources for clinical care in a rural environment	• Tablets preloaded with health apps were given to third-year students, who were also asked to complete surveys and a journal • An overall positive value for participants who "accessed essential clinical information, experienced improved patient education interactions, and accessed tools and resources to assist them in their experiences" • Lessons were learned regarding the project • A clerkship director's request has been made to integrate the project beyond the original pilot
2	Web-based medical resources: to describe the effect of the integration of the OMIM[b] database during the first year of medical school	• The OMIM database was taught to students who later performed self-assessments of short-term and long-term learning • Students' confidence in clinical genetics skills increased after the OMIM education session • Acknowledging and incorporating students' search preferences can engage them in the importance of identifying appropriate resources
3	Programming: to determine whether it is possible to teach medical students the basics of programming in 2 days and whether students value programming and its teaching in medical school	• The Coding for Medics course was developed. After 2 days of intensive teaching, participants were given a few weeks to submit a project • Basics of programming successfully taught in 2 days • Programming teaching should be offered but optional, "practical" and "relevant to clinical problems" • Computational thinking learned and considered "transferable" • Programming valued as an important skill for the future and oversubscribed because of enthusiasm • Programming deemed necessary for the development of eHealth technologies
4	Programming: to describe a new elective computing course and discuss how it prepares medical students to use computer science and technology	• A 14-month Computing for Medicine certificate course (C4M) was developed in collaboration with the Department of Computer Science, University of Toronto. The C4M included workshops, seminars, and a project • Reinforced valuing and understanding of technology • Programming and algorithmic and logical thinking skills were taught • Medical schools should consider computer literacy as an essential skill to enhance engagement with technology, collaboration with developers, and patient care quality • Questions raised about broader adoption of learn-to-code programs, whether elective or mandatory
5	EHRs[c]: to develop a course module and evaluate it to identify and share best practices and strategies	• Mandatory participation in EHR full-day intensive training over 2 days for fifth-year students within their seminar in internal medicine • Positive attitude toward EHR usage and software • Higher perceived benefits of EHR for doctors and nurses than for other professionals or patients • Low perceived benefits of EHR for coworking in multiprofessional team • Documentation is a core competency • More training, standardized examination, and awareness regarding EHR are needed
6	Online medical resources: to verify the hypothesis that removing the subscription cost barrier to accessing EBCRs[d] will lead to high student uptake and to an improvement in educational outcomes	• Agreement with Wolters Kluwer to facilitate the donations of UpToDate subscriptions to students • Access to devices and the internet is not a barrier • The focus should be on web-based tools and evidence • Higher use of EBCRs when cost barrier removed • Lower UpToDate uptake by preclinical students • The introduction of EBCRs during the last year of medical school may lead to habit formation • Improvement in examination performance of this graduating class • Equitable access to information is required
7	mHealth: to allow students to acquire and develop skills using devices and health apps in a clinical context	• A single-semester elective option, "Computer Games and Applications for Health and Well-being," was introduced for first-year students • Students not as adept at using mHealth devices as the literature had predicted • Ownership of a suitable mobile device was lacking • Availability of useful, free apps was limited • Key lessons were learned, which we wish will help prepare the medical curriculum
8	Telehealth and mHealth: to deliver orthopedics education through a mobile app, MyDoc, although teaching medical students about secure communication and the Personal Data Protection Act of Singapore	• Third-year students were asked to use the MyDoc mobile app that allowed communication in the form of personal messages, case discussions, and sharing of patient details with peers • Excellent acceptance and satisfaction • Technical issues needed to be addressed • There was a need for compliance with privacy laws in the context of the growth of telehealth, so medical schools should consider integrating this secure communication tool to their training

No.	Aspect of eHealth: aim of the study	Intervention and related findings
9	Online medical resources: to analyze the effectiveness of a new EBM OSCE[e] for the end of third-year students	• In this OSCE, students were provided with computer stations and performed online searches to answer a standardized patient’s questions • An average of 4 search tools were used • Most commonly used websites were UpToDate and Google • Most students successfully provided the patient with relevant evidence • This new OSCE allowed proper assessment of student EBM skill
10	EHRs: to verify the hypothesis that an educational intervention for second-year students improves their ability to use the EHR in a way that enhances patient-provider interaction (EHR ergonomics) during a SP[f] encounter	• EHR ergonomic training’s impact on patient-provider interaction during SP encounters was compared with the impact of basic EHR training with no additional EHR ergonomic training • EHR use improved with EHR ergonomic training • Students felt improvement in engaging the patients, articulating EHR use benefits, addressing patient concerns, positioning EHR device, and integrating EHR in patient encounter • A minimum of 3 ergonomic training sessions were necessary to see overall improvement • Self-perceptions were consistent with performance as observed by SPs and faculty members
11	mHealth: to determine whether medical students, with little or no prior knowledge or training in app development, can use development tools to develop useful health apps	• Medical students were taught the fundamentals of health app design and development and asked to use the iBuildApp environment to develop an app • Perceived need for such training increased • Previous programming experience was the strongest influencer of a positive experience • It is possible to teach medical students the fundamentals of app design so that they may contribute to health app development
12	mHealth: to determine the ways by which third-year students used mobile technology for learning and clinical decision support	• Students were provided an iPad and information was collected with beginning and end-of-year questionnaires, iPad usage logs, weekly rounding observations, and weekly semistructured student interviews over a 12-month period • Tablet computers used to enhance patient care and learning in clinical contexts • Data service capability and midlevel storage capacity should be provided on each device • Quarterly app training should be integrated to increase effectiveness in clinical decision support
13	EHRs: to address a training gap by describing the Sim[g]-EHR curriculum and sharing participant feedback and lessons learned	• The Sim-EHR curriculum, consisting of simulated charts for virtual patients, was implanted as part of the third-year family medicine clerkship • Increased comfort with finding information, inputting orders, and updating a health maintenance tool • Recognition of the value of the activity • Expressed frustrations with timing and opportunity costs • Improved ability to place orders and update chart • No difference in ability to use a health maintenance tool to create routine disease screening, prevention, and management alerts

[a]mHealth: mobile health.

[b]OMIM: Online Mendelian Inheritance in Man.

[c]EHR: electronic health record.

[d]EBCR: evidence-based clinical resources.

[e]EBM OSCE: Evidence-Based Medicine Objective Structured Clinical Examination.

[f]SP: standardized patient.

[g]Sim: simulated.

Table 3. Summary of the main findings regarding medical students' training in eHealth for articles that did not contain interventions.

No.	Aspect of eHealth: aim of the study	Main findings
14	AI[a]: to examine medical students' perceptions of the impact of AI on radiology, contributing factors, and influence on their choice of specialty	• Students believed education on AI is important • Students recommended inviting experts • Students recommended discussing AI in preclinical radiology lectures • AI was not mentioned in the curriculum • AI courses and projects were equally effective as formal computer science education • More education needed to relieve students' anxiety and ensure the long-term prosperity of radiology
15	AI: to assess medical students' feelings on AI in radiology and medicine and to evaluate whether they were worried about AI replacing radiologists and other physicians	• Students want AI and deep learning to be incorporated into medical curricula • Students need better understanding of deep learning and AI, as well as knowledge of "what data are needed for which type of tasks" and "how AI algorithms should be evaluated" • Training will maybe compensate for the tendency of males and more tech-savvy respondents to be more confident, less concerned, and more interested in AI being taught
16	Telehealth: to describe telemedicine education and training implementation and to evaluate the knowledge, attitudes, and practices of deans and associate deans	• Telemedicine training implementation was limited compared with mandatory legislation • Most respondents expressed a positive attitude toward telemedicine and its potential threats to present medical practices • Barriers such as lack of knowledge, resources, support, practice, and funding in telemedicine were identified
17	Telehealth: to analyze the legal, economic, and research-related factors associated with the implementation of telemedicine programs in various countries	• Student training in eHealth was one of the factors associated with higher odds of implemented teleradiology and telepathology • The average scholarly output related to telemedicine was much higher in countries with versus without training of health care providers
18	IoT[b]: to determine future health professionals' opinions regarding trends in health-related technology, to determine their readiness to use health technologies, and to identify the use of IoT technology in medical applications	• Most had no knowledge on the IoT and did not follow publications regarding the IoT • Most stated that IoT will affect health, education, genetic and data security, and medical and nursing practices, and that IoT can be used in smart patient follow-ups and mobile health apps • Opinions regarding the future of IoT should focus on vital follow-up (blood glucose and electrocardiogram), wearables, and chronic diseases • Not aware of the effects of robots or cannot imagine robotic health professionals
19	eHealth as a broad concept: to explore the progress of eHealth training according to curriculum staff and decision makers from all 19 Australian medical schools	• All participants knew about eHealth • No formal eHealth training programs had been established • Informal training and experiential learning during clinical placements were acknowledged • eHealth training was considered "important, but not important enough" • There were competing curricular priorities, a lack of dialogue with the health system, and no strong drivers for change • The situation was unlikely to change until accrediting bodies expect competence in eHealth
20	EHRs[c]: to examine student accounts of EHR use during a time period in which implementation of EHR systems dramatically increased	• Students used EHRs in the majority of their clerkships; this use increased from 2012 to 2016 • Increase in student entry of information into EHRs • Decrease in mean percentage of clerkships in which students entered orders • Decrease in student use of paper health records • Need to incorporate EHR training into medical school curricula to ensure patient safety and care
21	mHealth[d]: to better understand the experiences in implementing mobile technology initiatives during the clinical years of undergraduate medical education	• Eight best practices for introducing mobile technology in the clinical years were identified: plan before implementation, define focused goals, establish a tablet culture, recruit an appropriate implementation team, invest in training, involve students in mentoring, accept variable use, and encourage innovation
22	Web-based medical resources: to examine access, attitude, and training regarding use of electronic resources and EBM[e] by students after the implementation of the MEPI[f]	• Most did not receive formal training in EBM • Most who received formal training in EBM found it inadequate • Most who did not receive formal training wished to receive EBM training • Most did not receive formal training in journal club presentation and scientific reading skills, among which most showed interest in learning these skills • Most felt more or less confident in their capabilities of distinguishing the value of medical literature with only 8% (5/61) feeling extremely secure • Training required on evaluating sources • Inadequate training regarding access to medical literature and information; need to do better

No.	Aspect of eHealth: aim of the study	Main findings
23	Online medical resources: to describe medical students' behavior and training regarding information search and evidence appraisal	• Most reported receiving formal education on information searches • This education rarely covered general purpose internet sources, such as Google and Wikipedia, which students use the most • EBM summaries were often used and rated higher for accuracy and trustworthiness • Bibliographic databases were used the least and rated lower on accessibility and ease of understanding • Training on search tools including general purpose internet sources could enhance curriculum
24	EHRs: to determine the amount of time the student spent on EHR use and the potential benefits of student EHR use on education outcomes	• Students on the Internal Medicine rotation logged more hours per day on the EHR than students in other clerkships • Low EHR use in Obstetrics and Gynecology, Neurology, and General Surgery • EHR activity during the Internal Medicine rotation corresponded to half of an average workday • No association between self-reported and observed EHR use • No correlation between EHR use and patient care based on examinations
25	Telehealth: to characterize medical schools' approaches for implementing telemedicine training (mixed methods review)	• The diverse approaches were a promising sign of accelerating growth in this domain • Future effort needed on the part of institutions to make training meaningful and comprehensive • Concerns included telemedicine's inclusion in the curriculum being *cursory* or not *meaningful*

[a]AI: artificial intelligence.

[b]Iot: internet of things.

[c]EHR: electronic health record.

[d]mHealth: mobile health.

[e]EBM: evidence-based medicine.

[f]MEPI: Medical Education and Partnership Initiative.

Discussion

Overview of the Literature

This review aimed to evaluate the extent and nature of the existing literature on medical student training in eHealth, while examining what this education consists of, the barriers, enhancing factors, and propositions for improving medical curriculum. This review focuses primarily on key technologies such as mHealth, the IoT, telehealth, and AI. An overview of the literature is discussed in this subsection.

The most studied aspects of eHealth were mHealth, web-based medical resources, electronic health records (EHRs), and telehealth, while eHealth as a broad concept, the IoT, AI, and programming were the least studied aspects. The marked increase in the number of publications on eHealth and medical students in 2019 (6 times more than the previous year) indicates that a greater amount of research has been conducted in the last few years and is likely to signal a larger number of publications in the next few years.

A total of 52% (13/25) of the included articles contained an intervention. Some aspects of eHealth were mostly studied through an intervention; this was the case for mHealth, EHRs, web-based medical resources, and programming. On the contrary, no interventions were part of the methodology of most studies regarding telehealth, AI, the IoT, and eHealth as a broad concept. These results might indicate that some aspects of eHealth are easier to examine or best studied through interventions while others are not. For instance, the IoT and AI were only covered through surveys without any interventions, perhaps because it would be difficult to build a practical yet realistic training program regarding these topics. Programming for medical students was examined through studies containing interventions, which could be attributed to its arguably greater potential for hands-on training (eg, by asking students to develop a simple program) compared with other technologies. Overall, the study population consisted of slightly more females than males, in accordance with the gender distribution of medical students in western countries such as the United States and the United Kingdom [39,40].

Barriers, Enhancing Factors, and Propositions

The findings of the included studies comprehended barriers, enhancing factors, and propositions for improving medical training in eHealth and may also help researchers formulate other hypotheses on the subject. Identified barriers include competing for curricular priorities, lack of dialogue with the health care system, no strong drivers for change, technical issues (eg, internet access), and limited availability of useful, free items. Enhancing factors include student characteristics (eg, tech-savviness), students' interest, careful planning, and goal setting. Propositions include implementing new courses and rotations, inviting experts to medical schools, planning better before implementation, mentoring by students, and investing resources.

As there are probably many more barriers, enhancing factors, and propositions that have not been described in the extant literature, we recommend that additional studies be conducted to better identify themes for eHealth as a broad concept as well as for each technology.

Gaps in the Literature

No study has examined the impact of eHealth training on real health care outcomes, probably because measuring this would be too complicated, long, costly, and subject to many confounding and modulating variables. Only 2 studies directly observed clinical skills related to eHealth, although both times through simulated, standardized patients. These 2 articles evaluated medical student performances with web-based medical resources and EHRs. We therefore recommend that researchers evaluate both learning outcomes and patient care outcomes from training in eHealth.

Less data have also been collected about competencies that future doctors should develop to be ready for medicine that is increasingly digitalized. Therefore, we recommend conducting studies about what knowledge, abilities, and competencies medical students should acquire both in their preclinical and clinical forms.

Stakeholders would especially benefit from a significant increase in the literature on the IoT and AI, although we recommend that additional studies should be conducted regarding eHealth as a broad concept as well as regarding all related technologies.

Our recommendations are detailed in Table 4 in the form of research topics and specific aspects. No specific methodologies for future studies are recommended, but a diversity of study types would probably best enhance the literature. Studies either containing an intervention or not would be relevant.

Table 4. Recommendations in the form of research topics and specific aspects.

Research topics	Specific aspects
What is the current state of training in eHealth? (notably regarding the internet of things)	• Optimal training • Suboptimal training • Little to no training • Theory versus practical • Preclinical versus clinical • Optional versus mandatory
What are the barriers to training in eHealth?	• Student characteristics (eg, age, prior education) • Competing curricular priorities • Lack of dialogue with the health care system • No strong drivers for change • Lack of interest • Technical issues (eg, internet access) • Limited availability of useful, free items
What are the enhancing factors for training in eHealth?	• Student characteristics (eg, age, prior education) • Perceived relevance • Students' interest • Medical school personnel's interest • Governments and leaders' interest • Medical associations' interest • Strong drivers for change
What could be done to enhance training in eHealth?	• Increasing interest of students, medical school personnel, governments, leaders, and medical associations • Increasing requirements by accrediting bodies • Implementation of new courses • Implementation of new rotations • Inviting experts to medical schools • Planning ahead (eg, anticipating technical issues) • Mentoring (by students, residents, and doctors, etc) • Investing resources such as funding
What are the competencies and skills in eHealth that medical students want or should acquire?	• Knowledge of basic principles • Science, technology, engineering, and mathematics • Data for surveillance, planning, and managing of scarce resources • Data visualization, analysis, quality assessment, and governance • eHealth applied to public health and preventive medicine • Confidentiality and risks associated with data collection and communication • Critical appraisal • Technical skills (eg, programming) • Cognitive aspects (eg, computational thinking) • Interdisciplinary collaboration • Communication • Ethics and legal aspects
What is the impact of the implementation of an initiative such as a special course or a special rotation related to eHealth?	• Learning outcomes • Patient care outcomes • Students' appreciation • Costs • Best if optional versus if mandatory
How is ehealth training discussed in non–peer-reviewed publications?	• Broader discussion of this topic • Data, perspectives, information that might differ from peer-reviewed articles • Most of the specific aspects for other research topics listed above apply

Limitations

The results of this scoping review are subject to limitations. Articles published before 2014 that might nonetheless have retained relevance were excluded from this review. Conversely, the pressure on medical schools to implement new eHealth training could be so important that even some of the recently included studies might be already obsolete. As definitions of eHealth differ between authors, this review's scope might also be considered too narrow and therefore exclude relevant technologies, while the unequal number of keywords used for each technology in the initial search might have resulted in increased sensitivity for some aspects of eHealth, such as mHealth. In the same vein, terms such as *health/medical/clinical* *informatics* could have yielded more relevant articles on eHealth as a broad concept. In addition, including search terms related to EHRs could have yielded more studies on this aspect of eHealth, which would perhaps have allowed for a more detailed overview of medical student training in EHRs and best practices in this area. Overall, the choice of key terms searched has driven the outcome of this review. Furthermore, no hand-searching of printed sources was performed; however, all recent relevant articles on eHealth were assumed to be indexed on the web. Articles from *JMIR Medical Education* could be overrepresented because this journal's database was used in this review's study selection process. The selection of databases has probably driven the results of this review overall, but this decision is supported by the relevant results of our preliminary search on these databases as well as their characteristics. Other databases could have been considered including the Education Resources Information Center, which is more focused on education, although it could be considered less specific for medical topics. Similarly, searching the gray literature would have yielded different articles, but the scope of this review is limited to peer-reviewed articles. Finally, the generalizability of our findings might be limited for medical schools in countries not represented among the included articles.

Conclusions

This review highlights relevant research findings regarding medical student training in eHealth from 25 included articles. Although a definite assessment of the state of medical education in eHealth cannot be inferred from the extant literature, trends have emerged from the included studies regarding the suboptimal current state of eHealth training and the barriers, enhancing factors, and propositions for optimal training of medical students. We recommend additional studies on these themes, but also on what knowledge, abilities, and competencies medical students should acquire at the preclinical and clinical stages of their undergraduate education. Additional studies should be conducted on eHealth and each of the many technologies it comprehends, but more research is especially needed regarding the IoT, AI, programming, and eHealth as a broad concept. We also recommend that researchers evaluate both learning and patient care outcomes from training in eHealth.

The training of medical students in eHealth is critical to their future practice in clinical environments that is increasingly enabled by technology. There is room for improvement in this regard, which will require meaningful changes to their curricula and learning opportunities. How the challenge of medical student training in eHealth will be met will most likely have a significant impact on health care in the near future. The COVID-19 pandemic highlights the relevance of eHealth training as the need for innovative approaches to health care presents itself both as an opportunity and as a challenge.

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All authors contributed to this study, and their respective contributions are detailed in the Methods section of this paper.

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Conflicts of Interest

None declared.

Multimedia Appendix 1
Glossary.
[DOCX File , 22 KB - mededu_v6i2e20027_app1.docx]

Multimedia Appendix 2
Components of the data extraction grid.
[DOCX File , 22 KB - mededu_v6i2e20027_app2.docx]

Multimedia Appendix 3
Summary of characteristics of included studies.
[DOCX File , 26 KB - mededu_v6i2e20027_app3.docx]

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Abbreviations

AI: artificial intelligence
EHR: electronic health record
IoT: internet of things
JMIR: Journal of Medical Internet Research
mHealth: mobile health

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Review

Effectiveness of Virtual Medical Teaching During the COVID-19 Crisis: Systematic Review

Robyn-Jenia Wilcha[1]

[1]Faculty of Biology, Medicine and Health, University of Manchester, Manchester, United Kingdom

Corresponding Author:
Robyn-Jenia Wilcha
Faculty of Biology, Medicine and Health
University of Manchester
Oxford Road
Manchester, M13 9PL
United Kingdom
Phone: 44 (0)161 306 0211
Email: robynwilcha05@gmail.com

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Abstract

Background: In December 2019, COVID-19 emerged and rapidly spread worldwide. Transmission of SARS-CoV-2, the virus that causes COVID-19, is high; as a result, countries worldwide have imposed rigorous public health measures, such as quarantine. This has involved the suspension of medical school classes globally. Medical school attachments are vital to aid the progression of students' confidence and competencies as future physicians. Since the outbreak of COVID-19, medical schools have sought ways to replace medical placements with virtual clinical teaching.

Objective: The objective of this study was to review the advantages and disadvantages of virtual medical teaching for medical students during the COVID-19 pandemic based on the current emerging literature.

Methods: A brief qualitative review based on the application and effectiveness of virtual teaching during the COVID-19 pandemic was conducted by referencing keywords, including medical student virtual teaching COVID-19, virtual undergraduate medical education, and virtual medical education COVID-19, in the electronic databases of PubMed and Google Scholar. A total of 201 articles were found, of which 34 were included in the study. Manual searches of the reference lists of the included articles yielded 5 additional articles. The findings were tabulated and assessed under the following headings: summary of virtual teaching offered, strengths of virtual teaching, and weaknesses of virtual teaching.

Results: The strengths of virtual teaching included the variety of web-based resources available. New interactive forms of virtual teaching are being developed to enable students to interact with patients from their homes. Open-access teaching with medical experts has enabled students to remain abreast of the latest medical advancements and to reclaim knowledge lost by the suspension of university classes and clinical attachments. Peer mentoring has been proven to be a valuable tool for medical students with aims of increasing knowledge and providing psychological support. Weaknesses of virtual teaching included technical challenges, confidentiality issues, reduced student engagement, and loss of assessments. The mental well-being of students was found to be negatively affected during the pandemic. Inequalities of virtual teaching services worldwide were also noted to cause differences in medical education.

Conclusions: In the unprecedented times of the COVID-19 pandemic, medical schools have a duty to provide ongoing education to medical students. The continuation of teaching is crucial to enable the graduation of future physicians into society. The evidence suggests that virtual teaching is effective, and institutions are working to further develop these resources to improve student engagement and interactivity. Moving forward, medical faculties must adopt a more holistic approach to student education and consider the mental impact of COVID-19 on students as well as improve the security and technology of virtual platforms.

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KEYWORDS

virtual teaching; medical student; medical education; COVID-19; review; virus; pandemic; quarantine

Introduction

COVID-19 was declared to be a global health emergency by the World Health Organization on January 30, 2020 [1]. The first reported cases of COVID-19 originated from Wuhan City, Hubei Province, in China during the month of December 2019 [1]. Since then, despite stringent global containment measures, including quarantine, testing, and social distancing, the worldwide incidence of COVID-19 has increased rapidly, with a global death toll of 360,679 as of May 29, 2020 [2]. COVID-19 is caused by the novel betacoronavirus SARS-CoV-2; the most common clinical features of the disease include fever, dry cough, chest tightness, and dyspnea [3]. At present, patients with COVID-19 are only treated with supportive care due to the limited use of antiviral drugs [3].

Undoubtedly, one of the countries most affected by COVID-19 is the United Kingdom [2]. As of May 27, 2020, the United Kingdom had reported 268,619 confirmed cases and 37,542 deaths [2]. The public health measures enforced by the UK government center around household isolation [4]. Through government websites and daily televised COVID-19 updates from officials, messages of isolation were reinforced, including staying at home as much as possible, working from home if able, limiting contact with people outside one's household, and social distancing by remaining two meters apart from others [4].

The impact of COVID-19 on medical education has been substantial. Medical school attachments often require considerable clinical exposure; however, due to the risk of contracting COVID-19, many medical schools in the United Kingdom have discontinued placements [5]. Consequently, students have received decreased exposure to certain medical and surgical specialties, which may in turn reduce the students' examination performance, confidence, and abilities as future physicians [5]. In these exceptional circumstances, the COVID-19 pandemic has posed an unparalleled challenge to medical schools, which are aiming to deliver quality education to students virtually [6].

The objectives of this study are to review the advantages and disadvantages of virtual medical teaching during the COVID-19 pandemic using the emerging current literature.

Methods

A systematic review of peer-reviewed literature on the subject of virtual medical education during the COVID-19 pandemic was conducted from May 2020 to June 2020, consistent with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [7]. Electronic databases, including PubMed and Google Scholar, were searched using the following key terms: *medical student virtual teaching COVID-19*, *virtual undergraduate medical education COVID-19*, and *virtual medical education COVID-19*. Qualitative results from the review were obtained by comparing and summarizing existing evidence and theories from recent literature.

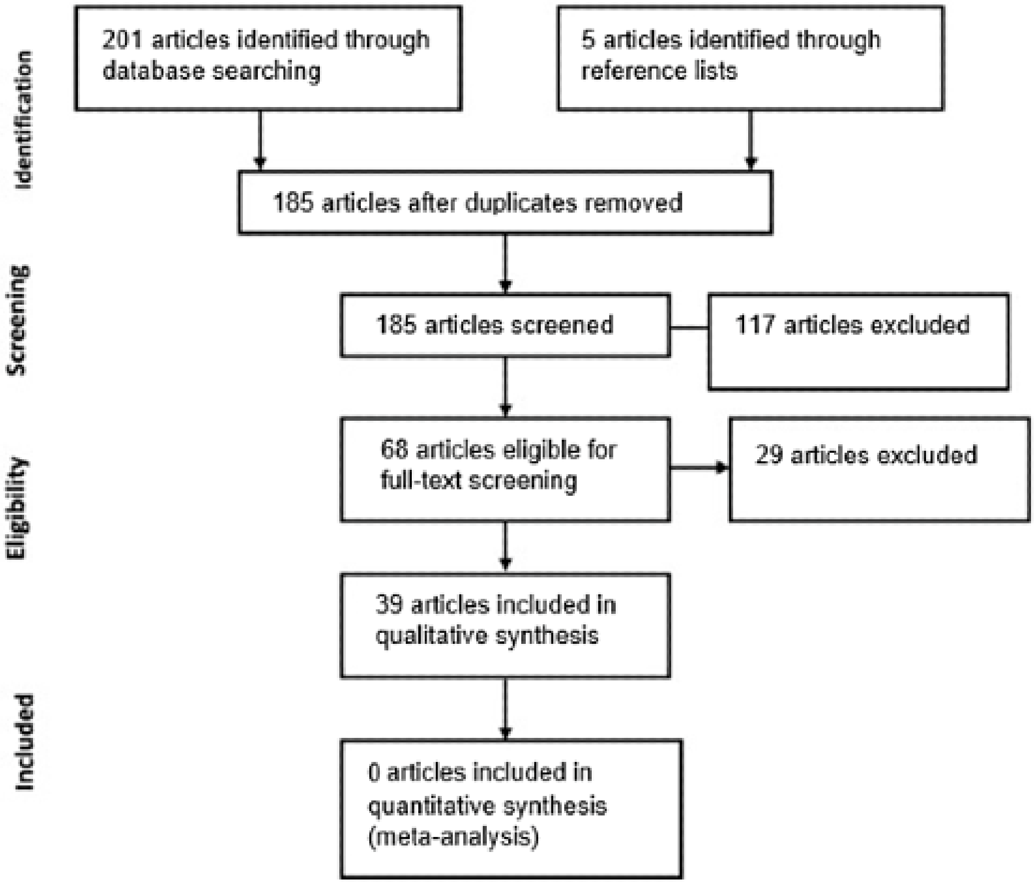
The quantitative and qualitative studies were chosen based on specific inclusion criteria. The first and foremost criterion was that the study must be published in a peer-reviewed scientific journal. Second, the study was required to present original data assessing virtual medical teaching for medical students, with objectives related to analyzing the effectiveness or perception of this mode of learning. Finally, the included articles reported on studies conducted worldwide between February and June 2020, a period of time central to the COVID-19 pandemic. Due to the shortage of available literature, this review considered any eligible study design, including case reports, case studies, cohort studies, randomized control trials, letters to the editor, commentaries, editorials, and perspectives. The first exclusion criterion was that the article was unrelated to undergraduate medical education. Excluded articles included those focusing on postgraduate medicine and on the teaching of other undergraduate health care professional students, such as dental, veterinary, or nursing students. Moreover, articles that assessed virtual teaching before the COVID-19 pandemic or articles relating to former pandemics were excluded.

The search algorithm yielded 92 articles from the PubMed database and 109 articles from the Google Scholar database. After successful removal of duplicate articles, 185 articles were processed to analyze their titles and abstracts, and a total of 68 articles were found to be eligible for full-text screening. Following the full-text screening, a total of 34 articles were included for data extraction. An additional 5 articles were added after manually searching the reference lists of the included articles. Prominent findings from the review are presented in a table under the following headlines: summary of virtual teaching, strengths of virtual teaching, and weaknesses of virtual teaching.

Results

In the initial search, 201 articles were found in electronic databases. Following the removal of duplicates, 185 articles were scanned on the premise of title and abstract, and a total of 68 articles were determined to be eligible for full-text screening, of which 34 articles satisfied the inclusion criteria. Manual reviews of reference lists enabled the addition of 5 articles to the review. Figure 1 presents the PRISMA flow diagram, which demonstrates the process of study selection.

Figure 1. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram demonstrating the process of study selection.



The findings from the 39 papers reviewed are tabulated in Table 1. The table documents key findings from original articles relating to the type of virtual teaching offered and the strengths and weaknesses of virtual education during the COVID-19 pandemic. Qualitative analysis of the included articles was conducted.

Table 1. Comparison and evaluation of the advantages and disadvantages of virtual education during the COVID-19 pandemic.

Summary of virtual teaching offered	Advantages of virtual teaching	Disadvantages of virtual teaching	Reference
An observational study that reported the use of virtual ward rounds to educate medical students (n=14) regarding COVID-19 cases	• It enables direct patient interaction with no risk of infection. • It provides insight into a novel disease and active pandemic for medical students. • Of the participants, 92.9% strongly agreed that the experience had increased their knowledge and that they were stimulated to learn. Moreover,13 students strongly agreed that they would recommend virtual ward rounds and would continue with this form of teaching. • One student remarked that it reconfirmed their motives for studying medicine.	No weaknesses noted	[6]
A letter to the editor that reported the use of web-based education networks for medical students, such as lectures, case discussions, journal clubs, and virtual grand rounds	• Immediate access to specialized teaching by medical experts irrespective of geographical location or cost • Ease of accessibility • Ability to stay up-to-date with the latest medical developments • Use of social media as an adjunct to virtual teaching • Virtual conferences to accelerate knowledge and interest	No weaknesses noted	[8]
An observational study that reported the use of a medical student response team consisting of 500 students during the COVID-19 pandemic; there were 4 virtual teams that centered around education and activism for both health care professionals and the community	• Encouraged development of internal motivation of students while increasing medical knowledge and making a difference • Improved team working skills to strive toward a collective goal • Students reported feeling empowered and enthusiastic and stated that they had a sense of purpose during the uncertain period of the pandemic	No weaknesses noted	[9]
A reflective study that documented the concerns of medical students regarding their education during the COVID-19 pandemic; the study included 852 students, and 127 responses were analyzed	Virtual mentorship programs and virtual surgical skills workshops were suggested by 67% of medical students, closely followed by webinars (62%) and virtual research symposia (46%).	• Loss of networking opportunities • Lack of clinical experience • Lack of assessments	[10]
A study evaluating the use of virtual medical education platforms	• Students could access educational material at their convenience in preferred environments. • The study evidenced that virtual reality simulation was as effective as direct patient contact.	• Isolation from medical school; reduced interaction and discussion with peers • Technical difficulties, including problems with internet access • Increased dependence on technology • Virtual teaching is costly and time-consuming for faculties, especially if the infrastructure is inadequate • Loss of boundaries between work and home • Lack of professional development due to absence of influential clinical role models	[11]

Summary of virtual teaching offered	Advantages of virtual teaching	Disadvantages of virtual teaching	Reference
A qualitative review documenting the challenges and innovations of virtual medical education platforms	• Ease of access with unlimited flexibility • Increased learning among medical professionals due to open-access medical resources and virtual conferences • Increased interdisciplinary learning to help accelerate evidence-based clinical management • Use of virtual interactive technology to promote active, engaging learning • Use of social media to promote virtual learning to a wider audience and to offer networking opportunities • Increased research and development of simulation programs to allow the continuity of technical skills at home	Loss of clinical opportunities: lack of bedside teaching, lack of direct patient care, halted improvement of examination skills, loss of feedback from tutors	[12]
An observational study that reviewed the use of academic coaching to supplement virtual medical education during the COVID-19 pandemic	• Strong support network; collaborative approach between tutor and student • Individualized goal-directed study plans with monitoring of study habits and follow-up meetings • Increased accountability from students, driving internal motivation • Holistic approach that supported students academically as well as mentally, emotionally, and physically	Without academic input, students may have ineffective learning strategies, poor motivation, and suboptimal communication skills, which are maximized by home learning.	[13]
A study highlighting the disruption of anatomy education, from dissecting laboratories to web-based virtual platforms, during the COVID-19 pandemic	No strengths noted	• Difficulties understanding anatomy without dissections, practical teaching, or physical aids such as bones, specimens, and models • Lack of human visual impact • Future scarcity of cadavers due to risk of COVID-19 infection	[14]
A letter to the editor that reflected on the difficulties of virtual medical education	No strengths noted	• Difficulties maintaining focus and concentration • Costly for facilities providing digital education • Inadequate infrastructure to produce a new, functioning virtual medical platform in a short amount of time • Inequalities of virtual education created by differences of quality and internet speed • Overload of virtual medical platforms	[15]
An analysis of the adaptations made to anatomical education in response to the COVID-19 pandemic. Anatomy education within the United Kingdom has moved away from the use of cadavers to virtual lectures and virtual cadaveric resources.	• Opportunity to develop web-based resources • Increased academic collaboration between institutions • Open access to web-based medical resources to aid anatomical learning	• Lack of formal assessments; 50% of universities canceled examinations • Time-consuming for facilities to provide virtual platforms with good quality and effectiveness • Reduced student engagement with virtual learning; attendance is not monitored • Increased risk of isolation, anxiety and boredom • Decrease in academic results, quality of life, and motivation as well as increased stress due to lack of social engagement and interactivity	[16]
A study that reported the use of virtual callbacks for patients recently evaluated in the emergency department during the COVID-19 pandemic		No weaknesses noted	[17]

Summary of virtual teaching offered	Advantages of virtual teaching	Disadvantages of virtual teaching	Reference
	• Student feedback was positive as a result of patient interaction and improvement of both clinical reasoning and communication skills. • The clinical burden on the medical team decreased. • Patients were reassured by receiving follow-up after discharge from the emergency department.		
A study conducted in Nepal evaluating the use of virtual medical education platforms	• The broader audience allows increased learning compared to the traditional classroom. • Web-based classes at set times hold students accountable for their learning.	• Requires all students to have a reliable internet connection and use of digital devices • Lack of knowledge on how to operate virtual platforms • Difficult to retain concentration while looking at a screen for long hours • Difficulties finding a quiet and private learning environment	[18]
A study that evaluated the use of virtual morning reports to deliver effective virtual teaching during the COVID-19 pandemic	• Enables development of clinical reasoning skills • Interaction between clinician educators, active medical students, and passive medical students, enabling immediate feedback • Supportive learning environment between peers and teachers • Ease of accessibility due to asynchronous viewing and multi-institution participation	• "Zoom bombing:" hackers can invade Zoom sessions, creating potential security breaches. • On occasion, critical and disrespectful comments were made by other Zoom users.	[19]
A study encouraging the sharing of virtual learning materials between institutions to aid virtual undergraduate medical education	• Rapid development of engaging and good-quality virtual learning materials • More robust content	No weaknesses noted	[20]
A study evaluating the use of web-based virtual platforms for medical students and the future role these platforms may play in medical education after the COVID-19 pandemic	• Increased class attendance due to ease of access • Increased student engagement due to student anonymity within sessions • Increased number of medical webinars to accelerate the exchange of ideas	• Technical difficulties, such as configuring hardware and software • Time-consuming and costly for faculties	[21]
A letter to the editor that explored how to sustain learning during the COVID-19 pandemic via the use of webinars, case-based discussions, journal clubs, and virtual classrooms	• Flipped classroom style of learning, allowing development of problem-solving skills, critical thinking, and self-directed learning • Accessibility of learning from experts around the globe. • Flexible learning • Increased research conducted during the pandemic • Increased personal development, such as resilience, during the pandemic	• Loss of clinical and surgical skills • Technical difficulties of virtual learning, such as reduced internet speed and quality • Not all students may have access to digital technology • Reduced student engagement; lack of focus, multi-tasking with other activities, and poor audio and video quality • Lack of physical, mental, and social support from peers and institutions; anxiety may hinder learning • Lack of formal assessments due to lack of security and validity	[22]
A pilot study that reported the use of virtual clerkship for medical students (n=6) for 14 days.		• It is time-consuming for clinicians to aid learning in light of extended work service due to the COVID-19 pandemic. • Virtual clerkship is not easily scalable to encompass all medical students.	[23]

Summary of virtual teaching offered	Advantages of virtual teaching	Disadvantages of virtual teaching	Reference
	• Advancement in medical knowledge and clinical reasoning skills through social learning and cognitive apprenticeship • Interactive sessions between teachers, students, and peers increase student engagement • Feedback provided by tutors to aid progression of studies • Use of virtual ward rounds to reinforce learning from independent study, podcasts, and conferences • Five of the six students provided positive feedback for the virtual clerkship and stated they would continue with this form of teaching		
A study conducted in Iran documenting the shift to virtual medical education	• Ease of accessibility due to asynchronous learning • Opportunity to enhance virtual medical education for the future	• Lack of preparation and inadequate infrastructure for virtual learning • Impossibility of training for all age groups within the medical curriculum • Inability to virtualize every aspect of a medical course	[24]
A study evaluating the use of virtual medical education for medical students	• Continuous learning despite the pandemic • Increased flexibility and accessibility to learning • Synchronous virtual sessions enable excellent communication between teacher and student • Complete digital access to world-class experts at any time	• Technical challenges, especially with audio and video • Issues with confidentiality and security	[25]
A study demonstrating the value of peer learning during the COVID-19 pandemic	• Peer discussion facilitates active discussion, sharing of ideas, critical thinking, and collaboration • Enhancement of motivation, teamwork, conflict resolution, and task management • Peer learning reduces stress and develops resilience • Increased examination performance documented for April 2020 due to improvement in problem solving	No weaknesses noted	[26]
A pilot study comparing face-to-face and virtual teaching of surgical skills for final year medical students (n=30)	• 40% of students highly recommended virtual teaching (score of 8-9/10) • 50% of students slightly recommended virtual teaching (score of 6-7/10) • Affordable manner of teaching surgical skills	• Recorded sessions removed teacher-student interaction • Difficulty learning intricate surgical skills due to limited camera angles • Technical difficulties accessing web-based platforms	[27]
A study highlighting the possible methods of virtual education, including modules, reading assignments, and virtual scenarios	• Continuous education during the pandemic • Use of social media, specifically Twitter, to promote virtual learning	No weaknesses noted	[28]
A letter to the editor documenting the structural changes of medical education within Brazil	No strengths noted	• No infrastructure for virtual education; investment in infrastructure is challenging for a developing country. • Students may not have access to digital technology. • Students may be socially vulnerable, increasing the challenges of educational activities.	[29]
A study conducted in Nepal demonstrating the difficulties faced by virtual medical education	Continuous education during the pandemic		[30]

Summary of virtual teaching offered	Advantages of virtual teaching	Disadvantages of virtual teaching	Reference
		• Lack of accessibility to virtual platforms as a result of difficulties establishing internet connection (cost, quality, and speed) and difficulties obtaining digital devices • Sense of isolation decreases student participation and may cause student withdrawal; lack of socialization is linked to decreased academic achievement and mental distress • Difficulty for tutors to assess student disengagement, frustration, or disinterest • No pressures for students to attend classes or access learning materials • Physical discomfort from virtual learning, such as exhaustion, visual discomfort from looking at screens, and muscle or joint pains from remaining stationary	
A letter to the editor documenting the impact of COVID-19 on the medical curriculum; the article references the effectiveness of Zoom and web-based lectures	• Zoom is a highly effective virtual learning tool with reports of high student engagement. • Web-based webinars are used to cover relevant material in a "bite-size" manner. Feedback from students was positive, with a regular number of medical students attending.	No weaknesses noted	[31]
A letter to the editor reflecting on the loss of clinical opportunities faced by current medical students	No strengths noted	Students must spend time on the ward with direct patient contact to prepare for the realities of working life.	[32]
A study evaluating the use of digital clinical placements in response to the COVID-19 pandemic	• Weekly set of interactive web-based cases supplemented by patient videos to increase student engagement and exposure to a variety of conditions • Development of clinical reasoning	Limited access to patients	[33]
A study evaluating the impact of virtual education on current medical students during the COVID-19 crisis.	• Gentle impact on preclinical medical students due to the normal lecture format of teaching • Open access to medical resources during the pandemic, aided by social media promotion • Use of Zoom as a highly effective tool for virtual learning	• Inadequate preparation for preclinical medical year students; no teaching of history taking or physical examinations, which are building blocks for the clinical years • Loss of clinical placements may affect ultimate specialty choice • Virtual learning can be time-consuming for clinicians, especially in times of uncertainty and increased demand • Difficulties in virtually assessing audience understanding and interest • Increased stress of balancing home life and work life, with little separation between the two	[34]
A study documenting the changes in medical education within the United Kingdom; the study references virtual teaching at Imperial College London, where patients are interviewed virtually by both physicians and medical students to facilitate teaching	• Excellent student attendance and interaction • Identification of a variety of pathologies, signs, and symptoms through patient interviews, which develops clinical reasoning skills and diagnostic thought processes • No exposure to infection despite patient contact. • Reduced burden on the health care system by providing an effective triage service	• Students reported a decline in confidence in their skills while conducting virtual learning. • Preclinical medical students were adversely affected due to a lack of clinical foundation.	[35]
A study that reported the effects of virtual medical education on students in Italy	Virtual learning is effective to achieve primary aims and continue education in the short-term.	Long-term virtual learning would have negative effects on students, administrative staff, and tutors.	[36]

Summary of virtual teaching offered	Advantages of virtual teaching	Disadvantages of virtual teaching	Reference
A study that documented the replacement of clinical general practice attachments with e-learning programs in Australia	• The study found that web-based learning is as effective as traditional teaching. • Students could submit a web-based learning portfolio to enable accurate assessment as well as to demonstrate competency.	• Technical difficulties can hinder learning. • Virtual learning may compete with other responsibilities. • Sharing of technology may hinder learning. • Virtual learning may not provide a medical student with a full skill set.	[37]
A letter to the editor reflecting on student perspective and feedback regarding undergraduate ophthalmology virtual learning during the COVID-19 pandemic	• 97.2% of students felt that web-based classes were a viable alternative to classroom lectures. • 84.7% of students were familiar with web-based virtual learning platforms. • Learning was easily accessible. • Students could review information to aid learning.	• Reduced interaction in comparison to classroom teaching • Increased doubts relating to knowledge • Internet difficulties relating to poor connection or unavailability of digital technology	[38]
A study evaluating the student perspective of e-learning during the COVID-19 pandemic; a survey was sent to 983 students in April 2020 questioning the effectiveness and satisfaction of web-based classes	• Students reported that virtual teaching was as effective as classroom teaching for improving communication, building skills and knowledge, preparing for their professional career, and submitting assignments. • Students were satisfied with the availability of electronic resources being offered.	Students found that virtual teaching was less effective than classroom teaching for convenience, interaction, understanding individualized learning needs, and balancing practical and theoretical skills.	[39]
A study that demonstrated the effectiveness of virtual OSCEs[a] during the COVID-19 pandemic; a teleOSCE[b] was performed through Zoom with 49 medical students	There was no difference in mean score (mean difference –1.1; 95% CI –2.8 to 0.7; *P*=.2) or failure rate (rate difference 2%; 95% CI 0.7% to 10.7%; *P*=.06) between the groups.	No weaknesses noted	[40]

Summary of virtual teaching offered	Advantages of virtual teaching	Disadvantages of virtual teaching	Reference
A commentary discussing the transition of medical education to the internet	• Use of flipped classroom style teaching before COVID-19; sense of familiarity for students • Latest medical research available on the internet	Lack of formal assessments	[41]
A study that evaluated the use of virtual pastoral support during the COVID-19 pandemic	• The service was convenient to use on smartphones and computers. • Students readily adapted to the service; levels of student engagement were high. • Peer support groups, facilitated by staff, were found to have a positive impact through student feedback; the groups offered relief of stress and respite from studies.	• Technical difficulties, such as poor internet connection and lack of access to technology or bandwidth • Staff cautious of virtual pastoral support due to general discouragement of social media contact and mobile phone contact with students • Virtual learning increased social withdrawal, contributing to anxiety and loneliness	[42]
A study that documented the web-based transition of MCQs[c] for a medical education faculty	• Use of Zoom with a web-based coach to help facilitate designing online MCQs; higher engagement in virtual sessions than in face-to-face workshops • Self-reflection on the quality of their own written MCQs • Newly designed MCQs in adjunct with the virtual workshops were higher in quality than previous MCQs	No weaknesses noted	[43]
A review noting the impact of COVID-19 on medical education as well as mental well-being	Virtual learning is not new; many faculty members had prior training in the use of web-based platforms.	• Demand for computers and information technology equipment came from students and families alike. • Assessment of virtual technology is underdeveloped; change of assessment structure, students may cheat. Some forms of assessment, such as laboratory practical assessments, are impossible to conduct on the internet.	[44]
A study that reported on the effectiveness of peer mentoring for medical students (n=371) during the COVID-19 pandemic via the use of WhatsApp	• 71% of junior medical students felt that mentoring helped them adjust more rapidly to the COVID-19 crisis. • Senior medical students reported that the experience enabled significant professional growth.	Students desired face-to-face social interaction despite virtual interaction	[45]

[a]OSCE: objective structured clinical examination.

[b]teleOSCE: teleconferencing objective structured clinical examination.

[b]MCQs: multiple choice questions.

Discussion

Summary of Results

This exploratory review questions the effectiveness of virtual teaching for medical students during the COVID-19 crisis by comparing the advantages and disadvantages listed in all available literature reports, as documented in Table 1.

Principal Strengths of Virtual Teaching

The COVID-19 pandemic has provided medical education institutions with a unique opportunity to adapt and advance their medical teaching methods. Previously, medical institutions relied upon classroom teaching, such as lectures, for preclinical year medical students, followed by various specialty medical attachments, completed in hospitals, for clinical year medical students [35]. As a result of the COVID-19 pandemic, university studies were suspended, and a rapid transition to virtual learning occurred [35].

The analysis of the available literature reveals several advantages of virtual teaching for medical students. First, the development of interactive virtual clinical teaching has been shown to be one of the most effective forms of virtual teaching, ranked by advancement of knowledge, student engagement, and student feedback. Hofmann et al [6] explored the use of virtual ward rounds to allow medical students to observe and interact with patients with COVID-19 while eliminating the risk of infection. Although their sample size of 14 students was limited, Hofmann et al demonstrated that students were enthusiastic to learn about a novel disease that is directly relevant to the world. Through student feedback, it was found that 92.9% of students recommended this form of teaching and agreed that it stimulated learning [6]. Similarly, a study by Murdock et al [19] evaluated the use of virtual morning reports to deliver effective and engaging teaching to medical students from multiple institutions worldwide. The strengths of this mode of teaching included the active development of student clinical reasoning skills as well as the ability to gain feedback from tutors and peers alike. Some institutions developed virtual clerkships, via the use of Zoom, to further increase medical students' clinical exposure. Chandra et al [17] reported on the use of virtual callbacks conducted by medical students for patients who had recently evaluated in the emergency department. This program was found to help all parties; student feedback was overwhelmingly positive as a result of the direct patient interaction, and the students further stated that they felt that this mode of teaching increased their clinical reasoning and communication skills. Moreover, there was a reduced clinical load for the medical team, and the patients found it comforting to receive a follow-up appointment upon discharge. Likewise, a pilot study from Geha et al [23] reported on the use of 14-day virtual clerkships for medical students. The results of this paper indicated an advancement in medical knowledge and clinical reasoning skills through social learning and cognitive apprenticeship, increased student engagement due to interactivity, and the ability to learn from real-life patients. Although the study was limited due to a sample size of 6 students, the study showed that 5 of the 6 students felt positive about the placement and wanted to continue with this form of teaching above others [23]. Furthermore, Imperial College London hosted virtual patient interviews for medical students; the study reported excellent student attendance and interaction, with benefits of increasing student clinical reasoning skills and diagnostic thought processes as well as reducing the burden on the health care system by providing an efficient triage system [35]. Finally, Harvard Medical School developed the use of virtual medical student response teams that consisted of 500 students arranged into 4 virtual teams with the aim to either educate or help the community or health care teams [9]. Due to the active role of helping during a worldwide pandemic, students reported feeling empowered and enthusiastic, and they felt a sense of purpose during uncertain times. Moreover, the project facilitated team working skills and indirectly increased student knowledge and awareness of COVID-19 [9]. Despite the highlighted successes of these highly interactive forms of virtual teaching, limited literature is available on these programs, suggesting that they are underdeveloped and not in use by most medical education facilities. Potential factors that may contribute to the underdevelopment of these specific programs are the scalability of the programs as well as the time commitments needed from clinicians when work demand is already at a critical stage [23].

The main format of virtual teaching for medical students is through virtual web-based platforms. Virtual web-based platforms consist of webinars, case discussions, reading assignments, and prerecorded virtual scenarios [28]. An advantage, noted through multiple publications available on this theme, was the ease of accessibility and unlimited flexibility of medical resources [8,11,12,19,22,24,25]. In a time of great uncertainty and doubt, providing students with increased flexibility and access to teaching materials may further encourage self-directed learning and motivation. Furthermore, open access teaching from world-renowned medical specialists, irrespective of location and cost, has now become available during the COVID-19 crisis [8]. Teaching provided by experts and promoted through social media platforms such as Twitter and Instagram Live can act as valuable adjuncts to virtual teaching. This teaching can also accelerate student knowledge and interest in specialties a student has not yet experienced and can enable students to observe the latest medical advancements [8,12,28,34]. Networking between students and physicians, which many students thought would be lost due to the suspension of attachments, has been revived through the use of virtual conferences and social media [8,12].

Peer mentoring during the COVID-19 crisis has proved to be a valuable form of teaching. Peer mentoring involves student-to-student teaching; it helps develop active discussion, exchange of ideas, critical thinking, and collaboration between colleagues [26]. In uncertain times such as the COVID-19 pandemic, peer mentoring can help drive student motivation and task management, increasing the effectiveness of self-directed study [26]. Personal development may also be improved by peer mentoring; qualities such as resilience, conflict resolution, and leadership may all be developed through this mode of teaching [26]. A study by Mohammed Sami Hamad et al [26] demonstrated that peer learning may also lead to increased examination performance due to improvements in problem-solving skills. Peer mentoring can also be used to provide psychological support to colleagues. A study by Rastegar Kazerooni et al [45] discussed the use of a WhatsApp group consisting of 371 medical students to provide advice and reassurance during the pandemic. Using student feedback from the study, it was found that 71% of junior medical students reported a smoother transition with quicker adjustment to the COVID-19 crisis, and senior students benefited from significant professional growth [45].

Student perception of virtual teaching is imperative to understand to deliver effective teaching throughout the pandemic. A study conducted by Sud et al [38] reported that 97.2% of students felt that web-based classes were a good alternative to classroom teaching during the pandemic. This was further reiterated by a study by Kaur et al [39] that surveyed 983 medical students on their satisfaction with virtual teaching during the COVID-19 crisis. The outcomes of the study showed that students felt that virtual teaching was as effective as classroom teaching for improving communication, increasing knowledge and skills, professional growth, and submission of assignments. Moreover, students were happy with the availability of electronic resources offered by virtual learning platforms [39]. Upon review of the current literature, it is evident that medical students have a strong passion and determination to learn during the pandemic. Articles written by Sandhu et al [21] and Marques du Silva [31] demonstrated increased class attendance at webinars and positive student feedback of web-based extracurricular lectures. Guadix et al [10] conducted a survey to understand what medical students with an interest in neurosurgery desired from virtual teaching. Of the 127 students who responded, 67% wanted virtual mentorship programs and virtual surgical skills workshops in addition to their medical school studies [10].

Principal Weaknesses of Virtual Teaching

A significant number of published studies indicated that a major disadvantage of virtual teaching is technical difficulties [11,15,18,21,22,25,27,29,30,37,38,42,44]. On further analysis of the technical difficulties experienced by students, several different challenges to virtual teaching arose. The largest problem presented by virtual teaching was that some students had no access to digital technology; thus, virtual learning was an ineffective or impossible form of teaching for those students [22,29,30,38,42,44]. Other technical challenges included difficulties establishing a reliable internet connection [11,18,27,30,38,42], problems with hardware and software for virtual learning platforms [21,42], problems relating to internet speed and quality [22,37], and problems with audio and video playback [25]. Moreover, a study by Machado et al [15] reported that virtual learning platforms may become overloaded due to the sheer number of students accessing the materials; overload of a platform stops the platform from working and hinders student learning [15].

Papers by Murdock et al [19] and Sleiwah et al [25] raised concerns with respect to confidentiality and security issues [19,25]. “Zoom-bombing” is a practice in which hackers invade Zoom sessions; therefore, virtual sessions that document real patient information may be at risk of security breaches [19].

The loss of face-to-face teaching was another significant weakness of virtual teaching. The loss of clinical attachments was referenced by numerous publications [10,12,22,34]. Dedeilia et al [12] suggested that the loss of clinical attachments, subsequently causing a loss of bedside teaching, a lack of direct patient care, and a loss of feedback from clinicians, halted the progression of the competencies of a medical student. This was further reiterated by Kaup et al [22], who reported a decline in the clinical and surgical competencies of medical students during the pandemic [22]. Interestingly, Sahi et al reported a possible cessation of professional growth of medical students due to a lack of influential clinical role models during this time [11]. Furthermore, Hilburg et al [34] described a life-changing effect in which the loss of clinical attachments during medical school may impact the specialty the student chooses to pursue in later life [34].

The transition to virtual teaching via the use of web-based medical education platforms presents its own individual disadvantages. Studies by Machado et al [15] and Atreya et al [18] reported the hardships of maintaining focus and concentration whilst sitting in front of a screen. Similarly, Lee et al [13] found that without academic input, students were more likely to have ineffective learning strategies, poor motivation, and reduced communication. Physical discomfort, such as exhaustion, visual problems, and muscle and joint pain, was also reported with long periods of virtual teaching [30]. Unsurprisingly, papers by Longhurst et al [16] and Kaup et al [22] found reduced student engagement levels associated with virtual teaching. Longhurst et al [16] suggested that student engagement decreased as a result of reduced monitoring of students, whereas Kaup et al [22] argued that reduced student engagement was due to a lack of student focus, interest in other environmental activities around students, and technical difficulties [22]. Surkhali et al [30] highlighted that a further disadvantage of virtual teaching is that tutors have difficulties assessing student disengagement, frustration, and disinterest; this may reduce the quality and effectiveness of virtual teaching. Loss of student-tutor interactivity was another potential causative factor for reduced student engagement, as evidenced by Michael et al [27] and Sud et al [38].

Concerns regarding preclinical year medical student education were also identified in this review. Studies by Hilburg et al [34] and Mian et al [35] highlighted that this student cohort would have significantly weak clinical foundations, which provide the building blocks for students’ clinical years and subsequent life as physicians. Hilburg et al [34] argued that the lack of face-to-face teaching for skills, such as history taking and physical examinations, would negatively impact students’ transition to their clinical years. Furthermore, suspension of studies has drastically disrupted the teaching of anatomy. A paper by Singal et al [14] documented the difficulties faced by students in understanding anatomy without the tools of dissection, practical teaching, specimens, or slides. A future concern of anatomists and medical education facilities alike is a lack of cadavers following the COVID-19 pandemic due to the potential risk of infection of the deceased [14].

The loss of formal assessments is an additional weakness of virtual teaching. A study by Longhurst et al [16] reported that 50% of medical student examinations had been cancelled, and even more had been adjusted to unfamiliar formats. Kaup et al [22] argued that this was due to a lack of security and validity of conducting virtual examinations. Interestingly, a study published by Lara et al [40] documented the novel use of a teleconference objective structured clinical examination (teleOSCE) during the COVID-19 pandemic. The results of this study indicated that for the 49 medical students who participated, there was no difference in mean score or failure rate between face-to-face and virtual OSCEs, suggesting that this form of assessment was an effective and reliable method of testing and could be explored in the future [40].

Weaknesses of virtual teaching identified by medical students included reduced interaction between peers and tutors, reduced understanding of individualized learning needs by tutors, and the difficulties of balancing practical and theoretical skills [39]. Virtual teaching platforms from the perspective of medical education faculties were found to be costly and time-consuming [11,15,16,21].

The Use of Virtual Medical Education Worldwide

The literature included in this review includes papers written worldwide. Upon analysis, it is evident that virtual teaching for medical students differs by country and that students may have exceedingly different learning experiences [9,18,24,29,30,35,37]. These different learning experiences delivered by virtual teaching may create inequalities of knowledge, confidence, and skills of medical students on a global basis [15].

In developed countries, such as the United Kingdom, Italy, the United States, and Australia, virtual teaching for medical students is a praised method of teaching [9,35-37]. Studies by

Soled et al [9] from the United States and Roskvist et al [37] from Australia highlight the advancement of virtual medical teaching formats away from the standard virtual web-based platforms. Soled et al discussed the use of interactive virtual medical committees consisting of 500 medical students with the aim to educate or partake in community activism to help with and understand the global pandemic, whereas Roskvist et al documented the replacement of normal clinical attachments with interactive e-learning placements in Australia. The results of the study by Roskvist et al [37] showed web-based learning to be as effective as traditional teaching. Virtual teaching within the United Kingdom mirrored virtual learning in Australia and America; more interactive and advanced technological forms of virtual learning were found to increase student engagement and focus [35]. Italy reported that virtual learning is an effective way to teach medical students during a time of crisis [36].

In stark contrast, developing countries such as Nepal, Iran, and Brazil negatively reported on the effectiveness of virtual teaching due to poorly funded and inadequate infrastructures for virtual learning [18,24,29,30]. Studies conducted in Nepal demonstrated apparent barriers to virtual teaching, including lack of knowledge on how to operate virtual platforms by staff and students alike, difficulties finding a quiet environment to study, technical challenges, reduced student engagement due to the use of self-directed learning with limited interactivity, and mental distress from social isolation [18,30]. In Iran, due to a lack of preparation of virtual learning resources, not all age groups within the medical curriculum had access to virtual teaching materials; also, medical education facilities experienced difficulties virtualizing different aspects of the medical course [28]. Finally, Carvalho et al [29] published a letter from Brazil documenting the challenges faced by the medical education system in Brazil. Similarly, the reported challenges to virtual teaching primarily arose due to a lack of investment. Moreover, Carvalho et al [29] documented the important points that not all students within Brazil have access to digital technology and some may be socially vulnerable, which further inhibits learning away from the university.

Mental Well-Being of Students During the COVID-19 Pandemic

Virtual teaching for medical students is novel, and the distinct lack of social interaction may increase feelings of isolation, anxiety, and boredom [16]. The lack of physical, mental and social support from peers and institutions during this time may prevent learning [22] as a result of decreased motivation, lack of social engagement, decreased personal assessment of quality of life, and increased stress levels [16.] Feelings of isolation may further contribute to social withdrawal and cause a lack of student participation with virtual teaching resources [30]; in turn, the factors mentioned above may decrease academic performance [16,30]. A study conducted in Italy recognized that while short-term virtual learning is effective, long-term virtual learning would have significant negative effects on students, tutors, and administrative staff [36].

A study by Hodgson et al [42] discussed the use of virtual pastoral support to help students through this unsettling time. Virtual pastoral support was conducted through smartphones or computers at times that were convenient to the students; student engagement with this service was in high demand and student feedback was positive, noting that this support offered relief from stress and respite from studies. Moreover, the study highlighted that staff offering pastoral support may be less likely to interact with students virtually due to universities previously discouraging social media interaction and mobile phone contact with students [42].

Limitations of the Review

Limitations to be considered in this review include its preliminary and exploratory direction; the literature available for review was restricted due to the emerging nature of COVID-19. In turn, this limitation governed a wider set of inclusion criteria and allowed the acceptance of all types of manuscripts within the review, which may reduce the acceptability of the results to a broader population. Moreover, PubMed was the only legitimate scientific database used, with Google Scholar providing supplemental searches. This limitation raises concerns that some papers relevant to the topic may have been missed. In addition, in the literature analyzed, many studies had small sample sizes; this may decrease the reliability of the findings. A further limitation of this review was the lack of studies that incorporated student perception of traditional teaching in comparison to virtual teaching.

Conclusions and Recommendations

Virtual teaching for medical students has enabled medical education to continue despite the effects of the pandemic. The COVID-19 outbreak has provided medical education faculties with the perfect opportunity to develop and further the application and effectiveness of virtual learning for medical students. Medical education faculties should embrace the transition to virtual teaching and continue to develop web-based materials, such as secure web-based assessments and resources with increased student interactivity, to ensure that the most effective and suitable teaching is delivered. Virtual teaching requires significant investment from institutions, and many education faculties worldwide are struggling; institutions should actively seek to share web-based learning materials to improve content and accelerate student learning. Technical challenges and security concerns are inevitable barriers to virtual learning; students and staff members alike should strive to minimize these barriers.

Conflicts of Interest

None declared.

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Abbreviations

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses
teleOSCE: teleconferencing objective structured clinical examination

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Viewpoint

The Need for Education and Clinical Best Practice Guidelines in the Era of Direct-to-Consumer Genomic Testing

Madeleine Myers[1], BS; Cinnamon Bloss[1], PhD

University of California San Diego, La Jolla, CA, United States

Corresponding Author:
Cinnamon Bloss, PhD
University of California San Diego
9500 Gilman Drive MC0896
Atkinson Hall
La Jolla, CA, 92093-0896
United States
Phone: 1 8585349595
Email: cbloss@ucsd.edu

Abstract

Many people share the results of their direct-to-consumer personal genomic testing (DTC-PGT) within the primary care setting, seeking interpretation of and counsel about the results. However, most primary care physicians (PCPs) are not trained to interpret and communicate about DTC-PGT results. New guidelines must be developed to help PCPs maximize the potential of emerging DTC-PGT technologies.

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KEYWORDS

personal genome testing; direct-to-consumer; primary care; patient-physician relationship; medical education

The early 2000s saw unprecedented improvements in genotyping technology and analysis: the human genome sequence (Human Genome Project) and the cataloguing of human genetic variation (International HapMap Project) were completed. Altogether, these discoveries led to large-scale, genome-wide association studies and the subsequent identification of genetic variants associated with the risk of common complex diseases [1-3]. These advances enabled the introduction of direct-to-consumer personal genomic testing (DTC-PGT), which refers to a type of genetic test a consumer can purchase and complete without a referral from a health care professional. Interest in these tests skyrocketed through 2016, 2017, and 2018. In fact, figures reported in 2017 and 2018 showed that the number of people opting for a DTC-PGT in each of those years was higher than that in all of the previous years combined [4]. By mid-2019, it was estimated that over 26 million people had purchased a test from the leading DTC-PGT companies. Currently, a health and ancestry test by the company 23andMe costs US $199; the company claims over 10 million customers, most of whom are in the United States [5]. Although purchases leveled off in 2019, these figures from recent years are impressively high and suggest that, at present, roughly 1 in 13 Americans may have access to their personal genetic data via DTC-PGT.

Primary consumer motivations for seeking DTC-PGT are ancestry, health information, and curiosity [6]. Following the regulatory approvals issued by the Food and Drug Administration in 2017 and 2018, it has become more common for DTC-PGT to bundle ancestry information with health information [7]. Interpreting health data can be a convoluted process, especially when undertaken by the consumer without the participation or input of a health care professional. For example, since the majority of common diseases are polygenic, the presence of gene variants known to be associated with a disease does not necessarily manifest as clinical symptoms; heritable diseases have variable penetrance (eg, where patients may only have minor signs and symptoms). Moreover, there is the issue of questionable accuracy of these tests. One study found that 40% of genetic variants reported in the DTC-PGT raw data were false positives—a high rate that would be unacceptable in clinical laboratories [8]. Finally, tests might be performed incorrectly or in an unaccredited, uncertified lab; the case of Theranos [9] is a recent reminder that even clinical laboratories are not immune to compromised quality of science.

Consumers often turn to their primary care physicians (PCPs) for help in interpreting their DTC-PGT health data and finding meaning in the test results [6,10-12]. The PCP is put in a challenging position because they did not order the test, the test may have limited clinical validity, and they may not have enough knowledge to interpret it or provide advice. The result is a potential quagmire of a clinic visit where the PCP needs to navigate these unsolicited test results while still providing compassionate care for the patient. The number of tests purchased from 23andMe alone, together with the existing data on rates of sharing DTC-PGT results with physicians, indicates that a large number of PCPs are likely to encounter patients with their DTC-PGT results. The mean rate of people sharing DTC-PGT results with their PCPs is 27% as per the existing research [6,11,12]. At this rate, if 80% of 23andMe's 10-million customer base are from the United States, it follows that about 2,080,000 people have already shared DTC-PGT results with their PCP. As of March 2019, the number of practicing PCPs in the United States was reported to be 479,856 [13]. On average, approximately 4 (precisely, 4.3) DTC-PGT test results reports are shared with each PCP, and this is likely an underestimate since it does not account for results from other companies (eg, Ancestry.com) or interpretation services.

Practicing PCPs are underprepared for this situation, and at present, there is no educational infrastructure in place to equip the next generation of PCPs. A study of 130 PCPs found that, although 88% had heard of 23andMe, less than a quarter of those PCPs (23%) felt comfortable discussing genetic risk factors for common diseases [14]. Although tech start-ups enthusiastically embraced genetics, medical education institutions were—and continue to be—lagging participants. There is still no widely accepted approach to genomics education. Some medical schools are starting to incorporate more genetic content into the curriculum [15], but the recipients of these lessons are vastly outnumbered by physicians educated before the era of genomics. In 2017, the majority of PCPs were between the ages of 45-49 years, and over one-quarter of PCPs were older than 60 years [16]. Thus, most practicing PCPs were trained prior to the completion of the Human Genome Project. Moreover, studies suggest that, among PCPs, there is a knowledge deficit as well as a paucity of confidence [11,14,17]. Therefore, teaching genomics content in medical schools does not necessarily translate into the ability of a PCP to interpret or communicate about genetic data presented to them by a patient. Medical students require opportunities to put the content of their genetics education into practice as they transition from the classroom to the clinic.

In the era of genomic medicine, the volume and complexity of medical knowledge exceed the capabilities of individual physicians. Moreover, scenarios involving consumer genomics often present complex problems interlaced with questions of ethics and beneficence. The ethical aspects associated with DTC-PGT are extensive. They include issues such as persuasive advertising, which is normal in the world of marketing but not in medical communication; unintended psychological impacts such as anxiety and distress related to testing and results; and the potential for genetic discrimination. Additionally, there are concerns about ambiguous practices related to informed consent as well as the storage, use, and third-party sale of genomic data. It remains largely unknown if PCPs are aware of these ethical challenges and, if they are, how best to address them in the increasingly shortened duration of clinical visits. Referring patients with DTC-PGT to geneticists and genetic counselors appears to be an obvious solution, but this is impractical and undermined by patients' preferences to first consult their PCPs. The impracticality lies in the sheer lack of geneticists in the United States. Although patient caseloads have increased (in one study, geneticists reported an average of 10.2 new patients per week), the number of geneticists has not increased in kind [18]. Altogether, these factors contribute to the added responsibility upon PCPs to interpret the DTC-PGT results and engage in meaningful communication about those results with patients.

To reduce the extent to which DTC-PGT encumbers PCPs, the development and implementation of best practice guidelines should be seriously considered. These guidelines would help orient PCPs toward an appropriate standard of providing compassionate counsel to patients who seek to understand and interpret their DTC-PGT results. Guidelines should emphasize both education and clinical practices. Genomics education should be further integrated into the programs of undergraduate medical education and continuing medical education, and should extend beyond the role of genetics in human pathologies. There should also be a focus on providing an understanding of differential test efficacy (eg, Sanger sequencing vs single nucleotide polymorphism genotyping); potential clinical utility; and the ethical, legal, and social issues surrounding DTC-PGT. In addition, the scenarios of a patient sharing their DTC-PGT results should be a part of the practice-based learning sessions, which would present an opportunity to help students learn how to communicate with patients who bring complex personal data to the clinical encounter. The incorporation of active learning elements across the 4 years of medical school is critical in ensuring that students can carry their understanding of genomics and precision medicine education from didactic to clinical environments.

Guidelines on clinical practice should be consistent with the larger archetypal shift from paternalistic medicine to patient-centered care, patient autonomy, and shared decision making. The crux of guidelines should be how to effectively communicate and engage in dialogue surrounding DTC-PGT. A patient ordering their own test and bringing the results to their PCP disrupt the system in which most PCPs were trained [19]. Thus, the guidance on helping PCPs navigate their patients' self-ordered, complex genetic information is of paramount importance. For the patient, the test may be less about genetic nuance and more about understanding their own story [20]. Finally, recommendations regarding DTC-PGT need to be mindful of the fact that physicians are currently in the midst of a burnout epidemic [21]. Burnout not only hinders the quality of patient care but also relinquishes the luxury of time and stymies enthusiasm to keep up with medical advances.

In 2019, Ancestry, a DTC-PGT provider company, awarded US $1 million to UpToDate—an organization that produces evidence-based information for clinical decision support systems [22]. This money was intended to aid the creation of content that assists physicians. Although well-intentioned, this initiative is not likely to be sufficient. Physicians need additional guidance regarding how to address their patients' DTC-PGT data as well as other consumer testing devices and health information. The trends of consumer interest and adoption of such genetic health tests and devices are on an upward trajectory, and such guidance is the key to maximizing the benefit of and minimizing the burden from these emerging consumer-focused health technologies.

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Conflicts of Interest

None declared.

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Abbreviations

DTC-PGT: direct-to-consumer personal genomic testing
PCP: primary care physician

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Original Paper

Evaluation of a Web-Based ADHD Awareness Training in Primary Care: Pilot Randomized Controlled Trial With Nested Interviews

Blandine French[1], BSc; Charlotte Hall[1], PhD; Elvira Perez Vallejos[1], PhD; Kapil Sayal[1], PhD; David Daley[2], PhD

[1]Institute of Mental Health, School of Medicine, University of Nottingham, Nottingham, United Kingdom

[2]Division of Psychiatry & Applied Psychology School of Medicine, University of Nottingham, Nottingham, United Kingdom

Corresponding Author:
David Daley, PhD
Division of Psychiatry & Applied Psychology School of Medicine
University of Nottingham
Triumph Road
Jubilee Campus
Nottingham,
United Kingdom
Phone: 44 01158230261
Email: david.daley@nottingham.ac.uk

Abstract

Background: Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder affecting up to 5% of children and adults. Undiagnosed and untreated ADHD can result in adverse long-term health, educational, and social impacts for affected individuals. Therefore, it is important to identify this disorder as early as possible. General practitioners (GPs) frequently play a gatekeeper role in access to specialist services in charge of diagnosis and treatment. Studies have shown that their lack of knowledge and understanding about ADHD can create barriers to care.

Objective: This pilot randomized controlled trial assesses the efficacy of a web-based psychoeducation program on ADHD tailored for GPs.

Methods: A total of 221 participants were randomized to either a sham intervention control or an awareness training intervention and they completed questionnaires on ADHD knowledge, confidence, and attitude at 3 time points (preintervention, postintervention, and 2-week follow-up). Participants in the intervention arm were invited to participate in a survey and follow-up interview between 3 and 6 months after the intervention.

Results: The responses of 109 GPs were included in the analysis. The knowledge ($P<.001$) and confidence ($P<.001$) of the GPs increased after the intervention, whereas misconceptions decreased ($P=.04$); this was maintained at the 2-week follow-up (knowledge, $P<.001$; confidence, $P<.001$; misconceptions, P=.03). Interviews and surveys also confirmed a change in practice over time.

Conclusions: These findings demonstrate that a short web-based intervention can increase GPs' understanding, attitude, and practice toward ADHD, potentially improving patients' access to care.

Trial Registration: International Standard Randomized Controlled Trial Number ISRCTN45400501; http://www.isrctn.com/ISRCTN45400501.

(JMIR Med Educ 2020;6(2):e19871) doi:10.2196/19871

KEYWORDS

ADHD; primary care; general practice; randomized controlled trial; online intervention; interviews

Introduction

Background

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder that affects up to 5% of children and adults [1]. The symptoms experienced by individuals with ADHD lead to considerable behavioral and cognitive impairment [2,3]. In adulthood, risks associated with undiagnosed and untreated ADHD, such as relationship or employment difficulties, can strongly affect the mental health of individuals and lead to economic and social burden [4]. Gaining a diagnosis of ADHD is important for access to appropriate treatment and minimizing the long-term impacts of ADHD. However, in many countries, ADHD is underdiagnosed and undertreated [5-7]. For example, in the United Kingdom, figures show that ADHD is underdiagnosed and undertreated, with 0.73% of children and 0.06% of adults receiving ADHD medication [8].

In the United Kingdom, general practitioners (GPs) often act as gatekeepers to specialist services where diagnosis and treatment take place. GPs do not always readily recognize ADHD symptoms, with many reporting low confidence, limited knowledge, and strong misconceptions about the disorder [9-11]. This is a key barrier for individuals with ADHD in accessing care [10]. Therefore, the development of interventions targeted at increasing the knowledge and confidence of the GPs is essential.

GPs in the United Kingdom need to participate in ongoing continuing professional development (CPD) to keep up to date with medical knowledge and changes in practice. Although many training packages and programs are continually being developed to improve medical skills of GPs [12-16], to our knowledge, there are no current web-based programs aimed at ADHD. Some published evidence indicates that primary care training on specific topics can improve patient care [15,17,18]; clinical outcomes [17]; and GP knowledge, confidence, and attitudes [19-21], highlighting the potential benefit for a targeted ADHD education package.

One perceived barrier to GPs attending and participating in training may be having to travel long distances to attend training sessions, which may be particularly burdensome for GPs serving in remote communities [22]. The development of web-based training may turn out to be beneficial in reducing this barrier, offering GPs easily accessible training at a time and place that fits their busy schedules. The use of web-based training by health care professionals has significantly increased in recent years [23-25]. Web-based training is an efficacious mode of delivery, with a recent review demonstrating that web-based continuing medical education improves knowledge and changes GPs' practice [22]. To our knowledge, no studies have been published on ADHD web-based psychoeducation programs developed for GPs, and data on the efficacy of ADHD training programs for GPs are lacking.

Objectives

This study presents the evaluation of a web-based intervention for GPs on ADHD. The web-based intervention was developed by the researchers following a strict development process, and its usability has been previously assessed [26]. In line with the Medical Research Council recommendations on the development and evaluation of complex interventions [27], this study aims to obtain preliminary findings on the effect of the *understanding ADHD in primary care* web-based program on the ADHD knowledge, attitudes, misconceptions, and change of practice of GPs to determine whether a future definitive randomized controlled trial (RCT) should be conducted. GP participants' opinions on the intervention and perceived impact on practice were obtained via qualitative interviews and a postintervention survey.

Methods

Study Design

The *understanding ADHD in primary care* trial was a pilot RCT registered with the International Standard Randomized Controlled Trial Number (ISRCTN) registry (ISRCTN45400501), with nested qualitative interviews. This parallel-group, single-blind RCT was conducted between August and November 2019 in primary care services in England. The interviews took place after the intervention between December 2019 and March 2020. The study received ethical approval from the University of Nottingham, Faculty of Medicine and Health Sciences Research Ethics Committee (reference: 19/HRA/1028; February 20, 2019) and from the Nottinghamshire Healthcare National Health Service (NHS) Foundation Trust Research and Development department (project ID 257567).

Participants

GPs and GP trainees were recruited from multiple sites across England, and they responded to invitation emails from local clinical research networks (CRNs) sent out via their practice. A total of 12 out of 15 English CRNs distributed the study invitation to hundreds of practices. Interested GP practices then circulated the study details to their GPs and trainees, with instructions to contact the lead researcher to express interest in the study. GPs and GP trainees practicing in England were included; the only exclusion criterion was having taken part in a previous usability study. Participants who expressed interest were sent a link to a web-based consent form. Multiple expressions of interest were received, representing most of England, and 231 consent forms were signed over 2 weeks. Unfortunately, it is not possible to know the exact number of expressions of interest; we received over 500 emails and were not able to map the sites that signed up after initial contact with us. Written informed consent was obtained for each participant before taking part in the study. Participants from the control group were sent a link to the web-based course after taking part in the study. Participants from the intervention group were invited to participate in a short qualitative interview and survey after completion of the intervention. Participants received an inconvenience allowance for participating in the study.

Intervention

Intervention: Understanding of ADHD in a Primary Care Web-Based Resource

The web-based noncommercial resource was delivered using a University of Nottingham server and built with an open-source learning management system. Further details on intervention development are reported in the study by French et al [26]. The complete web-based resource consisted of two 20-minute modules undertaken sequentially. The 2 modules followed the same format with text on the left side of the screen and interactive activities on the right. The activities included patient testimonies, drag and drop games, specialist videos, and pictures.

The 2 modules of the web-based resource are as follows:

- Module 1, called understanding ADHD, included the heterogeneous nature of ADHD; a brief description of

ADHD epidemiology and neuroscience; and ADHD symptoms, comorbidity, risks, and common misconceptions.
- Module 2, called the role of the GP, introduced the role of the GP in ADHD diagnosis and treatment pathways; the identification of ADHD and subsequent treatment options; the gatekeeping role of the GP and the pathway to care in the United Kingdom; and an ADHD toolkit, including downloadable screening tools, strategies, or useful websites [28].

Control Web-Based Resource

Participants allocated to the sham control group watched a web-based 30-minute video about the University of Nottingham Institute of Mental Health [29]. No information related to ADHD was provided during this video.

No changes were made to either the interventions or control during the trial.

Measures and Outcomes

Pilot RCT

Demographic Questionnaire

Exploration of demographic variables included the impact of the demographics of the participants on the Knowledge of Attention Deficit Disorders Scale (KADDS) scores. The demographics of the participants were recorded through a brief questionnaire developed by the study team at baseline (time point 1 [T1]).

Primary Outcome

The primary outcome was a change in the knowledge of the GPs assessed by the KADDS [30] questionnaire scores (T1 to time point 2 [T2] which is the primary end point). The knowledge of the participants was assessed using an adapted version of the KADDS and the GPs' understanding of the ADHD questionnaire [31].

KADDS Questionnaire

This 39-item self-report scale was originally developed to measure the understanding and knowledge of ADHD among teachers [32]. However, the itemized questions were not solely relevant to teachers and were also pertinent to general knowledge and the understanding of ADHD among GPs. A total of 27 questions from this questionnaire were used in this evaluation.

Secondary Outcomes

Changes in knowledge (assessed via the KADDS questionnaire) were reassessed 2 weeks after completing the intervention (time point 3 [T3]). The subscales of the KADDS questionnaire were also analyzed. Further secondary outcomes included the confidence of GPs in ADHD, awareness among GPs of the ADHD questionnaire, and usability questionnaire.

Confidence of GPs in ADHD

Change in confidence was explored through a self-rated visual analog scale (1=low and 10=high) assessing the confidence of GPs in their knowledge of ADHD.

Awareness of GPs of the ADHD Questionnaire

This questionnaire assesses the attitudes of GPs toward and their experience of ADHD [31]. Some questions were excluded as they were not relevant to the British health care system or were similar to the ones asked by the KADDS. A total of 13 questions from this questionnaire were used as they were specifically tailored to the experiences of GPs.

These questionnaires were administered on the web at 3 time points: baseline (T1), immediately after taking part in the study (T2), and 2 weeks after completing the study (T3). The time window for T3 was 2 weeks (−3 days or +10 days). The questions were the same at all time points and for both groups.

Usability Questionnaire

Participants in the intervention arm completed 2 visual analog scales on the usefulness of the intervention information and the likely impact on their practice at T2 only.

Postintervention Interviews and Survey

A 4-item open questionnaire was sent to all 56 participants from the intervention arm who consented to assess changes in practice and approaches 6 months after the intervention.

Secondary outcomes also included exploration of attitudes toward ADHD and long-term self-reported change in practice. Changes in practice were assessed through semistructured interviews and a short survey. The interview schedule included questions about the intervention and the impact it had on the attitude and practice of the GPs. As the aim of the interviews was to gauge the change in practice, it was noticed that 3 months was a short time to effectively assess this. Therefore, after conducting 11 interviews, it was decided that the remaining 12 interviews will be conducted 6 months after the intervention.

The outcome assessor and interviewer were not blinded to group allocation.

Randomization

Once recruited, participants were randomized before baseline data collection into either the intervention or the control arm. Randomization was initiated by the primary author and performed on the web through a randomization website [33] in batches of 20. Owing to the nature of the study, participants were blind to the study arm but may have been able to guess their arm once they started the study.

Procedures

Details of the study were sent to practices that had registered an interest in research within local CRNs. Participants wishing to participate signed a web-based consent form. Upon receiving consent, they were randomly allocated to the intervention or control group. After randomization, participants were then sent a link to the web-based resource of their allocated group. Upon following the link, both groups were directed to complete the baseline questionnaires (T1). After completion, an external link at the end of the questionnaire directed the GPs to their allocated intervention (ie, intervention or control). Upon completion of the intervention, both groups completed immediate follow-up measures (T2). Weekly reminders were sent via email for 4 weeks by the researcher. Follow-up measures were completed again 2 weeks postintervention (T3). All elements of the intervention were compulsory, and participants had to take part in all stages to contribute to the study. An inconvenience allowance and CPD certificate from the Royal College of GPs (RCGP) were attributed to the participants upon completion of the questionnaire at T3.

At 3 and 6 months after taking part, participants who had been allocated to the intervention group and had given consent to be contacted again were asked to take part in follow-up interviews. All interviews were originally planned to be conducted at 3 months (10 interviews); however, after noticing that this timeframe was not long enough, the remaining interviews (13 interviews) were conducted at 6 months. Participants who responded were interviewed over the phone for 15 minutes at the time of their convenience. Semistructured qualitative interviews were conducted over the phone. All 56 participants from the intervention arm who had given consent were also sent a short final survey to complete on the web.

Data Analysis

Data Preparation

Protocol Violation

Participants who took longer than 48 hours to complete the first 2 questionnaires were excluded from the analyses, as it was not possible to gauge whether any changes in scores were because of the intervention or external factors. Participants who did not complete all time points were also excluded from the completer analysis as an intention-to-treat analysis was not possible because randomization was done before baseline.

The KADDS questionnaire generated 3 types of responses: *true*, *false*, or *don't know*. These responses were classified into 3 categories: knowledge, misconception, and confidence [32].

- Knowledge included responses that were the right answers. If participants responded correctly to the question, they gained an extra knowledge point.
- Misconceptions included responses that were wrong. If participants responded incorrectly, then their misconception score increased by 1.
- Confidence included responses of don't know. By not committing to an answer, the lack-of-confidence scores of the participants increased by one.

Intervention Analyses Strategy

Preliminary checks were conducted to ensure that there was no violation of the assumptions of normality, linearity, homogeneity of variances, and reliable measurement of the covariate. A significant Kolmogorov-Smirnov test showed that the data were not normally distributed; therefore, nonparametric tests were used. Mann-Whitney U and Kruskal-Wallis tests were used to explore demographic differences between trial arms. A Spearman correlation was used to determine the relationship between the KADDS and confidence scores. The KADDS questionnaire scores were the primary outcome at T2; self-ratings of confidence were also explored; and both variables were analyzed using analyses of covariance (ANCOVAs), with T1 entered as the covariate, as an ANCOVA is robust to violation of the nonparametric assumption with moderate-to-large sample sizes greater than 15 cases per cell [34]. The outcome at T3 was also explored using the same analytical approach. Both the total and subscale scores of the KADDS were explored.

Qualitative Interview Analyses and Survey

The analytic strategy for this study was based on thematic analysis [35] enhanced by the principles of grounded theory [36]. Themes and subthemes were identified using an adapted approach of the 6-stage process of Braun and Clarke [20]. The analytic process began by transcribing each interview verbatim shortly after being conducted. Following this process, the lead investigator first familiarized herself with the interviews and made notes in a diary of preliminary thoughts on the content of the interviews. From this, preliminary codes were identified in a coding manual that were then collated and combined to be classified into broader themes using constant comparative analysis, both within and between transcripts. Finally, as the analysis evolved, these broader themes were reviewed and refined to generate the final themes proposed. An ongoing analysis allowed for a clear definition of the final themes.

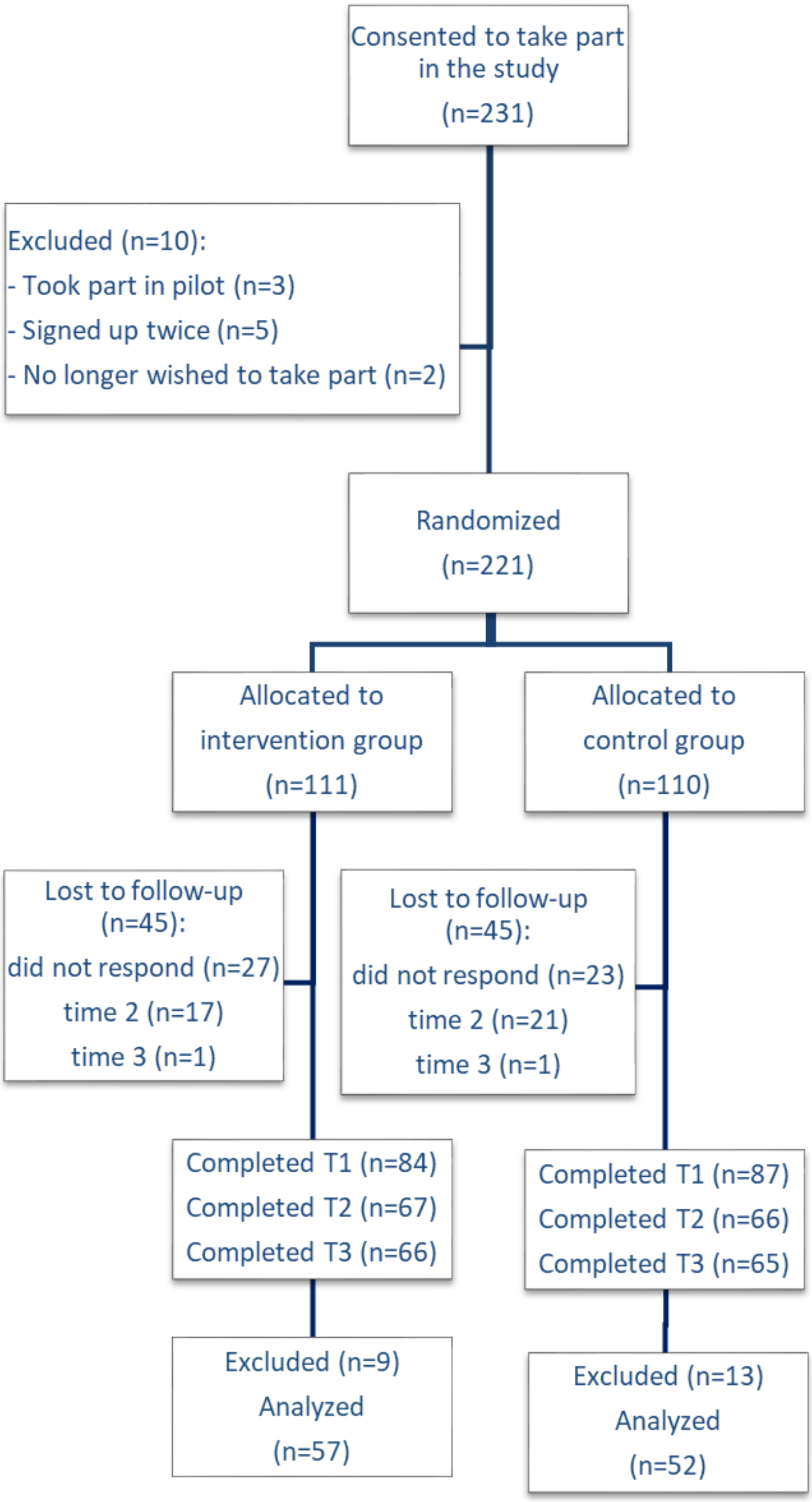
Themes were finally reviewed by a second researcher (EV) to ensure that they mapped to the original transcripts. Interrater reliability was tested on a small proportion (5/23, 20% of interviews) of the themes of the transcripts. The results were validated collectively as a team, and any discrepancies were discussed and reconciled. The survey responses were reported descriptively and were used to triangulate the responses from the interviews.

Results

Pilot RCT

Participants were recruited between July 10 and August 23, 2019 and were followed up until October 30, 2019. When the trial ended, a total of 231 GPs registered their interest in the study and consented to participate. A total of 10 GPs did not meet the eligibility criteria (Figure 1) and were not enrolled in the trial.

Figure 1. CONSORT (Consolidated Standards of Reporting Trials) flowchart of the pilot randomized controlled trial. A total of 18 participants were excluded because they did not complete the questionnaires at time point 1 (preintervention) and time point 2 (postintervention) within 48 hours, and 4 participants were excluded in the control arm for having received a link to the intervention before completion. T1: time point 1; T2: time point 2; T3: time point 3.



Therefore, 221 participants were randomized, 111 in the intervention group and 110 in the control group. After randomization, 51 GPs (27 in the intervention and 23 in the control groups) did not respond to the invitation to start the study. Figure 1 shows the number of participants lost to follow up at each point. Upon answering the baseline questionnaire, 37 GPs did not complete the postquestionnaires at T2 (17 in the intervention and 20 in the control groups) and 2 GPs at T3 (1 in the intervention and 1 in the control group). A total of 170 trainees or fully qualified GPs (103/170, 60.6% female; 6/170, 3.5% GP trainees) completed T1, 133 completed T1 and T2 (84/133, 63.2% female; 5/133, 3.8% GP trainees), and 131 (82/131, 62.6% female; 5/131, 3.8% GP trainees) completed the assessments at all 3 time points.

A total of 22 participants were excluded from the analyses following protocol violations. A total of 18 were excluded as they took longer than 48 hours to complete pre- and postquestionnaires (T1 and T2), and 4 participants from the control group were excluded after T2 as they inadvertently received a link to the intervention before T3.

Figure 1 shows that both trial arms had an even number of recruitments and comparable levels of nonengagement, dropouts, and excluded participants.

Baseline Characteristics

The baseline characteristics of the study group are summarized in Table 1. Most participants were females (103/170, 60.6%).

The age range was fairly, evenly split across the age groups, but most participants were aged below 45 years. However, the range of years of practice was very broad. The estimated number of children under their care with suspected ADHD ranged widely from 0 to 100. The number of individuals diagnosed with ADHD also varied widely. The number of times the participants identified ADHD in their patients was also varied, with most participants reporting that they had not identified more than 5 patients. When asked whether ADHD was part of their medical training, most GPs reported that it was not.

Table 1. Baseline characteristics.

Participants	Baseline (n=170)[a]		Participants included in completer analyses (n=109)[a]	
	Control (n=87)	Intervention (n=83)	Control (n=52)	Intervention (n=57)
Gender, n (%)				
Male	29 (33)	38 (46)	15 (28)	27 (47)
Female	58 (66)	45 (54)	37 (71)	30 (52)
Age (years), n (%)				
25-35	26 (30)	23 (28)	15 (29)	16 (28)
36-45	34 (39)	29 (35)	20 (38)	21 (37)
46-55	22 (25)	24 (29)	13 (25)	14 (25)
56-65	5 (5)	7 (8)	2 (8)	6 (10)
ADHD[b] part of general practitioner training, n (%)				
Yes	17 (19)	18 (21)	12 (23)	15 (26)
No	57 (66)	52 (63)	34 (65)	35 (61)
Unsure	5 (5)	4 (6)	2 (3.8)	1 (2)
Small part of teaching	8 (10)	8 (10)	4 (7.6)	6 (11)
Estimated number of children with suspected ADHD seen in practice annually				
Mean	14	19	11	16
Range	0-100	1-150	0-90	1-100
Individuals with a confirmed ADHD diagnosis currently in practice				
Mean	43	67	39	57
Range	0-400	2-500	0-400	0-500
Number of times ADHD was picked up by participant				
Mean	4.1	5.4	3.2	5.1
Range	0-30	0-50	0-30	0-50
Medical experience (years)				
Mean	15.1	16.5	14.7	15.9
Range	0-36	0-36	0-33	0-36

[a]Some data are missing for some questions.

[b]ADHD: attention-deficit/hyperactivity disorder.

Demographics

The demographics of the participants are presented in Multimedia Appendix 1.

Study Interaction

Participants were instructed to complete assessments in one go if possible; however, they had the option to log off and return if required. Participants who took longer than 48 hours between

T1 and T2 were excluded from the analyses. Participants from the control group mostly completed T1 and T2 in 1 session (41/52, 78%), whereas fewer participants in the intervention group completed T1 and T2 in 1 session (35/57, 61%). Among those who completed T1 and T2 in 1 session, the average time spent on the control video was 39 minutes (SD 20.79; range 13-85), and the average time spent on the intervention course was 55 minutes (SD 13.5; range 28-125). Most participants interacted with the video or intervention in both groups, suggesting that they were unsure of their group allocation.

Primary Outcome

The primary outcomes for this intervention were KADDS knowledge scores at T2. Table 2 illustrates the responses from these scores and responses from KADDS scores assessed as secondary outcomes.

Table 2. Descriptive statistics of the knowledge, misconceptions, and confidence scores of the Knowledge of Attention Deficit Disorders Scale (KADDS) for the 2 groups at the 3 different time points.

Groups	KADDS knowledge[a]	KADDS misconceptions[a]	KADDS confidence[a]	Self-rated confidence[a]
Control group, mean (SD)				
T1[b]	16.82 (5.15)	1.82 (1.78)	7.15 (6.07)	4.40 (1.66)
T2[c]	17.23 (5.18)	2.05 (1.62)	6.64(5.99)	4.57 (1.67)
T3[d]	17.13 (5.02)	2.24 (1.77)	6.69 (5.97)	4.88 (1.72)
Intervention group, mean (SD)				
T1	16.65 (3.88)	2.16 (2.20)	7.12 (4.30)	4.66 (1.70)
T2	23.71 (2.00)	1.54 (1.55)	0.73 (1.35)	7.40 (1.05)
T3	22.96 (2.13)	1.70 (1.65)	1.22 (1.71)	7.36 (0.89)

aThe knowledge scores of Knowledge of Attention Deficit Disorders Scale (KADDS) represent the number of right answers, KADDS misconception scores represent the number of wrong answers, and KADDS confidence scores represent the number of don’t know answers.

[b]T1: time point 1.

[c]T2: time point 2.

[d]T3: time point 3.

A one-way between-group ANCOVA was conducted to compare the effectiveness of the web-based intervention designed to change the attitudes of the GPs toward ADHD. There was a significant impact of the intervention on ADHD knowledge after controlling for baseline responses, with the intervention group reporting significantly more knowledge of ADHD, $F_{1,106}$=117.5, P<.001, and partial eta squared=0.52.

In addition, enhanced knowledge from the KADDS questionnaire was retained at the 2-week follow-up, $F_{1,106}$=96.25, P<.001, and partial eta squared=0.47.

Secondary Outcomes

ADHD Knowledge, Misconceptions, and Confidence

After controlling for differences in baseline responses, the intervention group showed a significant reduction in ADHD misconceptions compared with the control group, $F_{1,106}$=4.20, P=.04, and partial eta squared=0.03.

This effect was retained at the 2-week follow-up, $F_{1,106}$=9.21, P=.03, and partial eta squared=0.04.

Immediately after the intervention (T2), the intervention group also showed a significant increase in confidence compared with the control group: $F_{1,106}$=182.8, P<.001, and partial eta squared=0.63.

This increased confidence was retained at the 2-week follow-up: $F_{1,106}$=110.08, P<.001, and partial eta squared=0.50.

Factor Subscales

The original KADDS questionnaire had 3 subscales: associated features (general information about the nature, causes, and prognosis of ADHD), symptom or diagnosis, and treatment. These subscales aim to reflect content areas relevant to diagnostic decisions. The results of KADDS knowledge scores on these subscales were further explored. Multimedia Appendix 2 presents the responses for each subscale.

For participants in the intervention group, scores decreased on all the subscales after the intervention at T2 and T3—associated features subscale, T2: $F_{1,106}$=88, P<.001, partial eta squared=0.45 and T3: $F_{1,106}$=69, P<.001, partial eta squared=0.39; the symptoms/diagnosis subscale, T2: $F_{1,106}$=69.8, P<.001, partial eta squared=0.39 and T3: $F_{1,106}$=57.9, P<.001, partial eta squared=0.35; and treatment subscale, T2: $F_{1,106}$=45, P<.001, partial eta squared=0.30 and T3: $F_{1,106}$=45.9, P<.001, partial eta squared=0.30.

The relationship between the KADDS knowledge scores at T1 and self-rated confidence was investigated using Spearman rho correlations. A strong positive correlation between the 2 variables was observed, r=0.473, n=109, and P<.001, with high levels of self-rated confidence associated with higher scores of ADHD knowledge.

Intervention Group

At T2, participants in the intervention group were asked to rate 2 feedback questions on the usefulness of the information and likelihood to inform practice on a scale of 1 to 10. The results indicated that participants found the information to be useful (mean 8.2, SD 1.48) and likely to inform practice (mean 7.8, SD 1.5).

Attitude Toward ADHD

Another questionnaire on GPs' attitudes toward ADHD was included at all time points. Descriptive statistics for these 12 questions are presented in Multimedia Appendix 3.

The findings from this questionnaire demonstrate that most GPs do not endorse most common misconceptions and nonscientific associations with ADHD. However, changes in attitude and these misconceptions can be observed among participants from the intervention group, whereas control participants' scores remained unchanged over the 3 time points. The slight changes in attitude in the intervention group were mostly related to the following statements:

> *Most children with ADHD try to control themselves.*
>
> *Parents seek ADHD diagnosis as an excuse for their child's bad behavior.*
>
> *ADHD diagnosis relieves families from stress and supports problem solving.*
>
> *Do you believe ADHD is society's excuse for badly behaved children?*

Interviews and Survey

A total of 56 participants who took part in the intervention arm had given consent to be contacted again and were invited to take part in a short qualitative interview and a short survey. A total of 23 participants took part in the interviews, and 21 responded to a brief survey about the impact of the intervention on their clinical practice. The interviews lasted for an average of 10 minutes 30 seconds (range 6.43-15.45).

No differences were observed in the interviews of GPs who took part in the first wave of interviews (3 months) and the second wave of interviews (6 months). GPs reported similar changes in knowledge and practice; however, by allowing more time, a greater impact on practice was observed (more GPs reporting it), allowing training to filter through to their practice.

Interviews

Feedback on the Intervention

All participants thought that the format of the intervention was informative, useful, and appropriate. None of the participants thought that any content was missing. A couple of participants expressed that there was too much text and that the content could be more concise. Participants benefited mainly from the videos, information about adults, and the genetic explanation of ADHD. Participants highlighted the benefit of understanding the epidemiology and long-term aspects of ADHD as well as having experts' and patients' videos to help put ADHD into context, especially the videos of a GP with ADHD.

Participants were also asked about their reasons for signing up for the study. Although monetary rewards and demands to take part in research were cited as incentives, the main incentive was professional/personal interest in the topic. Most GPs stipulated that personal interest in ADHD was the reason they signed up, often acknowledging a lack of previous knowledge and/or medical school training on the topic.

The interviews highlighted 2 main themes, both related to the impact of the intervention. The first theme related to the personal impact the intervention had on the participants, exploring changes in their understanding, attitudes, and knowledge. The second theme explored broader changes and the impact the intervention had on other individuals. This included not only participants' change in practice, directly impacting their patients, but also the impact the intervention had on their personal lives and broader professional views.

Personal Impact: Change in Knowledge and Attitude of GPs

Increased knowledge and attitudes was the first theme highlighted. Most participants reported that taking part in the study greatly increased their knowledge of ADHD, especially as they had received very limited medical training on ADHD. Participants stated that it helped reduce misconceptions and demystified ADHD, which was especially useful for younger GPs or trainees. Many participants found that they knew very little about the topic, specifically with regard to adult diagnosis and biological/genetic components, as many believed or were taught that ADHD was a behavioral problem only present in childhood. Increasing accurate knowledge was especially helpful for GPs as they enjoyed learning about the positives of gaining a diagnosis and accessing the right treatment:

> *I was surprised how little I knew about it beforehand to be honest… I am much more sympathetic… The fact that I can remember so much about it is probably testament to how good it was at reinforcing and retaining the information.* [P12]

Participants who had some preliminary knowledge of ADHD stated that the course was a good refresher and confirmed what they already knew while adding a few extra unknown facts. These participants often mentioned that their knowledge was acquired in informal ways throughout their practice, and they felt reassured that this knowledge was confirmed by the intervention. However, a few participants raised the issue that although the intervention was informative, it was too simplistic for individuals who had extensive previous knowledge:

> *You pick up bits and pieces along the way and I think most of those were covered in the program and then I reckon about 50% I wasn't aware of.* [P9]

Increased knowledge and information received from the course led to almost all the participants reporting a change in attitude toward ADHD. More specifically, participants reported feeling more confident and being more understanding and more empathetic toward ADHD. Participants also reported being more tolerant and patient toward people seeking a diagnosis, having less prejudice, and being less dismissive. By demystifying some of the stigmas about ADHD, the resource allowed participants to gain a more empathic approach toward the disorder and change their mindset:

> *Actually it has changed my attitude, it's not very often that some sort of learning will do that because attitudes are quite hard engrained.* [P1]

> *I've got a couple of adults with ADHD (who have been refereed) and I'm able to empathize with them a lot more whilst we are "holding them" until they get to the top of the list to see a psychiatrist.* [P19]

Broader Impact: Change in Practice and Beyond

The second theme these interviews highlighted referred to the broader impacts of the intervention. Many participants reported changing their practice in many different ways. Some reported an increase in identification and referral, acknowledging that the course enabled them to make the process easier and quicker and develop a more structured approach to referrals. Others reported changes in practice in relation to the tools and information that they now use to refer to and manage ADHD, increasing referral to services and screening questionnaires. As one GP mentioned, "It is not so much *what* I do that has changed but *how* I do it." Some of the knowledge gained, for instance, in relation to the association between ADHD and depression or greater awareness about symptoms in adulthood, has helped GPs to now explore patients' histories further and ask additional questions. Participants who did not report change of practice reported that it was mainly because of the lack of opportunities in their practices with, for instance, the above-average older population. Nonetheless, these participants reported that even after 6 months of participating in the study, they knew how they could change their practice in the future when they came across a patient with ADHD:

> *I offer them extra support, give them extra time in appointments… There are certain questions I might ask now that I wouldn't before.* [P2]

> *My threshold to refer people for assessment would be much, much lower now.* [P12]

Finally, many GPs reported impacts beyond their practice. These participants discussed how the course allowed them to identify ADHD among family members or individuals they know in other settings. The participants also often disseminated the course within their contacts and practice, broadening the impact of the course. Finally, participants also reported seeking further training as a result of taking part in this course. Participants asked if we had more modules on similar topics available and also attended further training on ADHD and other developmental conditions as they wanted to learn more:

> *It helped me understand a little bit what was going on with my own son as well.* [P18]

> *It's completely changed the way I view them, I'm much more sympathetic.* [P14]

> *I was able to pass on the learning to other doctors in our doctors meeting so. I'm hoping that will have impact not just on me but doctors at the surgery too.* [P2]

Surveys

A total of 21 participants (10/21, 48% females) responded to a brief web-based survey 6 months after taking part in the study. The responses were from a mix of participants who took part in the interviews (12/21, 58%) and those who did not (9/21, 42%).

These responses triangulated with the interview responses, and similar findings were observed. When asked whether the participants gained any knowledge on ADHD and if there was any difference in how they approached ADHD before and after their interaction with the course, 91% (20/21) of the participants agreed. When asked if the intervention had impacted their practice yet, 66% (14/21) said yes, 19% (4/21) said no, and 15% (3/21) said that the intervention had not yet impacted their practice.

When asked to give an example of how it changed their practice, GPs mentioned similar topics to the ones in the interviews, including an increase in referrals, more confidence in discussing and identifying ADHD, better use of assessment/screening tools, and better awareness and understanding of patients with ADHD.

Finally, when asked if the course impacted their attitude toward patients with or at risk for ADHD, 19% (4/21) of the participants reported no changes. Participants who reported changes in attitude mentioned increased empathy, better understanding, increased awareness of the positive impact of a diagnosis, and the importance of quick referrals as well as increased confidence. A decrease in common ADHD stigma such as bad parenting and misunderstanding that it only happens in childhood were also mentioned.

Survey responses from the group of GPs who did not take part in the interviews triangulated with the interview themes. In reporting the personal impact that the course had, GPs felt that it did change their attitude and knowledge of ADHD:

> *Better understanding of impact on individual and the support they need.* [P14]

> *I am more sympathetic to parents.* [P19]

GPs also reported a wide impact in their change of practice:

> *I have increased my referral to adult ADHD specifically rather than to psychological therapies.* [P21]

> *I saw a young boy the day after the training and It was very useful to know what questions to ask.* [P8]

Discussion

Principal Findings

With the aim of understanding the potential clinical utility of a web-based psychoeducation program aimed at improving GPs' knowledge of ADHD, we conducted a pilot RCT and demonstrated that the intervention was potentially efficacious, with GPs reporting an increase in knowledge of ADHD, combined with a change in attitude, reduction in misconceptions, change in practice, and excellent reported levels of acceptability. Previous studies [9] have demonstrated that some of the major barriers in GPs' understanding and management of ADHD reflect their lack of training and knowledge and the presence of misconceptions. This study has shown that a short web-based education program can be easily implemented and that it can address these gaps while also impacting practice. This study (with over 115/170, 67.6%) of GPs having never received any training on ADHD) and others [37,38] have highlighted the lack of initial GP training on ADHD. No difference was observed between participants who had and had not received previous ADHD training, indicating that the present training is ad hoc. Therefore, this intervention is timely in addressing these gaps.

The findings also highlight positive feedback on the usability and implementation of the intervention tool. Participants enjoyed taking part in the intervention and found it useful. A few participants reached out personally to the researchers to enquire about whether the tool could be shared with colleagues and GP trainees in their practice as they found it highly informative. None of the participants could think of anything that they felt was missing or that could have been changed. The usability of the web-based resource was initially investigated in a small pilot study [26], and the findings from this RCT confirm that the web-based resource is ready to be used as it is and that no further adjustment needs to be made. The findings from the interview also triangulate our previous findings of barriers in ADHD services in primary care, such as lack of appropriate services and lack of training [10]. GPs acknowledged that the lack of training on ADHD prompted them to do this intervention in the first place; although the increase in knowledge was useful, the lack of services to refer to, especially for adults, was frustrating. In contrast to findings from previous studies on the misconceptions and attitudes of GPs [31], our findings showed fewer misconceptions and stigmatizing views expressed by GPs. The intervention did address some of these; however, we found that at baseline, GPs were much less prone to stigmas than previously reported.

Few studies have investigated the implementation of web-based interventions for GPs. This study contributes to the body of work investigating methods of increasing the awareness of specific disorders among GPs [15] and providing accessible web-based educational programs. As GP training on ADHD is limited and no other targeted web-based education resource exists on the topic, this study addresses a vital gap. Piloting is important as it permits valuable methodological lessons to be learned. Although many pilot RCTs struggle to establish statistically significant results often because of small sample sizes [39-41], this study indicates the potential efficacy of the intervention, despite the limited sample size.

The coproduction approach [26] taken in developing the design and format of the web-based resource offers many strengths to this study. The resource is optimal for GPs as it is time limited, easily accessible, and freely available, minimizing the costs and time of the GPs in accessing training. Despite previous research highlighting difficulties with recruiting GPs as research participants [22,42,43], this study had no difficulty with recruitment. On the contrary, recruitment was very fast and had to close after only 2 weeks. This could indicate a high interest in the topic or the strong need for training on ADHD. Alternatively, and similar to the advice given in recent studies, the presence of monetary and nonmonetary (CPD certificate) incentives [44] and regular reminders [42] might have also contributed to the success in recruiting for this study.

Limitations

A few limitations can also be highlighted in this study. The sample was not balanced across genders and included a high proportion of women (103/170, 60.6%). A recent report from the England General Medical Council [45] suggests that this is representative of part-time but not full-time permanent contracts in the NHS (only 4004/11,441, 34.99% of GPs on full-time permanent contracts are female, against 5008/8341, 60.04% part-time). Unfortunately, we did not collect information on whether the participants worked part-time or full-time, and this finding might imply that participants were more likely to participate if they worked part-time and therefore had more time to complete the study. It is also important to highlight that this study took place in England and is therefore specific to the British health care system where GPs acting as gatekeepers and providing referrals to secondary care services for diagnosis and treatment are the norm. Therefore, recommendations presented in the web-based resource as well as the design for this study reflected this specific system and might not apply to countries using a different approach.

Limitations also arose from a lack of methodological rigor that had to be adopted for pragmatic reasons. First, the assessor was not blinded to the study, and although the participants were blinded, they could potentially guess their group allocation. Although this can be an issue in reporting the rigor of this pilot RCT, the findings indicate that this had limited impact and are still worthy of a full RCT. Second, as a pilot efficacy RCT, there was no formal power calculation to inform the sample size. Nevertheless, the achieved sample size was sufficient to demonstrate postintervention differences between arms. Third, because of the format of the web-based intervention, randomization had to be performed before baseline, which is not common practice. Conducting randomization after baseline questionnaires would have added another step to the study, asking the GPs to spare time for more than one session, and therefore was believed to be likely to increase attrition. Sending specific links to either control or intervention groups so that GPs could complete questionnaires at T1 and T2 in 1 session seemed preferable to maximize the completion rate. However, despite clear instructions, less than 50% of the GPs completed in 1 session, and therefore randomization after baseline might not have had a significant impact on attrition. A total of 18 participants had to be excluded from the analyses after taking longer than 48 hours between the 2 time points. Therefore, completion in 1 session, although ideal for this study, seemed unfeasible for most participants.

Although a significant number of participants who completed consent forms did not take part in the study (60/231, 25.9%), this dropout can be explained by multiple factors. Recruitment in general practice is complex. Often practices are recruited for studies, and a selective number of GPs take part. Either practices or practice managers will express an interest for the participation of their practice. A couple of participants who were excluded as they had previously taken part in our pilot study explained that they provided consent on behalf of their practices. In the future, the expression of interest and consent for individuals versus practice will be made clearer. Attrition rates were moderate at 23.3% (40/171) between T1 and T3. However, the attrition rate between T2 and T3 was very low (2/133, 1.5%). A few retention strategies such as weekly reminders with clear deadlines and reinforcing the incentives were put in place, which seemed to minimize the attrition rate compared with average attrition rates of RCT [46,47].

Future research should address the methodological issues arising from this study. However, although it impacted attrition and exclusion rates, these issues do not seem to have impacted the findings for this study per se. Some changes in practice were observed; however, because of the time restriction for this study (6 months), we were unable to fully assess this impact over time. Future research should include a longitudinal assessment to explore whether changes in knowledge, attitude, and practice are retained over a longer period. Exploring the impact of this resource on other health care professionals, such as primary care nurses or secondary care professionals, would also allow for broader impacts of this intervention to be investigated. Finally, although qualitative data on change of practice were obtained in this study, assessing the impact on the number and quality of referrals was not possible within the context of this study. Future studies should include an assessment of referral or observational components to gauge changes in practice more directly.

Conclusions

This pilot RCT was successful in answering the hypotheses that a short web-based psychoeducation program would increase the awareness, knowledge, and attitude of GPs toward ADHD while also changing their practice. These findings need to be interpreted with caution, as this is the only study investigating the efficiency of this web-based intervention, and further studies are needed to replicate these findings. These findings however highlight potential significant clinical impacts on the care and policies for patients. Through improved GP understanding and knowledge, patients should receive more timely access to care, reducing the long-term impacts of untreated and undiagnosed ADHD. This web-based resource has already been adopted by the RCGP, which will impact the learning and awareness of many GPs beyond this study, having a broader impact on practice and potentially influencing commissioning decisions once the importance of training GPs on ADHD has been recognized.

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Conflicts of Interest

DD reports grants, personal fees, and nonfinancial support from Shire/Takeda; personal fees and nonfinancial support from Medice; personal fees and nonfinancial support from Eli Lilly; and nonfinancial support from QbTech, outside the submitted work. BF reports personal fees and nonfinancial support from Shire/Takeda. KS was a member of the National Institute for Health and Care Excellence ADHD Guideline Development Group (NG87). All others declare no conflict of interest.

Multimedia Appendix 1
Participants' demographics.
[DOCX File , 13 KB - mededu_v6i2e19871_app1.docx]

Multimedia Appendix 2
Descriptive statistics of the knowledge, misconceptions, and confidence scores of the Knowledge of Attention Deficit Disorders Scale for the 2 groups at 3 different time points.
[DOCX File , 15 KB - mededu_v6i2e19871_app2.docx]

Multimedia Appendix 3
Descriptive statistics of the knowledge scores of the Knowledge of Attention Deficit Disorders Scale on 3 subscales at 3 different time points.
[DOCX File , 18 KB - mededu_v6i2e19871_app3.docx]

Multimedia Appendix 4
CONSORT e-HEALTH Checklist V1.6.2.
[PDF File (Adobe PDF File), 101 KB - mededu_v6i2e19871_app4.pdf]

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Abbreviations

ADHD: attention-deficit/hyperactivity disorder
ANCOVA: analysis of covariance
CPD: continuing professional development
CRN: clinical research network
GP: general practitioner
KADDS: Knowledge of Attention Deficit Disorders Scale
NHS: National Health Service
RCGP: Royal College of General Practitioner
RCT: randomized controlled trial
T1: time point 1
T2: time point 2
T3: time point 3

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Original Paper

Confronting the Challenges of Anatomy Education in a Competency-Based Medical Curriculum During Normal and Unprecedented Times (COVID-19 Pandemic): Pedagogical Framework Development and Implementation

Nerissa Naidoo[1], BSc, PhD; Aya Akhras[1], HSC; Yajnavalka Banerjee[1,2], BSc (Hons), PhD, PGDME

[1]College of Medicine and Health Sciences, Mohammed Bin Rashid University of Medicine and Health Sciences, Dubai, United Arab Emirates
[2]Centre of Medical Education, University of Dundee, Dundee, United Kingdom

Corresponding Author:
Yajnavalka Banerjee, BSc (Hons), PhD, PGDME
College of Medicine and Health Sciences
Mohammed Bin Rashid University of Medicine and Health Sciences
Dubai Health Care City
Dubai, 505055
United Arab Emirates
Phone: 971 568345125
Email: yaj.banerjee@gmail.com

Abstract

Background: Anatomy is considered to be one of the keystones of undergraduate medical education. However, recently, there has been drastic reduction, both in gross anatomy teaching hours and its context. Additionally, a decrease in the number of trained anatomists and an increase in the costs associated with procuring human cadavers have been noted, causing a diminution of cadaveric dissections in anatomy education.

Objective: To address these challenges, there is an ardent need for a pedagogical framework such that anatomy education can be disseminated through active learning principles, within a fixed time frame, using a small team of anatomists and a small number of cadaveric specimens (for live on-site sessions) as well as collaborative learning principles. The latter is particularly important when anatomy education is delivered through distance learning, as is the case currently during the COVID-19 pandemic.

Methods: Here, we have blueprinted a pedagogical framework blending the instructional design models of Gagne's 9 events of instruction with Peyton's 4-step approach. The framework's applicability was validated through the delivery of anatomical concepts, using an exemplar from the structure-function course Head and Neck during the normal and COVID-19–mandated lockdown periods, employing the archetype of Frey syndrome. Preliminary evaluation of the framework was pursued using student feedback and end-of-course feedback responses. The efficiency of the framework in knowledge transfer was also appraised.

Results: The blueprinted instructional plan designed to implement the pedagogical framework was successfully executed in the dissemination of anatomy education, employing a limited number of cadaveric specimens (during normal times) and a social media application (SMA)–integrated "interactome" strategy (during the COVID-19 lockdown). Students' response to the framework was positive. However, reluctance was expressed by a majority of the faculty in adopting the framework for anatomy education. To address this aspect, a strategy has been designed using Mento's 12-step change management model. The long-term benefits for any medical school to adopt the blended pedagogical framework have also been explicated by applying Bourdieu's Theory of Practice. Additionally, through the design of an SMA interactome model, the framework's applicability to the delivery of anatomy education and content during the ongoing COVID-19 pandemic was realized.

Conclusions: In conclusion, the study effectively tackles some of the contemporary key challenges associated with the delivery of anatomy content in medical education during normal and unprecedented times.

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KEYWORDS

undergraduate medical education; anatomy education; Gagne's 9 events of instruction; Peyton's 4-step approach; Mento's 12-step change management model; Bourdieu's Theory of Practice; social media application; interactome; COVID-19; framework

Introduction

Anatomy education is an essential stipulation for medical students, general practitioners, surgeons, and for all those involved in invasive diagnostic and therapeutic procedures [1]. In the recent years, numerous factors are disadvantageously impacting anatomy education in medical specialties. These factors include, but are not limited, to a drastic reduction in anatomy teaching hours and its context and the number of trained anatomists, as well as an increase in the costs of human cadaveric dissections and the related ethical uncertainties surrounding the use of human cadavers.

The COVID-19 pandemic has added to these challenges, as most medical schools have suddenly shifted from face-to-face teaching to distance learning, requiring the design of innovative strategies that will allow for the delivery of remote anatomy education [2].

One way of effectively addressing these challenges is to design a "student-centered teaching framework" (easily implementable for both face-to-face and distance-learning modalities), where the essential "nuts and bolts" of anatomy can be delivered effectively: (1) within a limited and fixed time frame; (2) using a small team of trained anatomists; (3) using a small number of cadaveric specimens; and (4) by integrating principles of active learning, collaborative learning, feedback, and student autonomy.

Moreover, designing a pedagogical framework alone will not address the challenges of anatomy education. The designed teaching approach needs to be implemented in the delivery of anatomy education and then evaluated. Furthermore, a change management strategy needs to be adopted such that the pedagogical framework is able to initiate a change in pedagogical philosophy in the context of anatomy education.

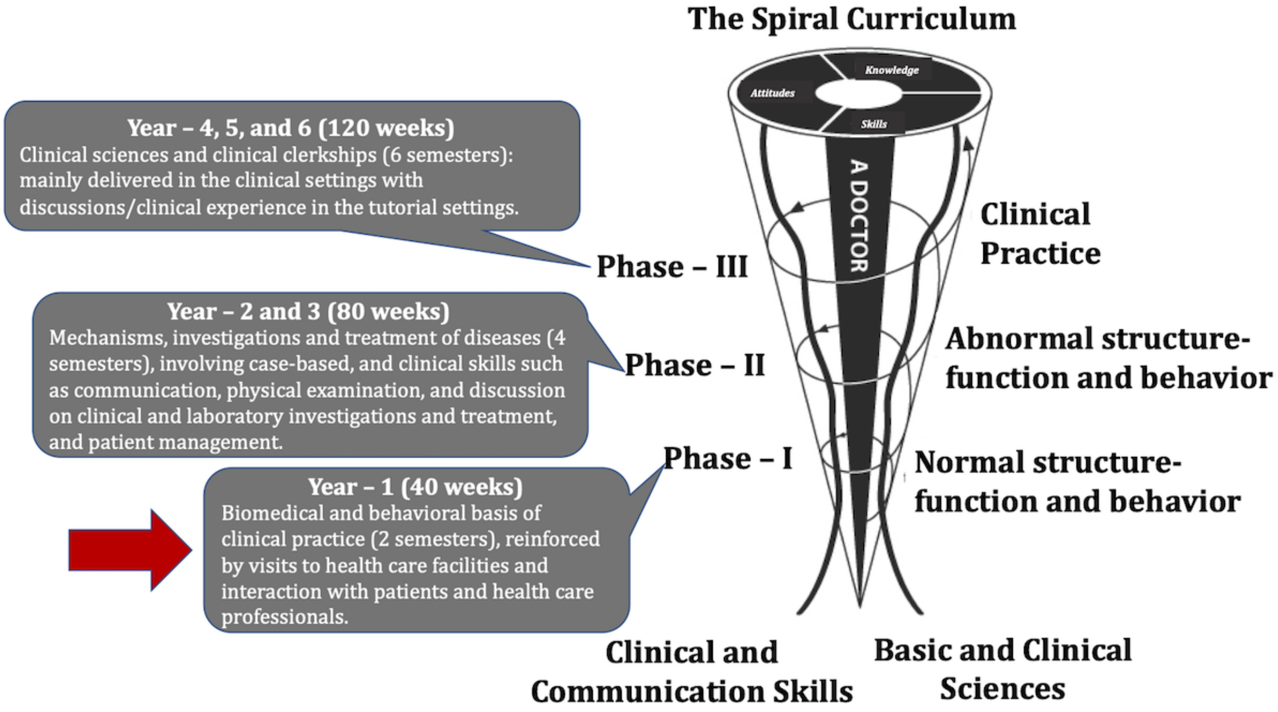
Here, we outline a pedagogical framework to tackle the aforementioned challenges of anatomy education in a competency-based medical curriculum (CBMC). A pedagogical framework was designed, blending Gagne's [3] and Peyton's [4-6] instructional design models. We have also demonstrated how this pedagogical framework can be effectively employed in the delivery of anatomical concepts using an exemplar from the structure-function course Head and Neck offered to first-year medical students in the preclinical phase of the undergraduate medical curriculum at the Mohammed Bin Rashid University of Medicine and Health Sciences (MBRU). Further, we have outlined a social media application (SMA)– integrated strategy (an SMA interactome), whereby the designed pedagogical framework could be employed in anatomy education during the COVID-19 pandemic. The efficiency of this solution in terms of knowledge transfer was evaluated by comparing the performance of the cohorts who were exposed to the pedagogical framework: (1) through face-to-face teaching and (2) through distance learning during the COVID-19 lockdown. A preliminary evaluation with regards to student perceptions toward the pedagogical framework was also conducted based on end-of-course feedback. Although the students responded positively to the pedagogical framework for both face-to-face and distance learning modalities, there was reluctance among instructors in adopting the framework for anatomy education across all anatomy courses. To address this, we have blueprinted a change-management approach employing Mento's change-management model [7], which will allow anatomy educators to implement the designed pedagogical framework in any CBMC. This paper primarily focuses on the description of the frameworks, and initial observations and reflections following their execution.

Methods

Study Landscape

The CBMC at MBRU comprises three phases (Figure 1). Each phase of the curriculum includes integrated courses and builds on the preceding one, such that the curriculum is a "spiral" [8,9], and the students repeat concepts relating to a subject, where with each successive encounter, concepts build on the previous one. The medical school caters to a student population from more than 19 different countries and from 20 different high school curricula. Approximately 75% of the students are female [10]. The designed pedagogical framework was implemented in the delivery of gross regional anatomy in the form of structure-function courses occurring primarily in Phase 1 of the curriculum (Figure 1). Four structure-function courses with specific timelines are delivered in semester 2 of Phase 1 over a 15-week period: (1) Limbs and Spine: weeks 1-4; (2) Thorax: weeks 5-7; (3) Abdomen, Pelvis and Perineum: weeks 8-11; and (4) Head and Neck: weeks 12-15.

Figure 1. The undergraduate medical curriculum at Mohammed Bin Rashid University of Medicine and Health Sciences (MBRU). The curriculum is divided into three phases and spans over 6 years. Note: Each phase of the undergraduate medical curriculum includes integrated courses and builds on the preceding one, such that the curriculum is a "spiral," and the students repeat the study of a subject, each time at a higher level of difficulty and in greater depth. The phase in which the teaching framework was implemented is indicated with a red arrow.



The structure-function courses are designed to provide students with in-depth understanding of the normal human anatomy and resulting physiological roles, with a focus on essential radiology and basic clinical correlation. The structure-function course Head and Neck where the pedagogical framework was implemented provides students with functional knowledge of the structures of head and neck regions that will enable further understanding of organ system courses in Phase 2 (Figure 1). The course also introduces the concept of "living anatomy of the head and neck" as visualized on conventional medical imaging and on the living human body. At the end of the course, students should be able to describe the major features of the skull, as well as the main structures present in the neck, face, and temporal and infratemporal regions. They should also be able to identify the main anatomical features of the face, nose, oral cavity and tongue, pharynx, soft palate, and larynx, and explain the basis of cranial nerve testing. They should also be able to explain the anatomical basis of upper airway obstruction, cervical swellings, facial nerve palsy, Frey syndrome, epistaxis, and dysphagia. In addition, through the course, students should develop an attitude of collaborative learning and autonomy.

Design of the Pedagogical Framework

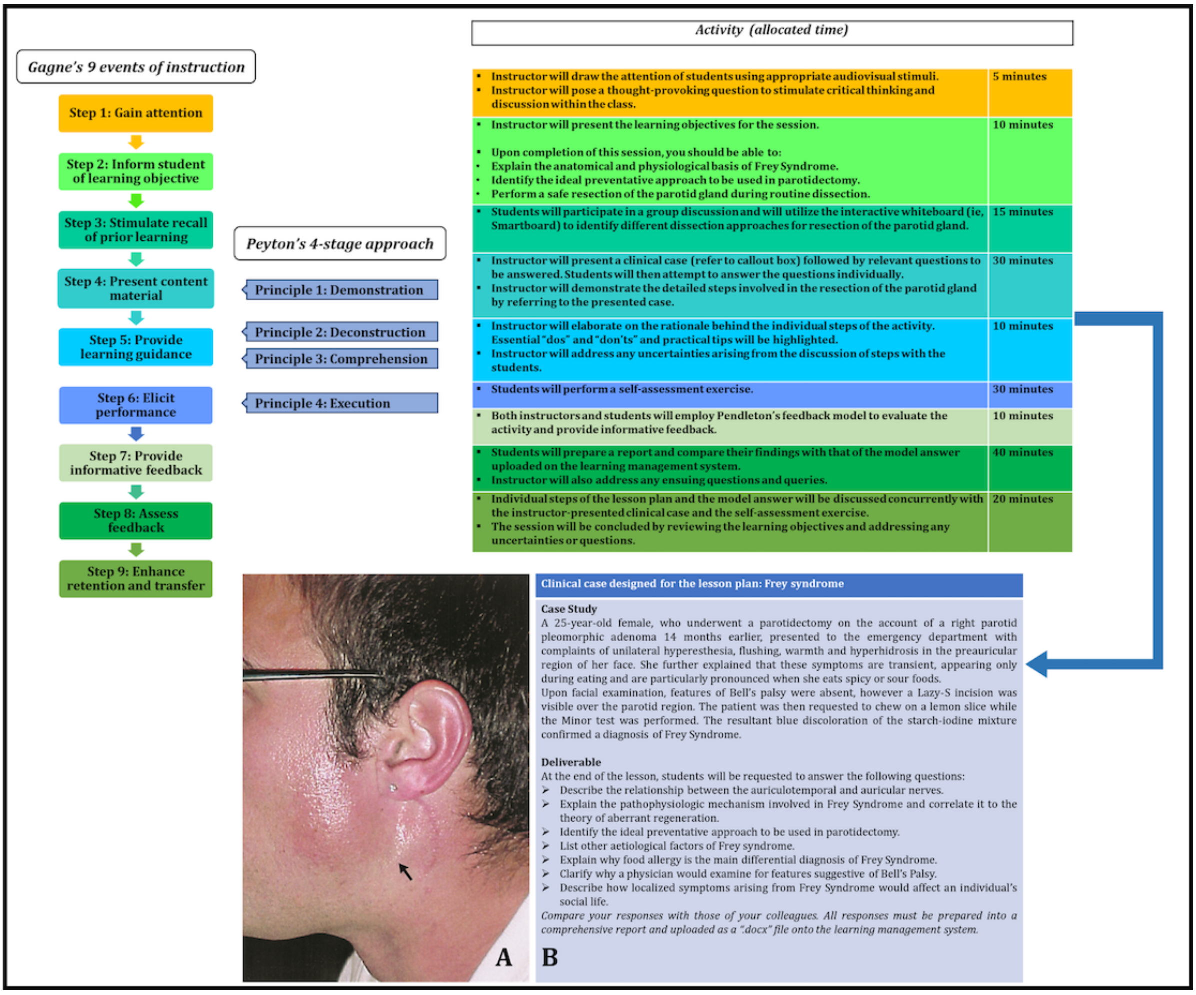
In order to design the pedagogical framework, we employed the instructional design models of Gagne [3] and Peyton [4,11]. Gagne's 9-step instructional model is based on a behaviorist approach to learning, whereas Peyton's 4-step approach avails a task-centered approach. Our pedagogical framework availed a blended approach similar to that of Tambi et al [10], which allowed us to disseminate both cognitive and noncognitive skills. These models were selected based on a pilot study conducted at MBRU, where the learning approaches of MBRU students were mapped using the Approaches and Study Skills Inventory for Students (ASSIST) learning approach investigation tool [12]. The pilot study indicated that most MBRU students avail deep/strategic learning approaches, suggesting that they favored constructivist learning approaches or strategies [12]. Therefore, we adopted Gagne's and Peyton's instructional design models to create our pedagogical framework, since these models support deep/strategic learning approaches [6,13-15].

Results

Implementation and Design of the Pedagogical Framework

The individual steps of the instructional plan associated with the pedagogical framework are described below (Figure 2).

Figure 2. Design of the pedagogical framework. The instructional design strategies of Gagne and Peyton were blended to design the framework. The blended steps are also indicated. On the far right, the dissemination of the teaching framework with the sequential steps is shown with the allocated time for each step. The clinical case associated with Frey syndrome and the associated deliverables are shown. The medical image of Frey syndrome was adopted from Prattico and Perfetti [16] with permission.



Learning Environment

For the implementation of the instructional plan, the anatomy dissection hall was chosen (Figure 3). The dissection hall is a well-lit rectangular room situated on the ground floor, with floor-to-ceiling windows spanning the length of two perpendicular walls. It consists of two dedicated teaching areas: the dissection area and the medical imaging and case-based discussion area (Figure 3).

Figure 3. Anatomy dissection facilities at the Mohammed Bin Rashid University of Medicine and Health Sciences. (A) Dissection area showing the dissection stations (each station comprises an adult cadaver placed in the supine position on a removal tray situated on the dissection table); (B) medical imaging and case-based discussion area; (C) and (D) prosection areas.

Prerequisites

In preparation for the session, students were requested to review the following concepts: (1) boundaries and contents of the parotid region and (2) the structural and functional aspects of the course and distribution of the facial nerve. In addition, for the instructional plan, we decided to use the exemplar of the clinical case associated with Frey syndrome. In line, by reviewing the above concepts, we believed students would be better prepared to tackle the questions accompanying the case.

Learning material in the form of PowerPoint slides, medical images, and reading material pertaining to the above concepts were uploaded to the learning management system [17] 1 week prior to the session. These prerequisites enabled students to be adequately prepared for the session to successfully execute the tasks outlined in each step of the instructional plan. The activities and time frame pertaining to each step of the instructional plan are depicted in Figure 2.

Dissemination of Individual Steps of the Instructional Plan

The steps were tailored employing a "blended" methodology in which Gagne's instructional model was integrated with Peyton's 4-step approach (Figure 2).

Step 1: Draw Students' Attention

The instructor applied the "pattern interrupt phenomenon" [18] to draw students' attention. The resounding ring of a doorbell was used as the sudden auditory stimulus. This was followed by the Socratic method of delivery [19], whereby the instructor posed the question: "How would you describe Frey's Syndrome to your younger brother?" A video available on The Doctors TV titled *Frey's Syndrome* [20] was also shown to the students. This technique concurrently addressed visual, auditory, and kinesthetic learning styles [21,22].

Step 2: Inform Students About Learning Objectives

Students were then provided with set learning objectives, which they were expected to achieve at the conclusion of the instructional plan (Figure 2).

Step 3: Stimulate Recall of Prior Learning

Students participated in a group discussion to determine and evaluate the safest dissection approach when resecting the parotid gland. This enabled students to revise concepts related to gross, variational, functional, and living anatomy and helped them appreciate how these contributed to the accurate interpretation of imaging anatomy, safe clinical practice, and successful surgical outcomes. This step touched on the theories of multiple concepts [23], social learning [10], and team-based learning [24], as it incorporated peer-assisted education into the instructional plan.

Step 4 (Blended): Present Content Material

Students were then presented with a clinical case (Figure 3). The detailed steps involving the resection of the parotid gland and identification of the intact facial nerve were summarized by means of a flowchart and presented as a PowerPoint presentation (Multimedia Appendix 1). Step 1 of Peyton's model was integrated here, which involved a demonstration of the steps of the dissection procedure.

Step 5 (Blended): Provide Learning Guidance

Principles of steps 2 and 3 of Peyton's 4-step model was integrated here. Interactive learning was emphasized in this step. The instructor explained the individual steps for the activity (ie, dissection procedure) and provided clarity on the rationale behind it. The instructor then analyzed each step thoroughly, highlighting the essential "dos" and "don'ts" and provided a few practical tips (Peyton's Principle #2). Students were encouraged to ask questions to clarify any doubts. This was followed by a conceptual phase during which philological and kinesthetic learning styles were encouraged as students were entreated to elucidate each step of the dissection procedure, while the instructor followed the guidelines (Peyton's Principle #3). Such a practice enabled students to articulate the dissection procedure gradually, concomitantly allowing the instructor to assess their understanding.

Step 6 (Blended): Elicit Performance

This step corresponds to Peyton's Principle #4. In this step, students were provided with the opportunity to reinforce their learning through performance; therefore, a larger amount of time was allocated to this step. The class was divided into 12 groups (approximately 5 students/group). Each group was assigned a cadaver and a dissection station (5 cadavers in total). In their designated groups, students attempted to perform the dissection procedure of the parotid gland as described by de Ru et al [25]. Students executed the dissection steps sequentially, followed by a group discussion on the results to ensure accuracy. This facilitated peer-assisted learning as it incorporated elements of interaction and collaboration [26]. Additionally, this step allowed the students to practice skills associated with the dissection of the parotid gland. Such dedicated practice of procedural dissection skills has been shown to increase students' confidence in anatomy education [27].

In this step, the student groups were also asked to address the questions listed under deliverables in the clinical case of Frey syndrome (Figure 2 [16]). Each group presented answers to one of the listed questions. Since the clinical case and deliverable were uploaded a week prior to the dissection session, students had an opportunity to prepare their responses. This fostered self-directed learning and student autonomy [28]. Additionally, some of the student groups presented their responses using research articles related to the questions. These presentations followed a guide plan similar to the 6D-Approach, a pedagogical framework previously designed by us [29].

Step 7: Provide Informative Feedback

Informative feedback was provided employing Pendleton's feedback model [30]. In their own group, students were able to provide feedback to their peers (ie, peer feedback [31]). This activity aimed at refining the student's own understanding of where things stand; a so-called "reality check" that concurrently provides a clear trajectory in terms of improving behaviors, attitudes, and skills. While students conducted their own peer-to-peer feedback within their designated groups, the instructor visited each group and provided individual assistance and instantaneous feedback such that it didn’t lead to any false assessment on the part of the student with regard to their own skills and abilities. Students were also advised to clarify and discuss any uncertainties and/or questions as they rise. To conclude this step, students provided feedback about the activity by addressing the following:

- What do you think went well?
- What do you think could be done differently?
- What could be further improved?
- How can this be achieved?

Step 8: Assess Performance

In this step, students prepared a reflective report on their dissection experience and how that experience helped them to better understand the anatomical changes associated with Frey syndrome. The students prepared their report using Gibbs’ reflective cycle framework [32]. The report was uploaded by students to the learning management system [17] and contributed 5% to the total assessment component of the Head and Neck course. This step encouraged students to think critically about the content disseminated, as well as improve their writing skills.

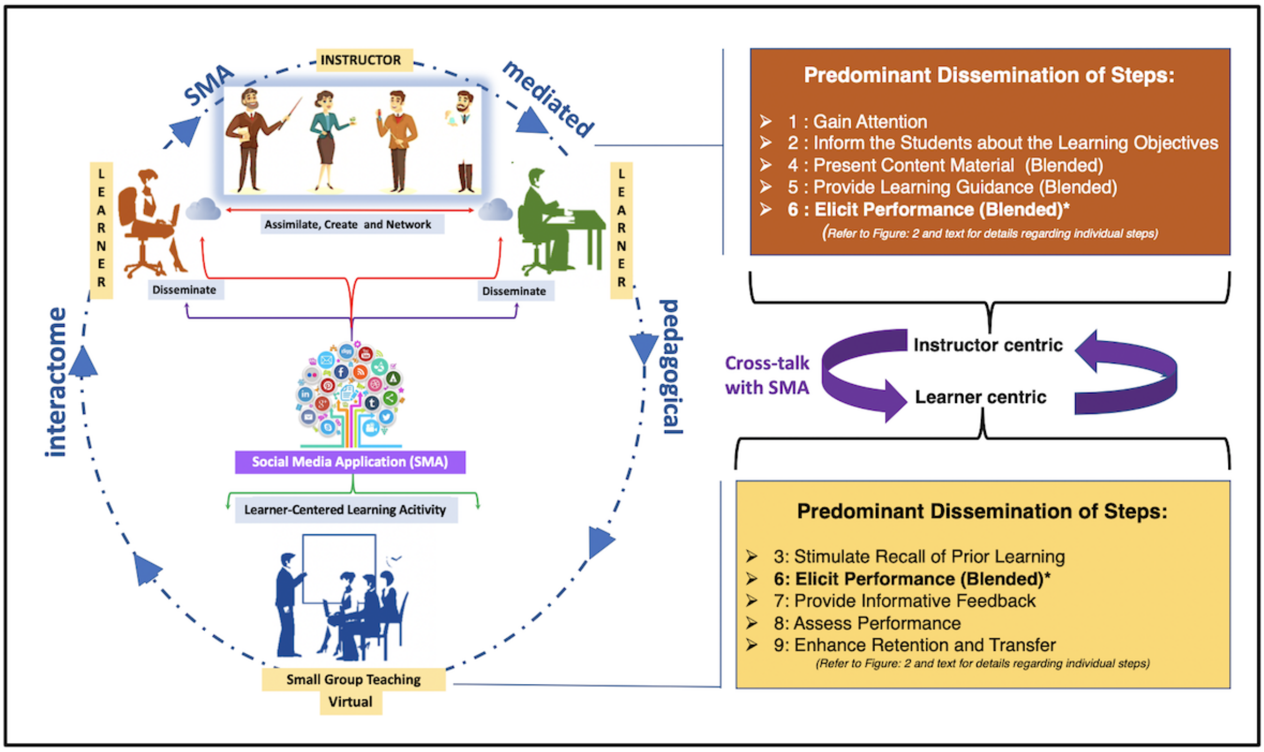
Step 9: Enhance Retention and Transfer

Following submission of the report, students were required to assess a clinical scenario similar to Frey syndrome (namely, facial nerve paralysis) using the sequential steps of the dissection procedure, which they were exposed to earlier [25], to grasp the learning activity, which concluded by reviewing the learning objectives and resolving any uncertainties.

The SMA Interactome Strategy to Implement the Pedagogical Framework During the COVID-19 Pandemic

Currently, with the COVID-19 pandemic sweeping across the globe, many medical schools have switched to the distance learning modality. So, we asked ourselves “Can our teaching framework adapt to this new pedagogical shift?” We have applied this framework again to the structure-function course Head and Neck, this time delivered through distance learning. To apply this framework, we designed an SMA-based “interactome” (Figure 4), such that different steps of the blended framework can be implemented using different SMAs. In fact, a pilot study at MBRU showed us that our students prefer the integration of SMAs such as YouTube and WhatsApp into their learning process [10]. Didactic sessions were delivered in the form of screencast using Microsoft Teams. For specific sessions, a flipped teaching approach was adopted, where students were provided with prerecorded lectures, which were uploaded to the learning management system at least a week prior to the session. In-session activities for sessions that adopted flipped teaching comprised of treatise focusing on the discussion of relevant clinical case(s) in small groups (consisting of 15-20 students in each discussion group), using the Microsoft Teams platform where the instructor (NN) was able to participate as well as moderate the discussion across several groups. Students were also encouraged to participate in discussions with their peers in designated WhatsApp group, which were created and moderated by the instructor. Such discussions primarily focused on tackling questions which could not be addressed in-depth during the SMA-integrated distance learning teaching sessions because of time constraints. Additionally, students were often directed to relevant podcasts and videos on YouTube, especially to demonstrate dissection procedures. For dissemination of our pedagogical framework during the COVID-19–mandated lockdown using the SMA interactome, we substituted the parotid gland dissection demonstration (which could not be conducted due to laboratory closures), with podcast videos available from different universities on YouTube [33]. The discussion associated with the clinical scenario of Frey syndrome was organized using Microsoft Teams and WhatsApp. Furthermore, for formative assessments, the instructor (NN) employed resources that were available from the University of Michigan [34].

Figure 4. The SMA (social media application) interactome. The dissemination of the teaching framework using SMA during the unprecedented times of COVID-19 is shown. The interactome consists of two aspects, one of which is instructor centric whereas the other is learner centric. Individual steps of the teaching framework attesting to the two aspects in shown. Step 6 is common to both the aspects (indicated by *). The crosstalk between the two aspects is facilitated by SMAs (YouTube and WhatsApp at the Mohammed Bin Rashid University of Medicine and Health Sciences, and also through discussion sessions on the learning management system at the university).



Efficiency of the Pedagogical Framework in Knowledge Transfer

The efficiency of the pedagogical framework in knowledge transfer was investigated by comparing the performance of students in the summative assessment of the Head and Neck course across three cohorts (Table 1): (1) a cohort where the course was delivered using traditional didactic pedagogy (n=58; mean score [out of 100] 64.9, SD 11.2); (2) a cohort where the course was delivered using the pedagogical framework but with the incorporation of dissection sessions (n=58; mean score 70.0, SD 11.6); and (3) a cohort where the course was delivered using the pedagogical framework but involved the use of the SMA interactome strategy (n=56; mean score 77.7, SD 11.1). As evident from Table 1 as well as the calculated mean scores, the implementation of the pedagogical framework in the delivery of anatomy education led to better performance, with the cohort that used the pedagogical framework along with SMAs having the highest scores (a mean score that was 19.7% higher than the control cohort). Furthermore, Kuder and Richardson formula 20 (ρ_{KR20}) reliability values calculated for the multiple-choice question component (accounting for 75% of a typical summative assessment) for all the summative assessments of all three cohorts was higher than 0.75. This indicates that the summative assessments had high reliability, which further confirms our observation that implementation of the pedagogical framework in the delivery of anatomy education leads to better performance, and hence, augmented knowledge transfer. However, more dedicated studies are warranted to better understand the aspect of knowledge transfer. These future studies will focus on assessing learners' perceptions of the pedagogical framework using validated tool and learning behaviors and styles of learners while being exposed to the framework.

Table 1. Performance of students in the summative assessment of the Head and Neck course across three cohorts: (A) cohort where the course was delivered on-site using traditional didactic pedagogy; (B) cohort where the course was delivered on-site using the blended pedagogical framework with incorporation of dissection sessions; and (C) cohort where the course was delivered using the blended pedagogical framework, with integration of the social media application interactome during the COVID-19–mandated lockdown period. Note: the performance of the students was better when the pedagogical framework was implemented in the delivery of anatomy education.

Cohort and range of % score	Students, n (%)
A (n=58; average % score=65)	
31-41	2 (3)
41-51	3 (5)
51-61	12 (21)
61-71	22 (38)
71-81	16 (28)
81-91	3 (5)
B (n=58; average % score=70)	
42-53	6 (10)
53-64	8 (14)
64-75	22 (38)
75-86	19 (33)
86-97	3 (5)
C (n=56; average % score=78)	
55.7-65.7	10 (18)
65.7-75.7	14 (25)
75.7-85.7	14 (25)
85.7-95.7	18 (32)

Preliminary Evaluation of Students' Perceptions Toward the Pedagogical Framework

In the present work, our focus was on the design and implementation of the pedagogical framework. An elaborate evaluation of the perceptions of students toward the pedagogical framework is still pending and will be addressed in our future work. The evaluation presented here is only preliminary.

The pedagogical framework was evaluated informally following Pendleton's approach [30] (Step 7 of the teaching plan). A measure with regard to the instructional plan's ability to facilitate knowledge retention was obtained by reviewing the students' reports at the conclusion of the course. We also reviewed the student feedback obtained at the end of the Head and Neck course.

The pedagogical framework was received positively by the students, who exhibited enthusiasm in both organizing and in participating in the event. Key points of note are as follows:

- Students from different academic backgrounds effectively functioned as a group.
- The reading habits of students improved significantly following their participation in the activity due to the increase in depth and content of the questions posed by the students during discussion. This observation is in line with the findings of Miner et al [35].
- Student autonomy was augmented, as many of them prepared concept/mind maps to correlate their understanding of the delivered concepts to their clinical significance.

Specific limitations that students believed need to be addressed are as follows:

- The time allocated for discussion (Step 6 in the instructional plan) was insufficient. The way to overcome this insufficiency is to integrate SMA into the delivery of the specific steps of the instructional plan, especially the ones that entail collaborative learning, similar to one of our previous studies [10].
- Students had difficulties accessing specific journals with regard to Step 6 of the instructional plan (since the institution didn't have a subscription to these resources). One of the ways to side-step this limitation is to encourage students to refer to articles in open access journals of repute.

Formal student feedback for the Head and Neck course was obtained by using an institution-approved questionnaire for the cohorts where the pedagogical framework was implemented. The feedback for the course indicated that students expressed satisfaction with the instructional plan employed in the course; 79% (44/56) of students in both cohorts where the pedagogical framework was implemented strongly agreed with the highest grading score "extremely satisfied." The majority of students (81/114, 71%) in both of the cohorts where the pedagogical framework was implemented indicated in open-ended comments that the instructional plan that was integrated into the Head and Neck course should be implemented across all structure-function courses in anatomy education, and if possible, especially in practical sessions involving dissection or discussion of clinical scenarios. Further, while evaluating the reports of the students, the instructor found that most students, while reflecting on their experience with regards to the instructional plan, identified that the pedagogical framework augmented their knowledge of anatomy pertaining to the session learning objectives, as well as helped them understand the clinical relevancy of the concepts.

Discussion

In this study, we have blueprinted a pedagogical framework blending Gagne's 9 events of instruction and Peyton's 4-step teaching approach, and employed the framework in the dissemination of anatomy education both during normal and COVID-19–mandated periods. The framework was positively received by the students, who recommended its integration across all structure-function courses in Phase 1. Based on this feedback, the director of Phase 1 (YB) and the instructor who implemented the pedagogical framework (NN) approached other instructors in other structure-function courses to encourage the adoption of this framework. However, initial discussions indicated that instructors were reluctant to adopt the framework as it entailed elaborate modifications to their teaching approaches, which involved conformist strategies employed in anatomy education. However, this observation is not unique to our institution, and similar barriers have been encountered in medical education [36].

Accordingly, we decided to design a change management approach to integrate the pedagogical framework across all structure-function courses. This design involved the use of Mento's change management model. We selected this model since it was previously used successfully to initiate change in pedagogical philosophy to implement active learning strategies in the medical curriculum, specifically in biochemistry and molecular biology courses [7]. The approach in which Mento's model will be used in implementing the pedagogical framework in anatomy education is shown in Table 2. Details regarding the individual steps of Mento's model have been discussed elsewhere; readers are requested to refer to Banerjee et al [7] for further information. We firmly believe that the versatility of both the pedagogical framework, and the proposed change management framework to implement it, will allow anatomy instructors to integrate the framework into any CBMC milieu.

In addition, the benefit of the pedagogical framework being adopted by a medical school can be elaborated using Bourdieu's Theory of Practice [37]. Bourdieu has developed three intimately related concepts: *field*, *capital*, *habitus* (refer to Figure 5 for details of the individual concepts). Applying Bourdieu's Theory of Practice, the designed pedagogical framework, when integrated into a CBMC, will allow medical schools to attract high-achieving students (academic capital), as well as allow a more effective delivery of anatomy teaching with a limited number of cadavers (only 5 cadavers were used in the delivery of the teaching plan, whereas the ideal cadaver-to-student ratio at some of the top medical schools such as University of California, Los Angeles, and University of Washington is 5:1 and 4:1, respectively, therefore requiring 12 and 15 cadavers, respectively, for a similar student population) (economic capital). This endeavour will augment the ranking of the medical school, which has adopted the teaching framework (symbolic capital), as well as facilitate the school in applying and receiving more funding or emoluments (economic capital) in the field of medical education and health professions education research. These aspects cumulatively will impact the medical school's values, primacies, and curricula (habitus). Furthermore, all the above will be reflected in the students the medical school will attract and train (habitus).

The fact that our pedagogical framework requires only a limited number of cadaveric specimens is pivotal, especially for medical schools in the Middle East where religion may play an imperative role in the number of cadavers available for dissection (Naidoo et al, unpublished data). Although Elamrani and colleagues [38] reason that, from a theological viewpoint, Islam does not prohibit dissection nor body donation, they posit that "the problem is actually cultural, societal and legislative and not religious." Whatever the reason may be, the availability of cadavers for dissection in Middle Eastern medical schools is limited, and most schools import cadavers from the United States (usually donated bodies), from India (usually unclaimed bodies), or from the Philippines (source of bodies unclear) [39]. This is not only expensive, but also unwieldy (as apart from the price of the cadaver, there is a myriad of paperwork that needs to be tackled while cadavers are imported) [40]. In addition, importing cadavers also raise concerns about an international "trade" of dead bodies, with an often-debateable ethical foundation [41].

Apart from the above, body donation programs in many countries are also affected by local and political history [42,43]. For example, Kramer and Hutchinson [43] indicate that in South Africa, Black Africans are more disinclined than other ethnic groups to donate their bodies for medical education and research, which is not only related to their "cultural beliefs" but also to the country's tumultuous "political history," where the bodies of Black individuals were exploited for the education of White students. Analogous reasons may also be behind the qualms of African Americans toward body donation in the United States [42]. Therefore, our pedagogical framework will not only be beneficial for medical schools in the Middle East, but also for schools who want to integrate anatomy dissection into their curriculum but have limited access to cadavers.

Conventionally, anatomy is often perceived as an uninteresting, labor-intensive discipline, taught using surface-learning strategies and rote memorization [44]. Accordingly, students are often unable to translate how the anatomical concepts can inform their clinical practice, creating a so-called "integration gap" [45]. Our pedagogical framework integrates a real clinical scenario (the clinical scenario was developed around a real clinical case of Frey syndrome [16]) and implements student-centric active learning strategies. This will not only address the integration gap but also promote students to take an active role in learning and utilizing their own creativity, curiosity, and intelligence.

Table 2. Guidelines outlining the activities and timeline corresponding to each step of Mento's change management model for the integration of a blended Gagne-Peyton instructional model in all structure-function courses.

Step	Mento's model of change	Activity to facilitate/implement the change	Timeline
1	The idea and its context	• Preliminary results from the HNSF[a] course in Phase 1, semester 2, showed that the blended instructional model of pedagogy facilitates better learning in UME[b]. The idea is to integrate the blended instructional model throughout all structure-function courses in semester 2 of Phase 1.	N/A[c]
2	Define the change initiative	• Present to concerned stakeholders the following: • What are the attributes of the blended teaching approach of Gagne and Peyton? • Benefits of the blended instructional model of Gagne and Peyton • Planning of the teaching approach • Successful case studies of the blended instructional model (eg, results of this study)	4 weeks prior to course initiation
3	Evaluate the climate for change	• Assess the necessary resources, prior knowledge of stakeholders, and technological proficiency required to successfully implement the blended instructional model in the structure-function courses through SWOT[d] analysis.	4 weeks prior to course initiation
4	Develop a change plan	• Work with the technology-enhanced learning (TEL) and Smart Learning Hub (SLH) teams at MBRU[e] to develop a faculty development plan to train stakeholders on the strategies to implement the blended instructional model of Gagne and Peyton in structure-function courses.	3 weeks prior to course initiation
5	Find and cultivate a sponsor	• Schedule meetings with MBRU academic leadership (dean/associate deans/departmental chairs, phase directors) to inform them about the benefits of the blended instructional model and the resources required.	3 weeks prior to course initiation
6	Prepare your target audience	• Organize faculty development workshops in collaboration with the TEL and SLH teams to inform stakeholders about *how* to implement the blended teaching approach in structure-function courses. • Circulate nano-lectures on active learning to stakeholders over WhatsApp.	2 weeks prior to course initiation
7	Create a cultural fit	• Create linkage between students' learning approaches and the blended teaching approach to explain to concerned stakeholders *why* there is a necessity to create a culture of innovative pedagogy in UME.	2 weeks prior to course initiation
8	Develop and choose a lead team	• Create an informal lead team consisting of the course coordinator and instructors of the HNSF course and digital advisors from the TEL and SLH teams, such that they can guide and encourage stakeholders to implement the blended teaching approach in the structure-function courses (at least 9 blended teaching sessions over 5 weeks).	1-5 weeks into the course
9	Create small wins for motivation	• Identify the stakeholders who successfully integrated the blended teaching approach into their courses and request them to present their experiences in this effort to the MBRU academic leadership and other concerned stakeholders.	4-5 weeks into the course
10	Constantly and strategically communicate the change	• During the whole transformation process: • Create a "learning community" such that stakeholders can learn from each other about strategies to successfully implement the blended teaching approach in pedagogy. • Try to address hurdles that are faced by stakeholders in their endeavours by communicating the change process to sponsors	1-5 weeks into the course

Step	Mento's model of change	Activity to facilitate/implement the change	Timeline
11	Measure the progress of the change effort	• Refer to the updated pedagogical techniques of the concerned courses to appraise the number of teaching sessions where blended teaching was implemented. • Evaluate the attitude of stakeholders toward blended teaching following the transformation initiative using an ADKAR[f] framework. • Assess the performance of the students in the structure-function courses to identify if blended teaching was beneficial over the traditional method. • Obtain student feedback to assess students' perceptions toward blended teaching.	6 weeks into the course following midterm assessments

12	Integrate lessons learned	• Using a reflective framework conduct an After Action Review to:
		  • Map the transformation process
		  • Identify hurdles that need to be tackled such that blended teaching can be successfully integrated in other courses
			6 weeks into the course following midterm assessments

Other notes		• Preparatory time for implementing the transformation: 4 weeks • Time required for implementing/assessing the transformation: 5 weeks • Total study duration (preparation + implementation + assessment): 9 weeks	

[a]HNSF: Head and Neck structure-function course.

[b]UME: undergraduate medical education.

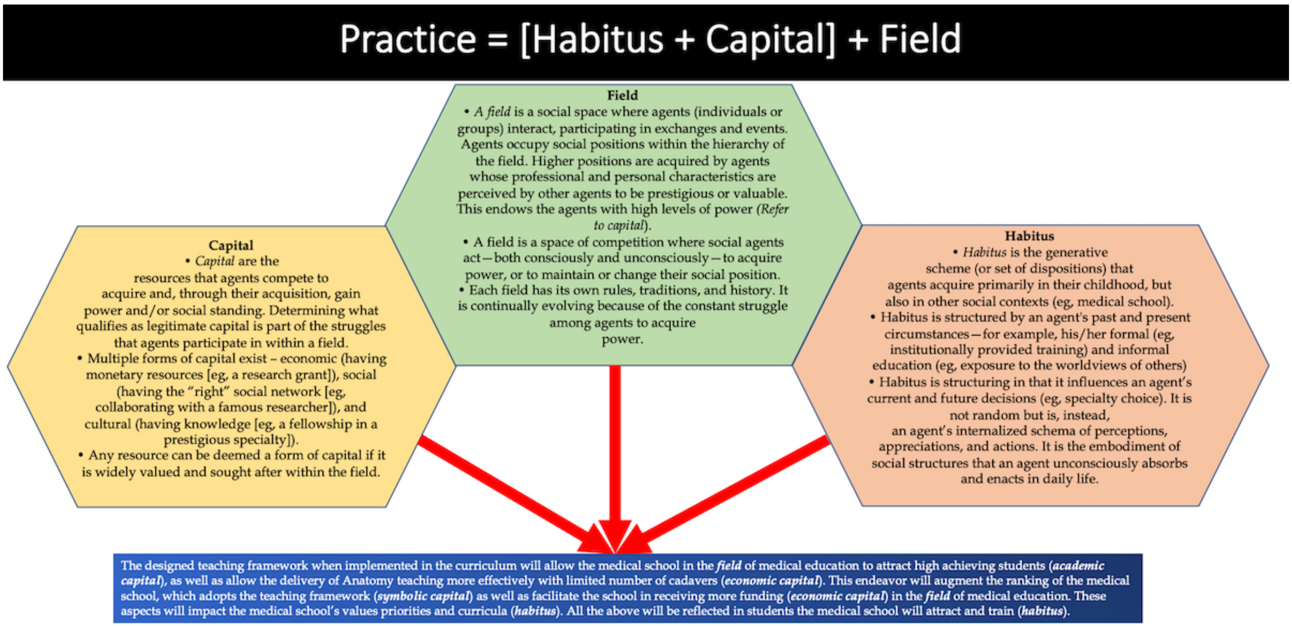
[c]N/A: not applicable.

[d]SWOT: strengths, weaknesses, opportunities, and threats.

[e]MBRU: Mohammed Bin Rashid University of Medicine and Health Sciences.

[f]ADKAR: awareness, desire, knowledge, ability, reinforcement.

Figure 5. Bourdieu's Theory of Practice. The figure elaborates on three intimately related concepts: field, capital, and habitus. The text box in blue elaborates how Bourdieu's Theory of Practice when applied to the current context demonstrates the benefit of the teaching framework being adopted by a medical school. The concept of the figure was derived from Brosnan [37].



Reflecting on our pedagogical framework against Harden's integration ladder [46], we find that it attests to the correlation step of the ladder. Harden [46] postulates that curricular integration can be viewed as a ladder, with discipline-based teaching (isolation) at the bottom of the ladder and full integration (transdisciplinary teaching) at the top. Harden's integration ladder has 11 steps from subject-based to integrated teaching and learning. In the first 4 steps (isolation, awareness, harmonization, and nesting) of the ladder, the emphasis is on the subjects or disciplines. As one climbs the ladder, the following 6 steps—temporal coordination, sharing, correlation, complementary, multidisciplinary, and interdisciplinary—underscore integration across multiple disciplines. In the final step (transdisciplinary), the students take responsibility for the integration and are given the tools to do so [46]. With regard to the correlation step in the ladder, an integrated teaching session is presented in addition to subject-based teaching. Our pedagogical framework attests to integrated teaching during dissection sessions; additionally, during in-class sessions, the instructor(s) can pursue subject-based teaching. Generally, in the early phases of a CBMC, integration is difficult to achieve [47]. The framework addresses this gap.

In recent times, anatomy teaching has undergone a paradigm change from "instructor-centered" to "student-centered" approaches [48-50]. Our teaching framework attests to this "paradigm change" as it mitigates two key challenges: (a) a dearth of trained anatomists for teaching anatomy (the dissemination of the framework requires only one trained anatomist [NN]); and (b) delivery of a large corpus of anatomy content within a limited time frame. These two benefits further advocate to Bourdieu's economic capital (as anatomy concepts can be disseminated with a limited number of trained anatomists), simultaneously attracting academic high achievers (academic capital) to the medical school that adopts this framework.

During the mandated COVID-19 lockdown, we were able to implement the pedagogical framework through SMA integration. This further attests to the versatility of our teaching framework, which can be tailored according to the demands of a given situation. Of course, the detailed analysis with regard to students' perception of this distance learning adoption of our pedagogical framework is still pending and will form the basis of our future studies.

Limitations

Although our pedagogical framework has several inherent benefits as discussed above, it also has several limitations. Our pedagogical framework integrates only real dissection. However, studies have indicated that integrating real dissection and radiology using 3D image postprocessing tools provides a more enriching learning experience, as such a pedagogical strategy imparts familiarity with imaging and image postprocessing techniques and also improves anatomical understanding, radiological diagnostic skills, and 3D appreciation [51]. Will the presented teaching framework allow the blending of real dissection with virtual dissection within a limited duration of time? This aspect needs to be addressed. Unfortunately, MBRU is a new medical school, where the anatomy teaching team does not have a trained radiologist, which prevented us from addressing this question.

The dissemination of this pedagogical framework requires extensive instructor preparation, which may not allow instructors to adopt it, especially instructors who teach anatomy using conventional strategies. Our proposed change management framework may aid in mitigating this limitation.

The pedagogical framework integrates the precepts of peer-assisted learning (PAL) in several steps. However, this may be disadvantageous for some students, many of whom may feel they would learn better when they relate to the instructor. Additionally, students learning in a group can encounter problems, especially if they find themselves working with members in a group with whom they are not keen on collaborating. Furthermore, students working in a group may veer away from the point of an exercise and discuss irrelevant topics of interest. These aspects may be effectively addressed by involving peer tutors in the dissemination of the teaching framework.

Our framework was implemented in only one structure-function course, that too in the delivery of anatomy teaching. However, implementation of this framework across all structure-function courses may lead to cognitive overload [52], as our teaching framework necessitates students to adopt and practice self-directed learning.

A typical cohort at MBRU has 50 to 70 students. Dissemination of our pedagogical framework was successful with limited student numbers. However, many medical schools have 150 to 200 students in a cohort, and there is a possibility that this pedagogical framework may not work as effectively in such large cohorts. This may be because organizing group-based activities required for the implementation of the pedagogical framework with a larger cohort may be challenging.

Implementation of the framework requires instructor(s) to be conversant with the theoretical underpinnings of the instructional design models that were employed in blueprinting the framework. This may not be the case for all medical schools, especially the ones who use adjunct or part-time faculty members for the delivery of anatomy content. One way to address this gap will be to organize Continuing Professional Development modules for anatomy instructors, where the advantages of integrating the framework in anatomy teaching and the theoretical foundations of the framework can be elucidated.

In this study, we have provided the initial evaluation of our pedagogical framework. However, the detailed evaluation of this framework is still pending. This also raises the question, "What evaluation model will be best-suited to appraise the framework?" Our framework predominantly employs PAL at multiple steps, which functions on the theoretical foundation of social and cognitive congruence [53]. Based on this, we believe the teaching framework can be best evaluated by Stake's Congruence-Contingency Model [54]. However, this needs to be explored further through dedicated studies. In addition, we can employ Kirkpatrick's framework [55] to evaluate the pedagogical framework. However, this also warrants further long-term investigations.

Conclusion

In conclusion, in this study we have delineated a pedagogical framework to teach anatomy during normal and unprecedented times, blueprinted using a blended approach exercising the instructional design strategies of Gagne and Peyton. The designed strategy integrates active learning principles and initiates a shift from the "sage on the stage" to "guide on the side" mode of delivery. Additionally, we have demonstrated the use of this framework in the successful delivery of anatomy concepts in a structure-function course in a CBMC both during normal and COVID-19 lockdown periods. Although our framework was well received by students, anatomy instructors at our medical school were reluctant to adopt the framework (a challenge that others may also face). To counter this, we propose a strategy designed using the change management model of Mento. We have also elaborated on the benefits to a medical school that adopts the pedagogical framework, which have been explicated through the use of Bourdieu's Theory of Practice. We firmly believe that the delineated pedagogical framework will allow instructors to efficiently and effectively deliver concepts in anatomy education using cadaveric dissection or through the effective use of clinical scenarios, in a limited span of time, which will not only benefit students but will also be advantageous for the medical school.

Conflicts of Interest

None declared.

Multimedia Appendix 1
PowerPoint presentation used in the delivery of the instructional plan.
[PDF File (Adobe PDF File), 6971 KB - mededu_v6i2e21701_app1.pdf]

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Abbreviations

ASSIST: Approaches and Study Skills Inventory for Students
CBMC: competency-based medical curriculum
MBRU: Mohammed Bin Rashid University of Medicine and Health Sciences
PAL: peer-assisted learning
SMA: social media application

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Viewpoint

Impact of the COVID-19 Pandemic on the Education of Plastic Surgery Trainees in the United States

Alireza Hamidian Jahromi[1,2], MD, MRCS; Alisa Arnautovic[3], BSc; Petros Konofaos[1], MD

[1]Department of Plastic Surgery, University of Tennessee Health Science Center, Memphis, TN, United States
[2]Department of Plastic Surgery, Rush University Medical Center, Chicago, IL, United States
[3]The George Washington University School of Medicine and Health Sciences, Washington, DC, United States

Corresponding Author:
Alireza Hamidian Jahromi, MD, MRCS
Department of Plastic Surgery
University of Tennessee Health Science Center
910 Madison Ave, Room 315
Memphis, TN, 38163
United States
Phone: 1 3185184600
Email: alirezahamidian@yahoo.com

Abstract

The current COVID-19 pandemic has vastly impacted the health care system in the United States, and it is continuing to dictate its unprecedented influence on the education systems, especially the residency and fellowship training programs. The impact of COVID-19 on these training programs has not been uniform across the board, with plastic surgery residency and fellowship programs among the hardest hit specialties. Implementation of social distancing regulations has affected departmental educational activities, including preoperative, morbidity and mortality conferences and journal clubs; operating room educational activities; as well as the overall education of plastic surgery trainees in the United States. Almost all elective and semielective surgeries across the United States were suspended for a few months during the COVID-19 pandemic; this constitutes a significant portion of plastic surgery cases. Considering the current staged reopening policies, it may be a long time, if ever, before restrictions are completely lifted. In this paper, we review the multidimensional impact of the current COVID-19 pandemic on the training programs of plastic surgery residents and fellows in the United States and worldwide, along with some potential solutions on how to address existing challenges.

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KEYWORDS

COVID-19; coronavirus; education; plastic surgery residency; plastic surgery fellowship; surgery residency; impact; trainee

> *Education is the passport to the future, for tomorrow belongs to those who prepare for it today.* [Malcolm X]

The current COVID-19 pandemic has vastly impacted health care in the United States and globally, and it is continuing to dictate its unprecedented influence on education systems, especially the health system and medical education field (ie, residency training programs). The impact of COVID-19 on residency and fellowship trainings has not been uniform across the board. Among the various programs, plastic surgery residency and fellowship programs are one of the hardest hit specialties. Almost all elective and semielective surgeries across the United States were suspended for a few months due to COVID-19. Considering the current staged reopening policies, it may take a long time, if ever, for restrictions to be completely lifted. Suspensions of various activities have considerably affected teaching opportunities for plastic surgery residents during this time, as many plastic surgery cases are elective and semielective in nature. Learning operative skills is a core aspect of education in the surgical specialties, which makes these surgical specialties more vulnerable than their medical counterparts in the COVID-19 era. In many instances, surgical residents have been left out of the operating room (OR) altogether, whereas in some others, they have instead been assigned to screening facilities, critical care facilities, and emergency rooms, wherein currently there is the greatest need for physicians and residents to staff undermanned hospitals and clinics [1]. Although surgical residents may find this somewhat problematic at the time, these assignments are absolutely necessary and can help them enhance their experiences and training in any future health crises. Moreover, these experiences will allow them to diversify their level of expertise and confidence in working in similar environments during times of uncertainty or health catastrophes in the future.

Overall, the impact of the limitation in operative or surgical exposure for residents due to COVID-19 is dependent on the level of the trainee (greatest for senior and impending graduate residents and fellows) and the general length of the training program (greatest for those enrolled into shorter training programs, ie, 1-year fellowships) [1]. For example, for a trainee in a 1-year fellowship (gender affirmation surgery, aesthetic surgery, or reconstructive microvascular surgery), the training opportunities lost and clinical activities curtailed between March and June 2020 due to the COVID-19 pandemic would account for about one-third of their entire fellowship training period, which would be difficult to compensate for [1].

Furthermore, because of social distancing guidelines, many in-person opportunities that enable plastic surgery residents to interact with attendings—a vital component of residency education—have been discontinued. The effects of these guidelines have been very drastic and may even be augmented if more waves of COVID-19 with subsequent restrictions and surgery suspensions arrive in the future. It is, therefore, necessary and important to analyze the educational impact of COVID-19 on plastic surgery residency and fellowship and to propose ways to address this challenge.

Certification in plastic surgery is possible through 2 avenues: an integrated pathway of plastic surgery residency (which is a 6-year training program) and an independent pathway that includes satisfactory completion of a formal training and board eligibility in general surgery, otolaryngology (ENT), neurosurgery, orthopedic surgery, urology, or oral maxillofacial surgery residency (which ranges from 5 to 7 years) followed by a 3-year plastic surgery fellowship. Oral maxillofacial surgery graduate candidates must complete 2 extra years of general surgery training in addition to an MD or DDS. For program accreditation based on Accreditation Council for Graduate Medical Education (ACGME) requirements, the annual review process of the residents and fellows and their minimum case logs requirements must all be met. However, many residents and fellows will likely not be able to complete the required number of operative assignments, clinical rotations, and patient care encounters due to COVID-19. Hence, the ACGME has given program directors the right to assess the competence of residents and fellows during COVID-19 to determine whether that specific individual has met the minimum competency to graduate and practice their specialty unsupervised [1,2]. Although the current circumstances due to COVID-19 necessitate program directors to make such assessments in light of reduced semielective and elective cases, this process recognizably has a few issues. First, certain parts of the United States have been disproportionately affected by COVID-19. Some residents and fellows may still be assigned to screening facilities, critical care facilities, and emergency rooms, whereas other trainees may currently be able to perform semielective and elective procedures, depending on local and state laws. Residents in both these scenarios would have had varying surgical exposure; as a result, the assessment of their competence in surgery or plastic surgery will have considerable differences, to no fault of their own. Second, this change also adds in a subjective component to how trainees are assessed, rather than relying on an objective requirement of minimum case logs to designate competence. Subjective evaluations always lead to differences in interpretation. At present, the real impact of this decision on surgery residents and fellows remains unknown, and whether this change in decision-making will have an impact on their eventual practice until the distant future cannot be ascertained.

In the United States, plastic surgery residency and fellowship training comprises 3 types of educational activities for trainees to achieve certification and graduate-level knowledge and skills: (1) didactic activities, including textbook and journal reading assignments; (2) departmental educational activities, including preoperative and morbidity and mortality conferences and journal clubs; and (3) OR educational activities. Each of these categories of educational activities has been affected by COVID-19 through multiple facets. The aforementioned activities are set to equip the candidates with the 6 core competencies set by the ACGME: (1) practice-based learning and improvement, (2) patient care and procedural skills, (3) systems-based practice, (4) medical knowledge, (5) interpersonal and communication skills, and (6) professionalism. Although solutions for each type of educational activity have been proposed currently, more insight into this escalating issue will be needed in the future. Through the didactic educational method or activity, program directors and attendings distribute reading and teaching materials (such as journal articles, operative case or technique video clips, posters, and textbook chapters) to trainees, allowing them to learn individually, in an unstructured manner. Then, residents or fellows and attendings convene in-person to discuss these materials in one-on-one or group discussion sessions. Due to social distancing, many of these in-person meetings have been cancelled, negatively affecting didactic learning opportunities for plastic surgery residents and fellows. However, this issue can be easily addressed, for the most part, with online technologies, such as Zoom, Skype, or WebEx. Through these virtual meetings, trainees and faculty physicians can gather via an online platform to discuss didactic materials. Not only does this practice abide by social distancing guidelines, but it allows for greater flexibility in scheduling and avoids travel cost, on-site hazards, and wasted time, thereby increasing convenience for everyone involved as they no longer have to convene in a common room. Thus, in the post–COVID-19 era, this may become the preferred method for didactic activities for residents and fellows.

Nevertheless, as many programs have not previously utilized remote conferencing for didactic educational methods, the quality of instruction and education will likely be affected during the learning curve of adapting to virtual meetings [1]. This would also require a number of essential preparatory steps such as local connection logistics; software download; system compatibility assessment with individuals' personal computers, laptops, and smart phone terminals; and security and privacy measures to avoid potential HIPAA (Health Insurance Portability and Accountability Act) violation. The aforementioned virtual platforms (Zoom, Skype, and WebEx) also pose potential security risks, especially with HIPAA-sensitive information.

Participants should be required to enter a meeting password when joining, which is provided by the host beforehand in order to prevent hackers from joining the call or spreading malware and viruses to participants' devices. Additionally, Zoom has also made end-to-end encryption available for all users, but this feature disables the participants from dialing-in via phone (they must use a computer), thus compromising user convenience [3]. Some virtual platforms (WebEx and Skype) also allow recording of the sessions, which could be problematic if the recordings are retrieved or accessed by a third party. Although there are obvious security concerns associated with using these virtual platforms, users have no alternative to using them to comply with social distancing guidelines. Nevertheless, secure conferencing must be of utmost importance, especially when sensitive information is being shared with regard to patient information.

From an educational standpoint, if participants turn off their video and microphone during these virtual calls, this allows for complete withdrawal from virtual learning [4]. However, in a neurology residency program, Morawo, Sun, and Lowden [4] were able to successfully stimulate viewer engagement in a virtual learning environment by utilizing retrieval practice questions asked via the interactive feature Poll Everywhere and a group quiz competition. Additionally, Zingaretti et al [5] reported that although many surgery residents have been using webinars during the pandemic, online technologies are beneficial but not sufficient given the complexity of plastic surgery topics. Nevertheless, using online technologies for virtual learning provides residents and fellows an opportunity to share information with other trainees worldwide. For example, online educational conferences or lectures by attendings could be opened up to participants in other countries or programs. Rare cases or surgeries could also be shared online to educate other trainees that may not have access to these cases in other areas of the world. Overall, live discussions and interactions, including point or counterpoint arguments, cannot be fully replaced with online technologies especially in complex fields like plastic surgery, but these online alternatives can supplement training in the current times.

The departmental educational activity component of the resident program consists of in-person faculty lectures, journal clubs, grand rounds, morbidity and mortality, and preoperative conferences. The same aforementioned didactic methods can be employed for department-specific residency and fellowship meetings. Other approaches to educational activities can also be utilized, such as texting-based educational material, but the costs and benefits of this technique must be considered. Clavier et al [6] investigated the distribution of educational documents via WhatsApp, an instant messaging app, instead of traditional online learning platforms for anesthesia residency programs. Younger generations are likely familiar with WhatsApp and open to using it as an educational platform. However, a previous study found that residents in the traditional learning group demonstrated higher medical reasoning than those in the WhatsApp learning group, although no differences in medical knowledge were observed between the two groups [6].

Similarly, Savoy et al [7] investigated the use of texting-based educational material in a general surgery residency program. Texts were sent to medical students about surgery rotations and to general surgery residents about observed cases or patients during rounds. Although this study was conducted at a single institution, the results suggested that students from both study groups favored text messaging for educational purposes [7]. This form of education serves as "academic epinephrine" because an educational stimulus is prompted when the student is not anticipating it [7], indicating this could be a valuable tool for departmental educational activities. Nevertheless, using mobile phones for educational purposes may lead to distractions during dedicated educational periods, clinical duties, or operative time, which should also be taken into consideration.

The third component of plastic surgery residency and fellowship is OR education, which includes preoperative evaluation of patients (marking and planning for surgery), postoperative rounds, performing or assisting in the operative procedure, live examination of patients and their wounds, and in-person review of radiological and laboratory studies with respective subspecialists. Plastic surgery operative cases can be divided into 3 categories: emergency, semielective, and elective, all of which require a minimum case log for all residents and fellows. Emergency cases, across all operative specialties, have and will continue to occur regardless of the pandemic, as emergency cases have not been impacted or are less impacted by COVID-19. However, emergency cases may be reduced or more staggered owing to limited hospital bed capacity during COVID-19 times, which is likely dependent on the hospital location and the local number of COVID-19 cases. Moreover, with quarantine regulations and many people being furloughed, losing their jobs, or working from home, some may argue that overall emergency or trauma-related plastic surgery operations have reduced during the last few months, since around the start of the COVID-19 pandemic. In some institutions, rotating shifts have been established for residents based on the current, and likely reduced, surgical schedule to minimize the risk of virus contraction [1]. As long as trainees have received proper training and adequate personal protective equipment (PPE), it should be safe for them to continue to partake in emergent plastic surgery cases. During the exponential phase of COVID-19, some hospitals imposed restrictions on the number of surgical apprentices who could scrub on a case. In the future, it may be beneficial to video-record emergent cases to play for other residents who are unable to scrub in during emergent cases, so that their training is not completely compromised.

The second category of plastic surgery cases is semielective, which means the surgery is not emergent but must be performed to save a patient's life eventually. In many hospitals, semielective surgeries are not being performed since a period of time based on recommendations of the American College of Surgeons *COVID-19: Elective Case Triage Guidelines for Surgical Care* [8] and the American Society of Plastic Surgeons [9] to cease elective and nonessential surgeries. Nevertheless, given the wide range of conditions that can be managed by plastic surgery, it is imperative, now more than ever, that residents and fellows continue to nurture their surgical skills during COVID-19 despite lack of opportunities to partake in semielective and elective surgeries. Potential methods to do so are to increase relevant reading material for plastic surgery residents; watch surgical videos; and train on mannequins, laboratory live animals, cadaveric animal parts, or training platforms. Such initiatives could help ensure that the residents' skills are not negatively impacted by the COVID-19 pandemic [10].

Finally, elective surgical cases are a vital component of plastic surgery residency and fellowship programs. In certain areas of the United States, semielective procedures may be taking place or may have been reintroduced, but elective surgeries were cancelled indefinitely all over the country. To preserve residents' surgical skills, the methods aforementioned for semielective procedures can be employed for elective surgeries (ie, continuing relevant readings, watching surgical videos, and using mannequins or cadaveric animal parts for surgical training). However, training in elective procedures will continue to remain a challenge for an unknown period of time, specifically in cities that are disproportionately affected by COVID-19, such as New York City, Boston, New Orleans, Philadelphia, Michigan, Chicago, and Washington D.C. Additionally, rhinoplasty, nasal reconstructive surgery, and other head and neck aesthetic surgeries (eg, brow lift and blepharoplasties) are very common elective procedures for plastic surgeons, and it is important to consider the potential aerosolization of virus particles during these operations [11]. Thus, if COVID-19 continues to remain prevalent, special precautions must be taken to minimize transmission of the virus; these include limiting the number of OR personnel, utilizing proper PPE and powered air-purifying respirators, and requiring patients who are undergoing surgery to report at least two or three consecutive COVID-19 negative tests in order to decrease the possibility of false-negative results [11].

With the special precautions necessary for specific preoperative evaluations of patients undergoing elective surgeries during this time, a number of challenges arise with the reintroduction of elective surgeries and the protocols required for them. Prior to surgery, patients must have at least one and preferentially two negative COVID-19 tests, with the most recent negative test taken 24-48 hours prior to surgery; however, this criteria requires patients to come in for their surgery early to be tested for COVID-19 [12]. Unfortunately, having to undergo 2 tests translates to an increase in travel time and a possible loss in work time, but it is necessary as the reverse transcription polymerase chain reaction (RT-PCR) test for COVID-19 is known to have up to 30% false-negative rate [13]. The RT-PCR test requires a nasopharyngeal or oropharyngeal swab sample, which are uncomfortable for the patients. It may also be difficult to actually acquire a viable sample, thereby contributing to the high false-negative rate. Furthermore, some testing centers may not test asymptomatic walk-in patients, which would require a preoperative testing request and coordination from the referring physician as well. Patients who have at least two negative COVID-19 tests should self-quarantine in their homes 24-48 hours prior to surgery, isolating from the family who could be potential carriers of the virus–doing so may be difficult for the patient and challenging for plastic surgeons to enforce [12].

Physicians, trainees, nurses, and hospital employees should also be regularly tested because they could be asymptomatic carriers, too. As elective procedures constitute a large part of plastic surgery (and physician's incomes), health care professionals may be less likely to report their symptoms or viral status in fear of having to cancel these elective procedures. Even with the testing protocol in place, there is still room for unpredictability and risk for viral transmission due to the high false-negative rate [12]. Although the false-positivity of COVID-19 tests is not well discussed, a false-positive test could cause financial burden for the patient and the health care system, and it may add to the complexity of the situation.

Surgical facilities must also have designated employees who screen patients on the phone beforehand and assess patients' potential risk of carrying the virus or having COVID-19 (by asking questions about symptoms, recent travel, close contacts, body temperature, respiratory symptoms, etc), which takes up time that the employee would have otherwise spent on performing other tasks [12]. Other factors to consider are the cost of proper PPE for all OR employees and hospital staff and provision of a functional powered air-purifying respirator device for each OR (which would imply additional costs if the hospital does not already own them, an issue for hospitals already strained on resources during this time). Patient surgical risk stratification is also important when deciding whether an elective procedure should be performed. Patient age, comorbidities (diabetes, hypertension, obesity, lung diseases, etc), and type or complexity of surgery must be considered [12]. Finally, even after the COVID-19 pandemic eases out, the virus will continue to exist, and although elective procedures form a substantive part of plastic surgery training and should eventually be reintroduced, it is vital that these prevailing challenges be acknowledged and addressed going forward.

The lack of elective surgical cases for residents and fellows may be further exacerbated in the future if there is a second wave resurgence of COVID-19 in the fall during the flu season, or further ahead into 2021 and beyond. Thus, the COVID-19 pandemic undoubtedly has had a negative impact on plastic surgery training and its effects in America remain ever-evolving. The European Academy of Facial Plastic Surgery Task Force [11] currently suggests using technology, such as surgical videos and webinars, as a teaching tool for residents and fellows during this time in order to protect residents from contracting the virus, conserve the limited PPE, and maintain their surgical skills. Other virtual tools that could be used for plastic surgery education include the Anatomage Table and Touch Surgery. The Anatomage Table allows for an advanced, 3D virtual dissection of a life-sized human cadaver, contributing to a more precise visual perception of the human body, which may not be available otherwise during COVID-19 [5]. Touch Surgery is a surgical application software that comprises 42 plastic surgery procedures for residents or fellows to watch [5]. These electronic tools cannot replace firsthand surgical experience; however, they can aid in surgical preparation and confidence for trainees during the pandemic.

Although the case log minima for residency and fellowship graduates during this time period will likely be interpreted in the context of the effects of COVID-19 on that specific program [1,2], more suggestions, creative ideas, and solutions are necessary to address the lack of surgical training in elective cases for plastic surgery residents. This pandemic will also lead to a backlog of facial and elective plastic surgery cases [10], which is another important consideration that will have to be addressed in the post-COVID-19 era. In other words, patients and their plastic surgery pathologies will wait to be addressed at the appropriate time, but they will by no means disappear.

Currently, there has been little research on how COVID-19 has affected medical residencies, and even less information pertaining to plastic surgery residencies and fellowships is available pertaining. The time a resident or fellow takes to mature, with their training culminating into the completion of their education, producing a capable, confident, and well-trained specialist has been compromised by the ongoing pandemic. The safety of patients, residents, fellows, and attendings is of utmost importance; nevertheless, the educational impact of COVID-19 on plastic surgery residency and fellowship is potentially devastating for future generations of the specialty and cannot be ignored. Additionally, the future of COVID-19 and its duration are unknown, which is why it may have a lasting impact on health care provision in the United States for many months and years to come. Therefore, more alternatives must be explored and utilized in plastic residency and fellowship programs in terms of didactic activities, departmental educational activities, and OR educational activities so residents and fellows receive adequate training and are confident in their surgical skills upon graduation.

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Conflicts of Interest

None declared.

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Abbreviations

ACGME: Accreditation Council for Graduate Medical Education
HIPAA: Health Insurance Portability and Accountability Act
OR: operating room
PPE: personal protective equipment
RT-PCR: reverse transcription polymerase chain reaction

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Original Paper

The Digital Skills, Experiences and Attitudes of the Northern Ireland Social Care Workforce Toward Technology for Learning and Development: Survey Study

Jonathan Synnott[1], BSc, PhD; Mairead Harkin[2], BA, MA; Brenda Horgan[2], BSc, MSc; Andre McKeown[2], BSc; David Hamilton[2], BSc; Declan McAllister[2], BSc, MSc; Claire Trainor[2], MSc; Chris Nugent[1], BEng, DPhil

[1]School of Computing, University of Ulster, Newtownabbey, United Kingdom

[2]Northern Ireland Social Care Council, Belfast, United Kingdom

Corresponding Author:
Jonathan Synnott, BSc, PhD
School of Computing
University of Ulster
Jordanstown Campus, Room 16E07
Shore Road
Newtownabbey, BT37 0QB
United Kingdom
Phone: 44 28 9036 8952
Email: j.synnott@ulster.ac.uk

Abstract

Background: Continual development of the social care workforce is a key element in improving outcomes for the users of social care services. As the delivery of social care services continues to benefit from innovation in assistive technologies, it is important that the digital capabilities of the social care workforce are aligned. Policy makers have highlighted the importance of using technology to support workforce learning and development, and the need to ensure that the workforce has the necessary digital skills to fully benefit from such provisions.

Objective: This study aims to identify the digital capability of the social care workforce in Northern Ireland and to explore the workforce's appetite for and barriers to using technology for learning and development. This study is designed to answer the following research questions: (1) What is the digital capability of the social care workforce in Northern Ireland? (2) What is the workforce's appetite to participate in digital learning and development? and (3) If there are barriers to the uptake of technology for learning and development, what are these barriers?

Methods: A survey was created and distributed to the Northern Ireland social care workforce. This survey collected data on 127 metrics that described demographics, basic digital skills, technology confidence and access, factors that influence learning and development, experience with digital learning solutions, and perceived value and challenges of using technology for learning.

Results: The survey was opened from December 13, 2018, to January 18, 2019. A total of 775 survey respondents completed the survey. The results indicated a workforce with a high level of self-reported basic digital skills and confidence. Face-to-face delivery of learning is still the most common method of accessing learning, which was used by 83.7% (649/775) of the respondents; however, this is closely followed by digital learning, which was used by 79.0% (612/775) of the respondents. There was a negative correlation between age and digital skills (r_s=−0.262; *P*<.001), and a positive correlation between technology confidence and digital skills (r_s=0.482; *P*<.001). There was also a negative correlation between age and the perceived value of technology (r_s=−0.088; *P*=.02). The results indicated a predominantly motivated workforce in which a sizable portion is already engaged in informal digital learning. The results indicated that lower self-reported basic digital skills and confidence were associated with less interest in engaging with e-learning tools and that a portion of the workforce would benefit from additional basic digital skills training.

Conclusions: These promising results provide a positive outlook for the potential of digital learning and development within the social care workforce. The findings provide clear areas of focus for the future use of technology for learning and development of the social care workforce and considerations to maximize engagement with such approaches.

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KEYWORDS

social work; learning; teaching methods; surveys; health care workers; mobile phone; digital divide; distance education; educational technology

Introduction

Background

The Northern Ireland Social Care Council (Social Care Council) is the regulatory body for the social care workforce in Northern Ireland. Established in 2001, the Social Care Council is one of the 12 health and social care regulators within the United Kingdom. The Social Care Council has over 42,000 registered members comprising social care workers and managers, social workers, and social work students. The purpose of the Social Care Council is to ensure that health and social care workers are regulated against relevant laws and standards [1].

Continual development of the social care workforce, in the form of postregistration training and learning, is a key element in enabling better outcomes for the users of social care services, as highlighted in the Social Care Council's 2017-2021 corporate plan [2]. This continual development is also a requirement to maintain the Social Care Council registration. The UK Department of Health and Social Care has released the Learning and Improvement Strategy for Social Workers and Social Care Workers 2019-2027 [3]. Within this strategy document, priority 6 focuses on social care practice within the digital world. In particular, this priority highlights the need to improve e-learning methodology and ensure that the workforce has the necessary skills to make the best use of the available technology. In 2017, Kennedy and Yaldren [4] stated that digital literacy was increasingly becoming a key requirement in contemporary health care and health education. They detailed several areas of health education that could benefit from technology-enhanced learning. These included accessibility and inclusivity, flexibility, development of professional identities and behaviors, signposting of resources, and improved collaboration. A report released by Health Education England in 2017 [5] also highlights the need for digital skills within the health and social care sector, emphasizing that the health care sector has traditionally been slow to adopt new digital tools and technologies. The report states that modern health and social care environments require lifelong, self-directed learners, which can be facilitated through digital tools. The report also highlights how an increase in digital literacy can dramatically increase the uptake and adoption of new digital tools and technologies, ultimately increasing the quality of care provided. The report highlights several key challenges in increasing the digital capabilities of the health and social care staff. One of these key factors focuses on human behaviors and attitudes toward digital literacy, including lack of confidence and unwillingness to use technology, and barriers in terms of organizational policy or lack of investment in technology.

Previous Work

In 2017, the Digital Health & Care Institute [6] published results obtained from a survey of 539 members of the social care workforce. This survey collected information on the workforce's attitudes toward digital technology and digital skills issues. This research highlighted that the social care staff and social care managers were aware of the potential benefits of digital technology in providing care services. However, the majority of the managers who responded to the survey stated that they believed the lack of staff capability was a challenge for using digital technology. This was in contrast to the opinion of the staff respondents, of which over 90% said that they were confident or very confident in their basic digital skills.

In 2019, De Gagne et al [7] reviewed the application of microlearning within health professional education in which knowledge or skills are acquired in the form of small units for continuing education. The review discussed the facilitation of microlearning through technology-based solutions, including podcasts and social media. This educational approach has been found to have a positive effect in areas such as knowledge and confidence in various practice areas. Wilkinson and Ashcroft [8] further highlighted the potential benefits of social media for health professional education, including the ability to overcome geographical and time barriers, and the fact that many students already access these platforms as part of their daily routine.

In 2014, a workforce learning strategy was developed by the Skills for Care and Development, Sector Skills Council [9]. This strategy highlighted the need for new learning resources to be developed around mobile technologies and stated that the workforce would require a level of digital literacy. As this 5-year strategy ended in 2019, this provides an opportunity to assess the current state of the workforce and identify opportunities for future direction. The use of mobile apps to educate the social care workforce is at an early stage [10]. Nevertheless, the Social Care Council has demonstrated previous success in the launch of digitally enabled learning solutions, including the Domiciliary Care Toolkit [11] and a series of award-winning Understanding Child Development apps that were updated in 2018 [10,12].

Objectives

The Social Care Council is currently developing a new learning and development strategy that will focus on the use of technology-enabled learning and development. This paper summarizes the results of a collaboration between Ulster University and the Social Care Council. The collaboration aimed to investigate the digital capability of the social care workforce in Northern Ireland and the attitudes of the workforce toward digital learning and development solutions. The purpose of this study is to identify the readiness of the workforce to engage with such digital solutions and to identify the potential barriers to the uptake that could then be addressed early in the design process.

This study is designed to answer the following research questions:

1. What is the digital capability of the regulated social care workforce in Northern Ireland?

2. What is the workforce's appetite to participate in digital learning and development?

3. If there are barriers to the uptake of technology for learning and development, what are these barriers?

Methods

Distribution

A survey was developed to answer these research questions. This survey was hosted on SurveyMonkey [13] and a link to the survey was distributed to the registered social care workforce via email. A participant information sheet was also distributed along with the survey link. The participant information sheet highlighted that participation would take 10 min, data would be stored on a secure Ulster University server for 10 years, the purpose of the study, that participation was voluntary, and contact details of the principle investigator.

The survey was further publicized through the Social Care Council website and social media accounts. To encourage participation, respondents were entered into a prize draw for a tablet computer and for 1 of 5 £50 (US $65.75) gift vouchers. The gift vouchers were sponsored by Silverbear PLC [14]. The anonymity of responses was maintained by collecting the participant contact details in a separate survey to the main data collection survey. The Ulster University Research Ethics Filter Committee reviewed and approved the study on December 11, 2018. The link to the survey was distributed from December 13, 2018, and the survey website remained open for data collection until January 18, 2019.

Design

The survey was used to collect both quantitative and qualitative data. The questions facilitated the collection of categorical and ordinal responses in the form of multiple-choice questions. Respondents were also offered the opportunity to provide qualitative, free text responses to elaborate on response selection where appropriate. In total, the survey facilitated the collection of 127 metrics for analysis, which were split into 2 sections. Each section was displayed on a separate page. Respondents were able to review any responses until the point of submission. Responses to all closed-ended questions were mandatory, and responses to any open-ended question were optional. Participation and view rates were not calculated, as unique internet protocol addresses were not logged as part of the ethical approval to maintain anonymity.

Section 1 collected demographic information, including job role, area of practice, age, and gender. This section also collected information relating to digital skills, confidence, and the frequency of using technology. Information regarding digital skills was captured through responses to a series of 10 statements, each regarding a technology-based skill, such as finding a previously visited website and installing apps. For each statement, respondents were asked to state whether they could perform this task if they were asked to. These statements were adapted from The Tech Partnership's *Get Digital: Basic Skills Assessment* questionnaire, which was featured in Lloyds Bank's UK Consumer Digital Index 2018 [15]. Reuse permission was granted.

Section 2 focused on attitudes and experiences with the use of digital technology to support learning and development at work. Respondents were asked about factors that influence them to learn and develop and the methods, location, and frequency of their learning and development. In addition, respondents were asked how useful they had found existing tools for digital learning and development and whether they would be interested in engaging with digitally enabled learning and development at home, at their workplace, or not at all. Finally, respondents were asked about their level of agreement with 6 statements regarding the value of technology to support learning and development and 7 statements regarding the challenges associated with technology to support learning and development. To maintain the logical flow of the survey, the items were not randomized.

The survey was reviewed by an independent sample of computing researchers and social care workers. These reviews primarily investigated the clarity of the questions, appropriateness of the closed-ended question response options, and length of the survey. Feedback from these users were discussed among the research team and agreed amendments were incorporated into the final version.

The inclusion criterion for the study was the membership of the Social Care Council's registered workforce. There were no exclusion criteria. This facilitated a convenience sampling of the target population. This was an open survey; however, only members of the registered Social Care Council workforce were given the participation URL.

The use of a web-based survey was the most cost-effective method to maximize exposure to a large number of potential respondents. The recruitment of participants through digital channels was identified as a potential source of bias within the study by potentially targeting members of the workforce who are already digitally active. However, all members of the workforce are encouraged to renew their Social Care Council registration on an annual basis using the Social Care Council's web-based registration portal. In addition, hardcopies of the survey questionnaires were offered upon request. Therefore, it can be argued that this web-based approach would not disadvantage or omit any member of the workforce from participating and that the bias associated with the study should be minimal.

Results

Overview

The survey received responses from 959 respondents. Of these, 19.2% (184/959) were removed from the analysis of the results because of partial completion. A total of 775 (80.8%) fully completed survey responses were included in the analysis of the results. No hardcopies of the survey questionnaires were requested. Table 1 provides an overview of the job role and gender of the respondents, and Table 2 provides an overview of the age distribution of the respondents.

Of the 539 social care workers, 31.2% (n=168) were domestic care workers, 29.3% (n=158) were residential care workers, 26.0% (n=140) were supported living care workers, and 13.5% (n=73) were daycare workers. Of the 222 respondents in the social work setting (excluding social work students), the most common sector of practice was health and social care trust (n=162, 73.0%) followed by the voluntary sector (n=23, 10.4%). Other common sectors of practice included the education sector (n=12, 5.4%) and the justice sector (n=9, 4.1%). The most common social work settings were mental health and addiction (n=23, 10.4%), training, education and governance (n=22, 9.9%), and looked-after children (n=19, 8.6%).

There was a substantially higher number of responses from females (629/775, 81.2%) than that of males (136/775, 17.5%). This imbalance reflects the gender imbalance of the Social Care Council's overall registered workforce. As of October 2019, 45,255 members of the registered workforce consisted of 86.14% (n=38,983) females and 13.70% (n=6204) males.

Table 1. Overview of the respondent job role and gender.

Job role	Gender				Overall, n (%)
	Female, n (%)	Male, n (%)	Other, n (%)	Prefer not to say, n (%)	
Social care worker	442 (82.0)	92 (17.1)	2 (0.4)	3 (0.6)	539 (69.5)
Social worker	175 (78.8)	42 (18.9)	0 (0.0)	5 (2.3)	222 (28.6)
Social work student	12 (85.7)	2 (14.3)	0 (0.0)	0 (0.0)	14 (1.8)

Table 2. Overview of the age distribution of the respondents.

Age category (years)	Number of respondents, n (%)
15-24	61 (7.9)
25-44	332 (42.8)
45-64	371 (47.9)
≥65	7 (0.9)
Prefer not to say	4 (0.5)

Digital Skills

Table 3 provides an overview of the digital skills results received from the respondents in each job role. Overall, the skills with the largest deficit included "Solve a problem with a device or digital service using online help," with 101/775 (13.0%) respondents stating that they could not do this if asked to; "Check that information you found online is accurate," with 70/775 (9.0%) respondents indicating that they could not do this if asked to; and "Buy and install apps on a device," with 7.1% (55/775) respondents indicating that they could not do this if asked to.

A digital skills score was calculated, which provided an overall summary of each respondent's digital skills based on responses to each of the 10 skills statements. Table 4 provides an overview of the mean digital skills score calculated for each job role. Cronbach α for the 10 digital skills score items was .877. The Kruskal–Wallis test indicated no significant difference (*P*=.08) between the social care worker and social worker digital skills score. A high mean digital skills score indicates a general high level of digital skills capabilities.

The relationship between age and digital skills was explored. Of note, responses under the age category of "Prefer not to say" have been excluded. Table 5 provides an overview of the mean digital skills score obtained for each age group.

It can be seen that there is a general trend of digital skills score decline with age. The Kruskal–Wallis test confirmed that there was a significant difference ($P<.001$) in the digital skills score between the age groups. There was a weak negative correlation between age group and digital skills score ($r_s=-0.262$; $P<.001$).

Table 3. Digital skills responses versus job role.

Response	Job role			Overall, n (%)
	Social care worker, n (%)	Social worker, n (%)	Social work student, n (%)	
I could do this if I was asked to	5098 (94.6)	2103 (94.7)	139 (99.3)	7340 (94.7)
I couldn't do this if I was asked to	242 (4.5)	113 (5.1)	1 (0.7)	356 (4.6)
I have no idea what you are talking about	50 (0.9)	4 (0.2)	0 (0.0)	54 (0.7)

Table 4. Mean digital skills score versus job role.

Job role	Digital skills score[a], mean (SD)
Social care worker	9.46 (1.47)
Social worker	9.47 (1.10)
Social work student	9.93 (0.27)
Overall	9.47 (1.36)

[a]The maximum possible digital skills score is 10.

Table 5. An overview of mean digital skills score versus age group.

Age group (years)	Digital skills score, mean (SD)
15-24	9.84 (0.55)
25-44	9.73 (1.17)
45-64	9.20 (1.50)
≥65	7.86 (3.02)

Confidence

Respondents were asked to provide an indication of their confidence with using 4 types of technologies: smartphones, tablets, desktop computers, and laptops. Confidence with each technology was recorded individually using a 5-point Likert scale with options spanning from *very confident* to *not confident at all*.

The technology confidence score was calculated for each respondent. This score provides a summary of each respondent's overall technology confidence based on the confidence response to each of the 4 technologies. The scores assigned for each response ranged from 0 (not confident at all) to 4 (very confident). The confidence score for each respondent was the sum of the scores from their responses. The maximum possible confidence score was 16, and the minimum, 0. Cronbach α for the 4 confidence score items was .952.

By Job Role

Confidence responses were categorized by job role. Table 6 provides an overview of these results. *Very confident* was the most common response provided by respondents from all job roles, followed by *moderately confident*.

Table 7 highlights the mean confidence score calculated for each job role. The Kruskal–Wallis test indicated no significant difference (P=.64) between the social care worker and social worker confidence score.

Table 8 provides an overview of the mean confidence score by technology type. The maximum possible confidence score for any technology was 4 (very confident), and the minimum possible value was 0 (not confident at all). It can be observed that, on average, respondents were most confident with the use of smartphones, followed by desktop computers and laptops. Respondents expressed the least confidence in using tablets.

Table 6. Technology confidence responses versus job role.

Response	Job role			Overall, n (%)
	Social care worker, n (%)	Social worker, n (%)	Social work student, n (%)	
Not confident at all	60 (2.8)	12 (1.4)	2 (3.6)	74 (2.4)
Only slightly confident	116 (5.4)	32 (3.6)	3 (5.4)	151 (4.9)
Somewhat confident	213 (9.9)	92 (10.4)	2 (3.6)	307 (9.9)
Moderately confident	617 (28.6)	260 (29.4)	11 (19.6)	888 (28.7)
Very confident	1148 (53.3)	489 (55.3)	38 (67.9)	1675 (54.1)

Table 7. Mean technology confidence score versus job role.

Job role	Confidence score, mean (SD)
Social care worker	12.97 (3.83)
Social worker	13.32 (3.35)
Social work student	13.71 (3.95)
Overall	13.09 (3.70)

Table 8. Mean technology confidence score versus type of technological device

Type of technology	Confidence score, mean (SD)
Desktop computers	3.28 (0.97)
Laptops	3.27 (1.00)
Smartphones	3.30 (0.97)
Tablets	3.24 (1.02)

By Age

Confidence responses were also categorized by age group. Of note, responses from respondents who selected *prefer not to say* for age group were not included. Table 9 provides an overview of the responses from each age group. It was observed that the most common response is very confident for all age groups except for the ≥65 years group. There is a steady decline in the proportion of the very confident responses as age group increases and a general trend of an increase in less confident responses.

To further explore this trend, the mean confidence score was calculated for each age group. This is summarized in Table 10. It can be seen that the mean confidence score decreases as age group increases (r_s=−0.314; *P*<.001).

Table 9. Technology confidence responses versus age group.

Age (years)	Technology confidence response				
	Not confident at all, n (%)	Only slightly confident, n (%)	Somewhat confident, n (%)	Moderately confident, n (%)	Very confident, n (%)
15-24	0 (0.0)	2 (0.8)	5 (2.0)	53 (21.7)	184 (75.4)
25-44	20 (1.5)	27 (2.0)	93 (7.0)	316 (23.8)	871 (65.6)
45-64	50 (3.4)	116 (7.8)	202 (13.6)	502 (33.9)	610 (41.2)
≥65	4 (14.3)	5 (17.9)	3 (10.7)	9 (32.1)	7 (25.0)

Table 10. Mean technology confidence scores versus age group.

Age (years)	Confidence score, mean (SD)
15-24	14.87 (1.94)
25-44	14.00 (3.12)
45-64	12.06 (4.04)
≥65	9.43 (5.13)

Confidence Versus Digital Skills

The relationship between digital skills and technology confidence was explored. A moderate positive correlation was identified (r_s=0.482; *P*<.001), which indicates that higher self-reported digital skills levels are associated with high technology confidence.

Learning and Development

Influencing Factors

Respondents were asked to state the factors that influence them to learn and develop. Table 11 provides an overview of the percentage of respondents who indicated each factor.

Table 11. Learning influencing factor versus job role.

Influencing factor	Job role			Overall, n (%)
	Social care worker, n (%)	Social worker, n (%)	Social work student, n (%)	
Future employment prospects	228 (42.3)	104 (46.8)	11 (78.6)	343 (44.3)
I want to develop my knowledge and skills	430 (79.8)	205 (92.3)	11 (78.6)	646 (83.4)
Obligation from employer	352 (65.3)	149 (67.1)	6 (42.9)	507 (65.4)
Obligation from regulating bodies	292 (54.2)	133 (60.0)	4 (28.6)	429 (55.4)
Other	6 (1.1)	7 (3.2)	0 (0.0)	13 (1.7)

Access

Respondents were asked to indicate the methods they used to access learning. Table 12 provides an overview of these results.

Respondents were provided with a list of e-learning tools and asked to state which of them they used to support learning and development at home and at work. Table 13 provides a comprehensive overview of the responses provided overall and by job role.

Table 14 provides an overview of the responses received regarding the usefulness of e-learning tools

Respondents were asked whether they would be interested in participating in e-learning and development delivered at home and at work. Table 15 presents the willingness to engage with e-learning tools by job role.

Table 12. Methods used to access learning versus job role.

Method of accessing learning	Job role			Overall, n (%)
	Social care worker, n (%)	Social worker, n (%)	Social work student, n (%)	
Face-to-face	444 (82.4)	192 (86.5)	13 (92.9)	649 (83.7)
e-learning	421 (78.1)	182 (82.0)	9 (64.3)	612 (79.0)
Reading information leaflets or workbooks	310 (57.5)	175 (78.8)	6 (42.9)	491 (63.4)
Other	25 (4.6)	26 (11.7)	1 (7.1)	52 (6.7)

Table 13. e-learning tools used at home and at work versus job role.

Type of technology, Location used	Job role			Overall, n (%)
	Social care worker, n (%)	Social worker, n (%)	Social work student, n (%)	
Electronic books				
Home	195 (36.2)	108 (48.6)	10[a] (71.4)	313[b] (40.4)
Work	111 (20.6)	66 (29.7)	6[a] (42.9)	183[b] (23.6)
Mobile learning apps				
Home	276 (51.2)	106 (47.7)	8 (57.1)	390 (50.3)
Work	133 (24.7)	57 (25.7)	7 (50.0)	197 (25.4)
Online communities				
Home	221 (41.0)	81 (36.5)	5 (35.7)	307 (39.6)
Work	126 (23.4)	58 (26.1)	5 (35.7)	189 (24.4)
Others				
Home	44 (8.2)	9 (4.1)	1 (7.1)	54 (7.0)
Work	18 (3.3)	4 (1.8)	1 (7.1)	23 (3.0)
Podcasts				
Home	89 (16.5)	65 (29.3)	3 (21.4)	157 (20.3)
Work	26 (4.8)	28 (12.6)	1 (7.1)	55 (7.1)
Vlogs				
Home	67 (12.4)	26 (11.7)	2 (14.3)	95 (12.3)
Work	17 (3.2)	6 (2.7)	0 (0.0)	23 (3.0)
Websites				
Home	394 (73.1)	175 (78.8)	13 (92.9)	582 (75.1)
Work	313 (58.1)	195 (87.8)	12 (85.7)	520 (67.1)

[a]Total n=14.

[b]Total n=775.

Table 14. Usefulness of e-learning tools versus job role.

Usefulness of e-learning tools	Job role			Overall, n (%)
	Social care worker, n (%)	Social worker, n (%)	Social work student, n (%)	
Extremely useful	112 (20.8)	40 (18.0)	6 (42.9)	158 (20.4)
Very useful	196 (36.4)	89 (40.1)	5 (35.7)	290 (37.4)
Somewhat useful	164 (30.4)	75 (33.8)	3 (21.4)	242 (31.2)
Not so useful	23 (4.3)	6 (2.7)	0 (0.0)	29 (3.7)
Not at all useful	7 (1.3)	3 (1.4)	0 (0.0)	10 (1.3)
I haven’t used them	37 (6.9)	9 (4.1)	0 (0.0)	46 (5.9)

Table 15. Willingness to engage with e-learning tools versus job role.

Willingness to engage with e-learning tools	Job role			Overall, n (%)
	Social care worker, n (%)	Social worker, n (%)	Social work student, n (%)	
Yes, at home in my own time	337 (62.5)	116 (52.3)	11 (78.6)	464 (59.9)
Yes, at work	304 (56.4)	174 (78.4)	7 (50.0)	485 (62.6)
No, neither	54 (10.0)	21 (9.5)	2 (14.3)	77 (9.9)

The Value and Challenges of Technology Use for Learning

Respondents were asked to rate how strongly they agreed or disagreed with 6 positive statements about the value of technology to support learning and 7 statements regarding the challenges. Figure 1 summarizes the responses to the value statements, and Figure 2 summarizes the responses to the challenge statements. The majority of responses to statements regarding the benefits were positive. A total of 64.8% (502/775) of the respondents strongly agreed to the statement in relation to the flexibility of access from anywhere at any time. In addition, 60.5% (469/775) of the respondents strongly agreed that the technology is easily available and can be used continuously for learning and reference.

In terms of challenges, 64.9% (503/775) of the respondents at least somewhat agreed that there is not enough time to undertake digital learning because of work demands, and 42.8% (332/775) of the respondents at least somewhat agreed that the use of this technology to learn reduces the support available to the learner.

A technology value score and technology challenge score were calculated to summarize each respondent’s level of agreement or disagreement with the value and challenge statements. For each respondent, the scores were calculated by summing the values of the responses given to each of the respective statements. Values assigned to each response option ranged from −2 (strongly disagree) to 2 (strongly agree). The technology value score had a Cronbach α of .918. The maximum possible technology value score was 12 (strong agreement with all statements) and the minimum possible technology value score was −12 (strong disagreement with all statements). The technology challenge score had a Cronbach α of .766. The maximum possible technology challenge score was 14 (strong agreement with all statements) and the minimum possible technology challenge score was −14 (strong disagreement with all statements).

The mean technology value score was calculated for each job role. This is summarized in Table 16. It can be seen that the mean technology value score for all job roles was positive. There was a significant difference in the technology value score for each job role (P=.01).

The mean technology value score was also calculated for each age group. This is summarized in Table 17. Of note, responses from those who indicated age as *prefer not to say* were not included.

Figure 1. An overview of the level of agreement and disagreement to statements regarding the value of using technology for learning.

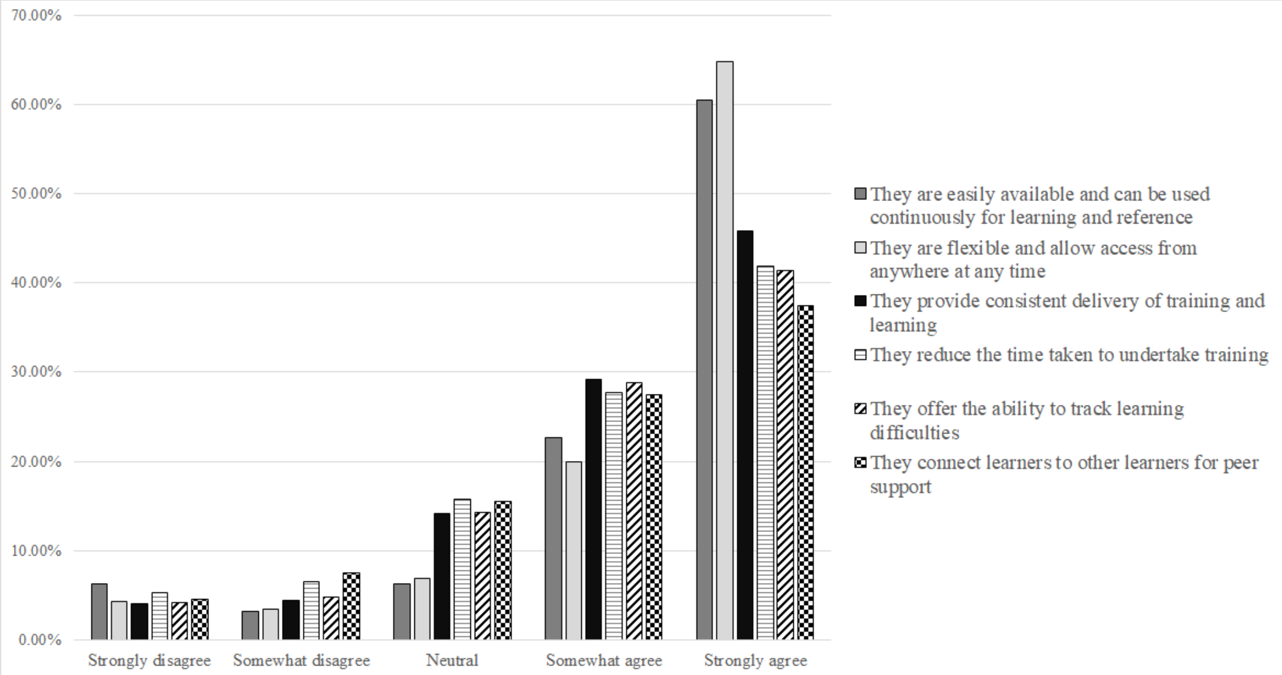

Figure 2. An overview of the level of agreement and disagreement to statements regarding the challenges of using technology for learning.

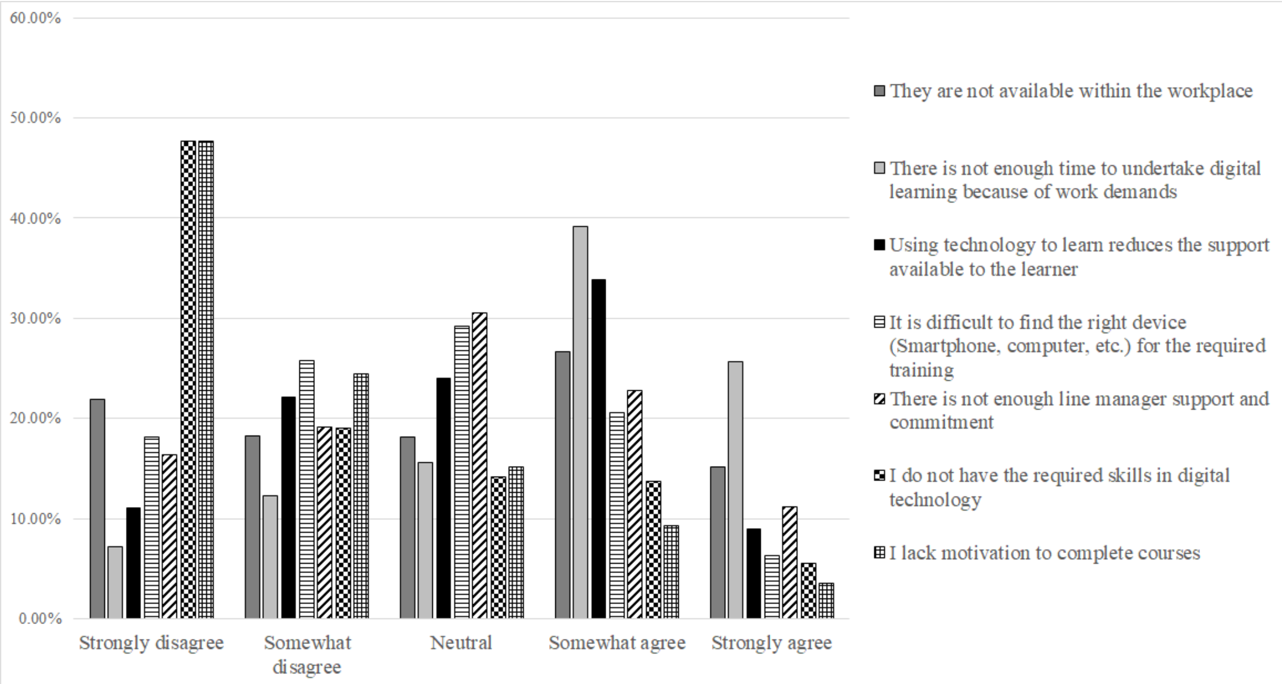

Table 16. Mean technology value score versus job role.

Job role	Technology value score, mean (SD)
Social care worker	7.2 (5.3)
Social worker	5.7 (6.1)
Social work student	6.6 (8.0)
Overall	6.8 (5.6)

Table 17. Mean technology value score versus age group.

Age (years)	Technology value score, mean (SD)
15-24	7.6 (4.2)
25-44	7.4 (5.1)
45-64	6.2 (6.2)
≥65	3.9 (6.0)

The mean technology value score for all age groups was positive. It can be seen that as age group increases, the mean technology value score decreases. There was a weak negative correlation between age and technology value score (r_s=−0.088; *P*=.02).

The mean technology challenge score was calculated for each job role. This is summarized in Table 18. It can be seen that each job role had a negative mean technology challenge score. There was no significant difference in the technology challenge score for each job role (*P*=.79).

The mean technology challenge score was calculated for each age group. This is summarized in Table 19. It can be seen that each age group had a negative mean technology challenge score. This indicates that respondents within each age group slightly disagree with the challenges of technology use for learning.

A total of 9.9% (77/775) of the respondents indicated that they would not be willing to engage with e-learning tools at home or at work. Upon further analysis, it was revealed that these respondents had a mean digital skills score of 9.26 (SD 1.43), which is below the average digital skills score of 9.47 (SD 1.36). In addition, the mean confidence score for these participants was 11.61 (SD 4.48), which is below the overall mean confidence score of 13.09 (SD 3.70). The mean technology value score for these respondents was 4.79 (SD 5.86), which is below the overall mean technology value score of 6.8 (SD 5.6), and the mean technology challenge score for these respondents was 0.86 (SD 5.48), which is higher than the overall mean of 1.6 (5.5).

Table 18. Mean technology challenge score versus job role.

Job role	Technology challenge score, mean (SD)
Social care worker	−1.6 (5.7)
Social worker	−1.6 (5.3)
Social work student	−2.1 (3.2)
Overall	−1.6 (5.5)

Table 19. Mean technology challenge score versus age group.

Age (years)	Technology challenge score, mean (SD)
15-24	−1.84 (5.1)
25-44	−2.0 (5.5)
45-64	−1.3 (5.7)
≥65	−1.1 (4.2)

Other Comments Regarding the Use of Technology for Learning and Development

Respondents were invited to provide further feedback regarding elements that may help or hinder them from using technology to support learning and development. Of the 131 additional comments that were provided, 28.2% (37/131) of comments mentioned that high workload or lack of time was a hindrance to engaging in training opportunities. Several respondents stated that they would like to have time ring-fenced to allow them to engage with digital learning opportunities.

Discussion

Digital Skills and Confidence

Respondents provided an overall high level of self-reported digital skills (mean digital skills score of 9.47, SD 1.36), with no significant difference in responses provided by respondents in each job role. The digital skills score was found to decrease as age group increased (r_s=−0.262; *P*<.001); however, the oldest age group still demonstrated a high mean digital skills score of 7.86 (SD 3.02) out of a maximum possible score of 10. This is a very positive result, which indicates that the majority of respondents possess the core skills required to engage with digital learning and development solutions.

Technology confidence was again mostly positive, with 54.11% (1675/3095) of responses stating that they were very confident in their use of technology. This indicates that the majority of respondents felt confident in the use of the various platforms that would be suitable for deploying digital learning and development solutions. The same is true when analyzing by job role, with no significant difference (*P*=.64) in responses from each job role. This is a positive result; however, the results indicate key areas for focus. Particular focus should be given to members of the workforce within all job roles who indicated that they were only slightly confident or not confident at all in the use of technology. Overall, 2.39% (74/3095) of the respondents' responses indicated that they were not confident at all in the use of a particular technology and 4.87% (151/3095) indicated that they were only slightly confident. There was a negative correlation between age group and confidence score. A total of 14% (4/28) of responses from respondents aged ≥65 years indicated that they were not confident at all in the use of some technologies. A total of 13.0% (101/775) of the respondents indicated that they would not be able to solve a problem with a digital device using web-based help, 9.0% (70/775) indicated that they would not be able to verify whether the web-based information they found was accurate, and 7.1% (55/775) could not buy or install apps on a device.

Although the majority of responses are positive, it is clear that there is a small portion of the workforce who would benefit from increased training in the use of technology. This is critical to ensure that every member of the workforce is able to benefit from the potential of digital learning and development and that a digital divide is not created. The results indicate that there is a positive correlation between self-reported digital skills and confidence score (r_s=0.482; *P*<.001). As a result, it is recommended that members of the workforce who felt less confident are provided with the opportunity to engage with training sessions to increase their core digital skills. Comparison of the confidence score with the other metrics provided interesting results for consideration. It should be noted, however, that one limitation of this study is that the confidence score used in this survey is a novel score that has not been previously validated.

Learning and Development

Encouraging results were received with regard to factors that influence respondents to learn and develop. "I want to develop my knowledge and skills" was the most popular response, selected by 83.4% (646/775) respondents. This suggests that respondents were motivated and have a genuine interest in learning and development, as it was a more popular response than *obligation from employer* (507/775, 65.4%) and *obligation from regulating bodies* (429/775, 55.4%). Interestingly, *future employment prospects* was the least popular option (343/775, 44.3%). This result indicates that a considerable portion of respondents are motivated to develop their knowledge and skills for reasons other than future employment prospects.

Face-to-face delivery was the most common method to access learning by all job roles. Although 83.7% (649/775) of the respondents accessed learning in this manner, this was closely followed by e-learning (612/775, 79.0%), which indicates that the majority of respondents were already engaging in informal methods of digital learning and development. This provides a promising foundation that can be further developed through formal provision of digital learning and development solutions. Websites were the most commonly used e-learning tools, followed by mobile learning apps. Interestingly, every e-learning tool was more commonly used at home than at work, which indicates that respondents are currently engaging in additional out-of-hours learning. The majority of respondents found e-learning tools to be very useful or extremely useful. This is encouraging, as these positive experiences with e-learning tools may translate to increased engagement with formal digital learning and development solutions. Nevertheless, a small number of respondents did not use these tools (46/775, 5.9%) or found them not so useful (29/775, 3.7%) or not at all useful (10/775, 1.3%). It would be beneficial to provide members of the workforce of this nature with an increased opportunity to engage with such tools and to further investigate why they did not find these tools useful.

Overall, the majority of respondents were willing to engage with e-learning tools at home or at work. Notably, 9.9% (77/775) of the respondents were not willing to engage with e-learning tools at home or at work.

The results indicate that the majority of respondents either somewhat or strongly agree with the value of using technology for learning and development. As the age group increases, the strength of agreement tends to decrease. Opinion on the challenges associated with technology for learning and development is further divided. The majority (517/775, 66.7%) of the respondents did not agree that they lacked the required skills in digital technology or that they lacked the motivation to complete courses (559/775, 72.1% at least somewhat disagree). This indicates a predominantly motivated workforce, the majority of which did not feel hindered by their level of skills in digital technology. Nevertheless, there is a clear benefit in offering additional digital skills training, as 19.2% (149/775) of the respondents at least somewhat agreed that they did not have the required skills in digital technology to facilitate learning and development. In addition, the majority (503/775, 64.9%) of the respondents at least somewhat agreed that they did not have enough time to undertake digital learning because of work demands.

Maximizing Engagement With Digital Learning and Development Solutions

These results show that respondents who were not willing to engage with e-learning tools at home and at work were more likely to have lower self-reported digital skills, less technology confidence, see less value in technology for learning and development, and agree more with the challenges associated with technology for learning and development compared with the average respondent who was willing to engage with such tools. These findings suggest that offering training to increase digital skills and technology confidence, in addition to raising awareness of the benefits of the use of technology for learning and development, may increase the overall engagement with digital learning and development solutions.

Conclusions

Continual development of the social care workforce is a key element in enabling better outcomes for the users of social care services. This work aims to identify the digital capability of the regulated social care workforce in Northern Ireland, in addition to exploring the workforce's appetite for and barriers to using technology for learning and development. A total of 775 survey respondents facilitated the analysis of 127 metrics. The results indicated a workforce with an overall high level of self-reported basic digital skills and confidence. The results also highlighted a positive correlation between digital skills and technology confidence, a negative correlation between age and digital skill, and a negative correlation between age and perceived value of technology.

With regard to digital learning and development, the results also indicated a predominantly motivated workforce in which a considerable portion already engaged in informal e-learning. Reassuringly, respondents were more likely to be motivated to learn and develop through the desire to further develop their knowledge and skills rather than obligation from their employer or regulating bodies.

The results also indicated that lower self-reported basic digital skills and confidence were associated with less interest in engaging with e-learning tools and that a small portion of the workforce would benefit from additional basic digital skills training. These results provide clear areas of focus for the future use of technology for learning and development of the social care workforce.

Acknowledgments

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Conflicts of Interest

None declared.

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Original Paper

Developing Patient-Centered Inflammatory Bowel Disease–Related Educational Videos Optimized for Social Media: Qualitative Research Study

Carine Khalil[1,2*], PhD; Welmoed Van Deen[1,3*], PhD; Taylor Dupuy[1], BA; Nirupama Bonthala[3,4], MD; Christopher Almario[1,3,4], MD, MSPH; Brennan Spiegel[1,3,4], MD, MSHS

[1]Division of Health Services Research, Center for Outcomes Research and Education, Cedars-Sinai Medical Center, Los Angeles, CA, United States
[2]LIRAES, Paris Descartes University, Paris, France
[3]Department of Medicine, Cedars-Sinai Medical Center, Los Angeles, CA, United States
[4]Division of Gastroenterology and Hepatology, Cedars-Sinai Medical Center, Los Angeles, CA, United States
[*]these authors contributed equally

Corresponding Author:
Carine Khalil, PhD
Division of Health Services Research
Center for Outcomes Research and Education
Cedars-Sinai Medical Center
116 N Robertson PACT Building
Los Angeles, CA, 90048
United States
Phone: 1 2133361585
Email: carine.khalil@cshs.org

Abstract

Background: Important knowledge gaps have been identified related to the causes and symptoms of inflammatory bowel disease (IBD) and medical treatments and their side effects. Patients with IBD turn to social media to learn more about their disease. However, such information found on the web is misleading and often of low quality.

Objective: This study aims to gain an in-depth understanding of the unmet educational needs of patients with IBD and to use the resulting insights to develop a collection of freely available, evidence-based educational videos optimized for dissemination through social media.

Methods: We used design thinking, a human-centered approach, to guide our qualitative research methodology. We performed focus groups and interviews with a diverse sample of 29 patients with IBD. Data collection was performed in 3 phases (inspiration, ideation, and implementation) based on IDEO design thinking. Phase 1 offered insights into the needs of patients with IBD, whereas phases 2 and 3 involved ideation, prototyping, and video testing. A thematic analysis was performed to analyze the resulting data.

Results: Patients emphasized the need for educational videos that address their challenges, needs, and expectations. From the data analysis, 5 video topics and their content emerged: IBD treatments' risks and benefits; how to be a self-advocate; how to stay healthy with IBD; how to cope with IBD; and educating families, friends, and colleagues about experiences of patients with IBD.

Conclusions: Design thinking offers a deep understanding and recognition of the unmet educational needs of patients with IBD; this approach informed the development of 5 evidence-based educational videos. Future research will formally test and disseminate these freely available videos through social media.

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KEYWORDS

inflammatory bowel disease; educational videos; patient education; design thinking; qualitative research; mobile phone

Introduction

Background

Inflammatory bowel diseases (IBD), including Crohn disease and ulcerative colitis, are inflammatory conditions of the intestines that can cause debilitating symptoms and decrease patients' quality of life [1,2]. Accurate information and education are important aspects of IBD treatment, as they can improve the quality of care and help patients cope with IBD-related worries and concerns [3,4]. However, critical knowledge gaps have been identified among patients with IBD, including lack of knowledge about the disease's causes and symptoms and medical treatments and side effects [5-7]. Consistently, a large Swiss study assessing informational needs and concerns in 728 patients with IBD highlighted that the information patients received about their disease was insufficient [8].

Many patients are unhappy with the information they receive after diagnosis. Although most would prefer to receive educational content through their doctor's office, their education needs are often not met in this setting [7]. Information provided is commonly based on clinicians' assumptions of what patients need to know and is not always aligned with patients' actual needs [4]. Therefore, many patients turn to other sources, including the internet and social media, to obtain additional information, share their experiences, and connect with other people with IBD [4,6,9]. In fact, in our previous study that used social media data to examine patients' understanding of the risks and benefits of biologics in IBD, more than 25% of posts were from people seeking information and support through the online IBD community [6]. Although there is growing interest among patients to use social media for IBD-related information, information on the web is misleading and often of low quality [9].

Involving patients throughout educational materials development is critical for a deeper understanding of their expectations and addressing their needs. Design thinking—an iterative human-centered approach that emphasizes empathy, collaborative thinking, prototyping, and learning from failure—is well suited for designing interventions from the perspective of those impacted by it [10,11]. This methodology emphasizes the use of qualitative research methods within a structured framework for design purposes and is used across industries to improve product development, user experience, and customer service. Given the increasing focus on patient-centered care, the use of design thinking in health care is also gaining interest. By prioritizing end users' core needs and continuously integrating their feedback, design thinking offers a way to develop interventions, including digital solutions that are successful, acceptable, and useful to the patients [12-14].

Design thinking has been applied to develop patient- and provider-facing interventions across diverse health conditions, including diabetes, chronic obstructive pulmonary disease, and posttraumatic stress disorder, among others [15]. Although several educational interventions have been developed for IBD, few were informed by patients' input. In these studies, design thinking was implemented with various degrees of rigor. Not all studies used direct end-user input to assess users' needs, and none reported brainstorming or ideation sessions, which are essential for the collaborative generation of solution concepts for the target population [4]. In addition, previous studies did not obtain end-user feedback on low-fidelity prototypes [15], an essential step that allows the design-thinking team to get user feedback at an early stage in the intervention-development process [10].

Objectives

Here, we aim to gain an in-depth understanding of the unmet needs and expectations of patients with IBD for web-based educational videos. We then used these insights to inform the development of a series of short educational videos optimized for dissemination through social media. We applied design-thinking methodology to understand patients' experiences, identify their challenges, and obtain iterative input on video prototypes during the development process.

Methods

Design-Thinking Approach

To guide our qualitative research methodology, we applied a design-thinking model developed by IDEO, a global design-thinking company that creates human-centered products, services, and organizations. This model is widely used to explore solutions for social problems faced by communities and uses 3 iterative phases to design innovative solutions [16]. In the first phase, called the inspiration phase, researchers learn about people's lives, preferences, expectations, needs, thoughts, emotions, and challenges. It consists of collecting stories and gathering inspiration from patients and requires building empathy to understand what they need and how they behave, feel, and think. In the second phase, called the ideation phase, ideas are generated by the research team, which are then converted to low-fidelity prototypes that can be tested by end users. The third and last phase—the implementation phase—consists of testing high-fidelity prototypes before producing the final product and launching it into the market. Multimedia Appendix 1 shows our study design based on IDEO's design-thinking model.

Phase I–Inspiration Phase

In the inspiration phase, we performed 2 in-person focus groups with 11 patients with IBD and 6 semistructured phone interviews with individual patients with IBD to obtain an in-depth understanding of their preferences, expectations, and unmet educational needs. The focus groups allowed interpersonal discussions to elucidate similarities and differences among participants' experiences and beliefs. The individual interviews enabled us to conduct in-depth discussions with patients who have different needs and expectations, such as those with higher disease severity or lower literacy levels compared with *typical* patients with IBD.

Phase II–Ideation Phase

In the ideation phase, low-fidelity prototypes were developed based on the data synthesized and analyzed in the inspiration phase (phase I). Prototypes consisted of 5 video scripts and character and location prototypes for the videos. The scripts were developed iteratively in a series of ideation sessions with health services researchers, physicians with expertise in IBD, video producers, and patients with IBD. In the first session, the inspiration phase results were presented to all coauthors by a qualitative researcher (CK) on the team. The team then deliberated about potential topics for each of the videos and created outlines of each video's content. The outlines were shared with the video production team, who then developed the initial scripts and prototypes of the videos' characters and locations. To ensure that the videos were suitable for dissemination through social media, the scripts were designed to be short and concise with an anticipated video length of ≤90 seconds. The initial scripts were first reviewed and revised based on input from the research team. Afterward, 2 in-person focus groups were conducted with 12 patients with IBD, including some of those who participated in the inspiration phase, to gather their feedback on the scripts and character and location prototypes. In an additional ideation meeting, we reviewed participants' feedback with our multidisciplinary team and incorporated their feedback in designing 5 high-fidelity video prototypes.

Phase III–Implementation Phase

In the final implementation phase, high-fidelity prototypes of the videos were developed by the production team based on the final script, which was tested by 10 patients with IBD via in-person interviews. These interviews aimed to test the videos' practicability and obtain additional insights and feedback from a sample of additional users. Hence, 10 patients with IBD tested the high-fidelity prototypes and made minor comments on their format and content, based on which additional changes were made to the videos. This phase helped us understand how well the 5 videos met patients' expectations and needs.

Population

For the inspiration phase (phase I), we included patients with different disease severity, literacy, and digital levels. Both the 2 focus groups included a diverse representation of 5 to 6 *typical* patients with IBD, including participants from diverse age groups, genders, races and ethnicities, and IBD type (Multimedia Appendix 2). By recruiting a diverse sample, we aimed to obtain broad perspectives and insights regarding the needs, expectations, and traits of potential viewers of future videos. For the interviews, we recruited 6 patients with needs and behaviors that differed from those of *typical* patients. We included patients with a particularly mild and severe disease course, a patient with a recent IBD diagnosis, patients with low health and digital literacy, and a patient with reduced access to care. Their inclusion in the study population helped us generate additional insights and identify high-priority issues that need to be addressed in the educational videos (Multimedia Appendix 2).

In the ideation phase (phase II), we recruited a diverse group of patients with IBD for the 2 focus groups (6 patients in each) to obtain feedback on the scripts. This phase included participants who previously participated in the inspiration phase to confirm that we correctly interpreted what they told us and appropriately translated the findings into the video scripts. We also included new patients during this step to ensure the transferability of the results to other patients. Finally, in the implementation phase (phase III), we recruited a convenience sample of 10 patients with IBD who had not previously participated in the study to obtain feedback on the prototyped videos. By recruiting a group of new patients in the final phase, we aimed to collect unbiased perspectives.

Data Collection

Semistructured interview guides were developed for the focus groups and interviews (Multimedia Appendix 3). All discussions were audiotaped and transcribed with the consent of the participants. For the focus groups, a researcher moderated the sessions while 2 other researchers recorded detailed notes; 2 researchers conducted the interviews. Data on demographics, disease characteristics, medical literacy, and digital literacy were collected using a short survey before the focus groups and interviews.

In the inspiration phase (phase I), we conducted 2 in-person focus groups and 6 phone interviews with patients with IBD. The semistructured interview guide (Multimedia Appendix 3) included open-ended questions such as "What type of challenges did you deal with when you were first diagnosed with IBD?", "Do you discuss treatment options with your doctor?", and "How can educational videos help you participate in your treatment decision?".

In the ideation phase (phase II), 2 in-person focus groups were performed with patients with IBD to gather their opinions and perceptions of the initial video scripts and prototypes of the characters. The semistructured interview guide (Multimedia Appendix 3) included questions such as "What are your thoughts on the content of each video?", "How does the video improve your knowledge?", "Does it reduce your anxiety or fear or depression?", and "What do you think about the animation characters?".

In the implementation phase (phase III), 10 in-person interviews were conducted to assess their opinions and perceptions of the prototype videos. The interview guide (Multimedia Appendix 3) included both closed- and open-ended questions related to the content and format of each video: "Was the language easy to understand?", "What do you think about the music?", "How can we improve the videos?", and "What did you think of the video?"

Data Analysis

A thematic analysis approach was used to examine the interview and focus group data. The analyses were performed by an experienced researcher (CK) with formal training in qualitative methods. The qualitative data were carefully reviewed and rereviewed to immerse ourselves in the language and obtain a global sense of what patients expressed during the discussions. Throughout the reading, sentences and/or paragraphs were coded, and important sections of texts were highlighted and labeled. Hence, key labels were inductively identified in the unstructured data [17]. After sorting and combining the identified labels, a set of inductive themes and subthemes were defined and justified with verbatim quotes [18]. Table 1 illustrates examples from the coding process in each phase.

Table 1. Extracts from the coding process in phases 1, 2, and 3.

Phases	Quotes	Themes
Phase 1–Inspiration	• "When you research it's like one site will say something and the other site will contradict what someone has said…. I'm really trying to change my diet and how to do that is what I'm really searching out right now."	• Conflicting information on the web • Looking for diet information
Phase 2–Ideation	• "Each drug has so many different risks, but maybe mention it a couple more times in the video so the person knows to get some more information on what the potential risks could be."	• Important to stress the risks associated with each drug
Phase 3–Implementation	• "It would be great to show this video to people who have just been diagnosed and are going to the doctor for the first time." • "I thought the video had a good message that you should support people with IBD."	• Perceived usefulness of the video when first diagnosed • Satisfaction with the main message of the video

Ethical Considerations

This study was approved by the institutional review board of the Cedars-Sinai Medical Center under the protocol number Pro55548. Patients were initially approached by their treating physician, who explained the study's purpose and asked for their permission to be approached by a member of the research team. Information sheets were provided, and verbal consent was obtained from all participants before the focus groups and interviews. Participants were reminded of their right to pass on answering any question or discontinuing the interviews or focus groups at any moment. Participants received a US $100 Amazon gift card at the beginning of the focus groups or interviews.

Results

Phase 1–Inspiration Phase

A total of 17 patients with IBD were included in the focus groups (n=11) and one-on-one interviews (n=6) during the inspiration phase. The demographics and clinical characteristics of the patients are shown in Table 2. Although most patients in the focus groups were highly educated and with high digital literacy levels, we purposefully sought to increase diversity in these aspects in the individual interviews (Table 2). The focus groups lasted 2 hours, and interviews lasted between 15 mins and 1 hour. Several key themes were identified, and thematic saturation was achieved after 2 focus groups and 3 interviews.

Table 2. Demographics of participants.

Demographic	Phase 1–Inspiration		Phase 2–Ideation	Phase 3–Implementation
	Focus groups (n=11)	Interviews (n=6)	Focus groups (n=12[a])	Interviews (n=10)
Female gender, n (%)	8 (73)	5 (83)	8 (67)	8 (80)
Age, (years), median (range)	41 (22-83)	34 (21-64)	41 (23-83)	25 (36-52)
Race, n (%)				
Black	4 (36)	2 (33)	4 (33)	0 (0)
Native Hawaiian or other Pacific Islander	0 (0)	0 (0)	1 (8)	0 (0)
White	4 (36)	2 (33)	6 (50)	10 (100)
Multiracial	2 (18)	0 (0)	1 (8)	0 (0)
Other	1 (9)	2 (33)	0 (0)	0 (0)
Hispanic ethnicity	1 (9)	2 (33)	2 (17)	0 (0)
Insurance[b], n (%)				
Employer-sponsored	9 (82)	3 (50)	9 (75)	8 (80)
Marketplace	1 (9)	1 (17)	1 (8)	0 (0)
Medicaid	0 (0)	2 (33)	1 (8)	2 (20)
Medicare	2 (18)	0 (0)	2 (17)	0 (0)
Highest education, n (%)				
High school	0 (0)	3 (50)	0 (0)	3 (30)
College degree	4 (36)	3 (50)	6 (50)	4 (40)
Graduate degree	7 (64)	0 (0)	9 (50)	3 (30)
Computer or smartphone use, n (%)				
Every day	11 (100)	5 (83)	11 (92)	10 (100)
A few times per week or month	0 (0)	0 (0)	0 (0)	0 (0)
Occasionally	0 (0)	0 (0)	1 (8)	0 (0)
Never	0 (0)	1 (17)	0 (0)	0 (0)
Type of IBD[c], n (%)				
Crohn disease	8 (36)	4 (67)	9 (75)	7 (70)
Ulcerative colitis	3 (27)	2 (33)	3 (25)	3 (30)
Disease duration (years), median (range)	15 (2-39)	12.5 (1-22)	17.5 (2-39)	19 (2-36)

[a]10 participated in phase 1 and phase 2.

[b]Multiple answers may apply.

[c]IBD: inflammatory bowel disease.

Patients' Web Experience

Participants emphasized the need for educational videos that address patients' challenges, needs, and expectations: "I think it's actually really great and helpful [to develop educational videos for IBD], and I think it would be helpful to tackle it in multiple ways…" Moreover, developing videos tailored for social media was aligned with patients' behavior and their extensive use of the internet: "before, they would send you home with a brochure… but now it's the Internet… [I am] on Facebook all the time, every day…" However, participants reported conflicting experiences with the information they found on the web. On the one hand, IBD-related information on the web was perceived as overwhelming and unreliable: "there's so much stuff on the Internet... some of it is just conflicting." This affected their trust in information on the web ("I don't trust the Internet, there's a lot going on"; "you can also get conflicting information") and created "panic and anxiety" for some people with IBD. In this regard, our participants underlined the importance of using reputable sources such as Mayo Clinic, Harvard Medical School, and WebMD to get the information they needed to manage their disease. On the other hand, participants noted that the internet was helpful and supportive: "it's really nice that there is support at our fingertips with a bunch of people with shared experiences." It helped patients "feel better and less alone" as it made them realize "how many other people out there are dealing with this [IBD].” Patients used the internet to seek information about nutrition, healthy recipes, alternative remedies, and lifestyle choices. They also used the internet to find articles related to patients’ shared experiences, advances in the field of IBD, and available medication options and their associated side effects.

Concerns Regarding IBD Treatments

Concerns were expressed by participants regarding the use of biologics and its side effects:

> *I remember being really nervous about starting biologics*
>
> *the side effect of medication is worse than the disease*

Patients also noted a need to learn about the different treatment options and their associated risks and benefits:

> *It’s good to know what the risks are so that you are informed*
>
> *It’s all about the pros and cons.*

Learning about medication risks and benefits helped patients make informed treatment decisions:

> *now that you have the information, you can take it and you can make decisions.*

Perceived Importance of Self-Advocacy

Patients also emphasized the importance of self-advocacy in managing their IBD. They often struggled to get IBD medications approved by their insurance and delivered on time:

> *It’s a hassle to get the medication*
>
> *I missed a few months because the insurance wasn’t happening*

They also described their experiences with insurance companies as being *tough*, *a hassle*, *a nightmare*, *a hell of a process*, *worrying*, and *stressful*;

> *it’s really tough to work with the insurance*
>
> *I think insurance is a nightmare and it's so stressful;*
>
> *I was getting a little worried like I don't know if my insurance will cover it.*

Therefore, participants expressed the need to be persistent and self-advocate to get the right medication and dosage approved:

> *You have to be persistent with them* [insurance]
>
> *I think that providing people with insights and tips on how to be aggressive about it [getting the injections] would be very helpful.*

They also reported that it is essential for patients with IBD to feel comfortable sharing their symptoms, concerns, and questions with their providers:

> *you could have stopped it from happening if you talked to your doctor;*
>
> *letting them [doctors] know what you found out.*

Need for a Healthy Lifestyle

Patients with IBD often looked for health information in brochures from their doctor’s office or on the web:

> *I am on Facebook daily, so every now and then I see an article about IBD that catches my eyes, I’ll click on it and read it.*

They believed that their IBD symptoms were highly affected by their lifestyle choices. Hence, it was important for them to learn how to adjust their lives and keep their bodies in shape. They expressed the need to develop a video that highlights the benefits of exercising and includes recommendations for a healthy diet and lifestyle:

> *I think that it would be helpful to tackle it in multiple ways such as telling people types of foods to eat, recipes, lifestyle choices.*

They also reported that the video should emphasize the importance of physical activities and meditation to alleviate stress.

Importance of Mental Support

Participants also pointed out that they can feel overwhelmed and alone with their illness and that they believe that IBD is also a mental disease. Hence, they wanted tips on coping with their IBD diagnosis and living with their condition: “no matter how much medicine you take, if you don’t have a positive mental state it won’t help.” Patients often sought support from people who also have IBD or other autoimmune diseases:

> *I just went online finding people with IBD;*
>
> *I keep this close-knit circle of people with autoimmune disease.*

It was also important to participants that the video highlighted that there are many effective treatments for IBD, patients with IBD have a normal life expectancy, and other people are also going through it: “when I see another person is experiencing the same thing I feel less alone.”

Perceived Lack of Understanding From Their Surroundings

Furthermore, our participants highlighted the lack of understanding they perceived from their families, friends, and colleagues:

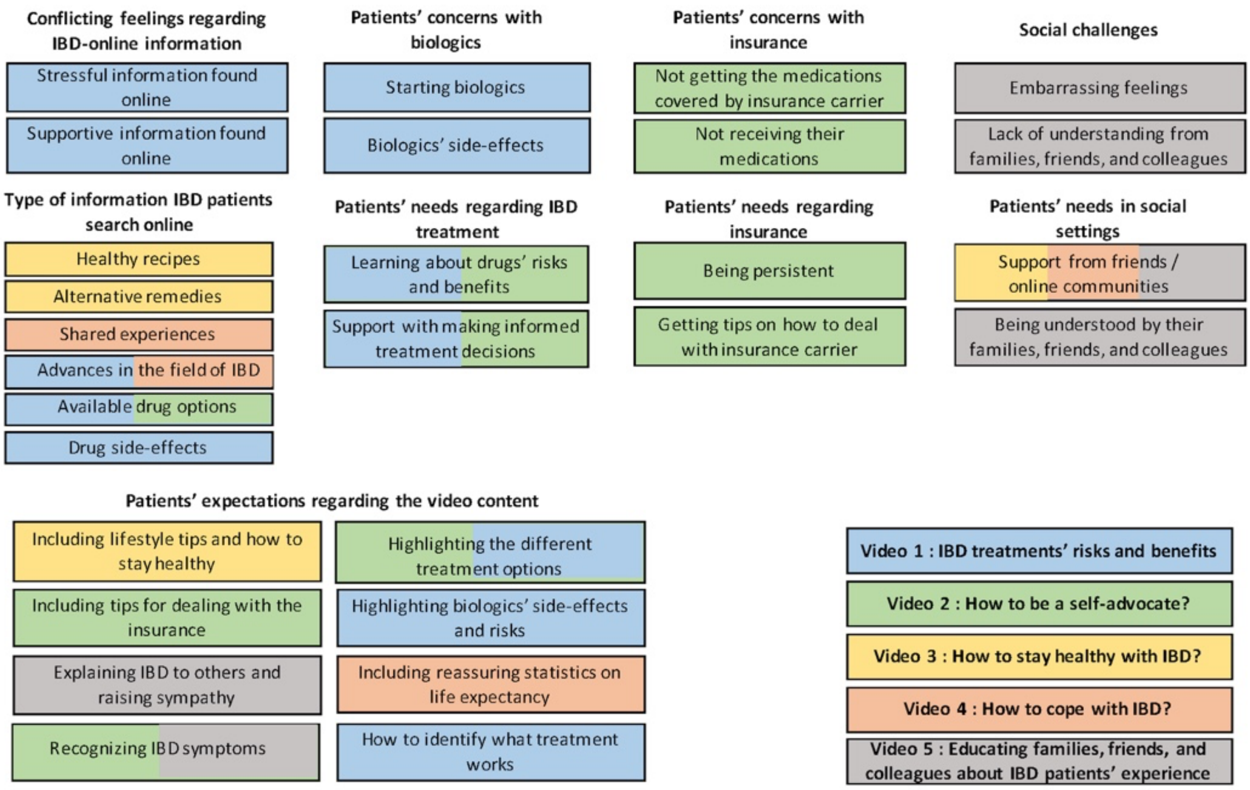
> *they really don’t understand; they think you are just not being sociable;*
>
> *because we look normal that’s the problem;*
>
> *what you see on the outside is not what’s happening on the inside.*

Therefore, they expressed the need to improve others’ understanding of what patients with IBD go through: “you can’t eat like everyone else, they don’t get it.”

Phase 2–Ideation Phase

In the ideation phase, we interpreted the data obtained in the inspiration phase to blueprint the content of the 5 educational videos. The following 5 topics emerged: (1) IBD treatments’ risks and benefits, (2) how to be a self-advocate, (3) how to stay healthy with IBD, (4) how to cope with IBD, and (5) educating families, friends, and colleagues about experiences of patients with IBD. Figure 1 shows how the themes and subthemes identified in phase 1 mapped to each video topic.

Figure 1. The emergence of 5 video topics based on the themes identified in phase 1. IBD: inflammatory bowel disease.



On the basis of these findings, 5 video scripts and character prototypes were developed, which were reviewed by 12 patients with IBD during 2 focus groups (Table 2). Overall, participants were satisfied with the 5 video scripts' content and expressed that they aligned well with their needs and experiences. However, some improvements were suggested that helped to further align the videos with patients' needs and expectations. For example, participants expressed the need to introduce biologics in a "less scary way," as "some people are scared from biologics" and to highlight that "biologics are the most effective treatment" for those with IBD. They also found it important to emphasize that patients with IBD should do their own research on the web, discuss their concerns with their provider, and be part of their treatment decision making. In addition, they insisted on reformulating specific parts of the scripts:

> *you should change from saying healthy diet to essential nutrition;*
>
> *taking care of yourself shouldn't be in there. It's more about you are not always able to control what happens to you;*
>
> *it's not an isolation that you want, it's an isolation because you are ill*

and changing the representation of a few characters:

> *I don't think that it's necessary to show the person dealing with these symptoms as being physically looking a mess.*

We then developed 5 high-fidelity video prototypes that incorporated patients' feedback.

Phase 3–Implementation Phase

In total, 10 patients with IBD (Table 2) were interviewed to obtain feedback on the high-fidelity video prototypes. We found that participants were generally satisfied with the videos (Multimedia Appendix 4). They reported that they were *informative*, *easy to understand*, *accurate*, and *helpful* and that they were aligned with their perspectives and expectations:

> *I like the part where they said to write down your symptoms;*
>
> *being persistent is a good tip;*
>
> *I like that part of it because your family, friends, and co-workers don't understand… they don't see what's going on, on the inside;*
>
> *the ending was good, them walking by the bathroom without needing to go in;*
>
> *it's very informative. It helps people to put everything in perspective from the medication point of view.*

Multimedia Appendix 4 shows specific feedback from patients on how to improve the content and format of each video. For example, participants reported the following:

> *I don't think the farting was great, there are many other symptoms;*
>
> *you should talk to friends and research online. There are communities and group meetings that can be helpful;*
>
> *adding hobbies that are fulfilling emotionally… painting, music;*
>
> *emphasizing that it is a difficult disease but that you are not alone;*

> *There are probably non scary ways to show that biologics are injections without like showing needles too.*

Their feedback was taken into consideration and integrated into the final products (see Multimedia Appendix 5 for the final videos [19-23]).

Discussion

We used a human-centered qualitative approach to gain an in-depth understanding of the educational needs of patients with IBD. A series of focus groups and interviews were performed with patients, which informed the iterative development of 5 educational videos optimized for dissemination through social media. First, we explored the patients' needs and expectations, which informed the development of low-fidelity video prototypes. We then obtained the patients' feedback and recommendations on these prototypes before developing a set of high-fidelity video prototypes. Finally, we further improved the high-fidelity video prototypes by considering the patients' specific suggestions for improvements before releasing the final videos. Throughout each of the phases, the data analysis indicated that the 5 videos were aligned with the patients' needs and expectations. We believe this model can be used to develop other types of patient educational materials, both in IBD and beyond.

In line with previous work, we found that patients have conflicting thoughts about the information on the web and are unsure about the quality of such information [9]. Our data revealed the need to develop and disseminate information from authoritative groups on IBD medical treatment options, the role of diet and nutrition in IBD, how to cope with IBD, how to navigate insurance coverage, and self-advocacy; these are in line with the needs identified previously [7]. Additionally, we identified the need to educate patients' family, friends, and colleagues, as patients often experience lack of empathy and understanding from their surroundings.

IBD is associated with an increased prevalence of anxiety and depression and feelings of loss of control and social isolation [24,25]. Previous work has shown that medical education and self-management training can decrease disease-related worries and concerns and help patients develop better coping mechanisms [25]. This emphasizes the need to develop educational materials that not only help patients understand their disease but also provide support on how to make informed decisions, develop adaptive coping strategies, and be an effective self-advocate. In addition, good nutrition is important in IBD, as it is estimated that the prevalence of malnutrition is between 16 and 36% in the general IBD population [26,27] and up to 60% in patients with moderate or severe disease [28]. In addition, 76% of the patients with IBD reported that they avoid certain types of food, and 88% believed that nutritional guidance from a health care professional would be beneficial [26]. However, many health care providers report knowledge gaps related to nutrition in IBD [29]. Similarly, although regular exercise is associated with decreased fatigue, improved mental health, and improved quality of life in IBD [30-32], 79% of the patients reported avoiding exercise because of their IBD [29]. Although improving awareness of the importance of nutrition and exercise through the development of educational videos is a first step to address these gaps, more work is warranted to fully understand how to provide patients and providers with the tools they need to eat healthy and stay active.

This study's main strength is the rigor of the qualitative methodology and the implementation of a design-thinking mindset that guided the development of educational materials. Using a structured design-thinking approach that includes a thorough assessment of human needs, idea generation in brainstorming sessions, prototyping, and testing is fundamental in developing interventions that are feasible, successful, and aligned with users' needs. Compared with previous studies, our study used a more thorough design-thinking methodology. The rigor of the approach allowed us to build empathy, which was crucial to develop an in-depth understanding of the target population and allowed us to develop educational materials that aligned well with the needs of patients with IBD, as evidenced by the feedback we collected in patient interviews. As for our data collection, 3 team members were present during each of the focus groups, and notes were compared after each session to ensure credibility and reduce the influence of researcher bias on the results. Although qualitative data analysis was performed by only 1 of the researchers, data summaries were presented to all research team members to discuss different perspectives on the insights obtained. Peer debriefing also helped to strengthen the data and improve the quality of the findings. We also obtained iterative feedback from patients throughout the 3 phases, which increased the credibility of our interpretations.

Nevertheless, our study has some limitations. Although our focus group sample was diverse in terms of race, gender, age, diagnosis, and disease duration, focus group participants lacked diversity in terms of education and literacy levels, and many people in our sample used biologics. However, we specifically sought out these missing perspectives in the individual patient interviews, as a key goal of qualitative research is to obtain views from diverse types of patients. Finally, we could not address a key challenge reported by patients: insurance coverage and access to care. In 2018, 8.5% of the US population was uninsured [33], but even with insurance coverage, biologics are frequently denied coverage, and delays are common [34]. Indeed, insurance policies are often not aligned with current IBD guidelines [35]. Although we encourage patients to be proactive about insurance coverage in the educational videos, this is a challenge that can only be addressed by major reforms of the health care system.

Conclusions

In summary, we used design-thinking methodology to develop 5 IBD-related educational videos for dissemination through social media. This approach led to deep insights and understanding of the unmet educational needs of patients with IBD, which informed the creation of relevant and useful educational materials. This model may be adopted for developing other educational materials in IBD and beyond. Future research will test the impact of educational videos on (1) people's ability to understand what patients with IBD think and feel and (2) patients' confidence in self-managing their

IBD. The videos will be freely available and will be broadly disseminated on social media using a targeted approach to reach patients with IBD and their family members and friends.

Acknowledgments

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Authors' Contributions

The first two authors (CK and WD) contributed equally.

Conflicts of Interest

BS is on the advisory board of Takeda Pharmaceuticals USA, Inc. The remaining authors declare no conflicts of interest.

Multimedia Appendix 1
The study design, based on IDEO’s design-thinking model.
[DOCX File , 113 KB - mededu_v6i2e21639_app1.docx]

Multimedia Appendix 2
Sampling for focus groups and interviews.
[DOCX File , 16 KB - mededu_v6i2e21639_app2.docx]

Multimedia Appendix 3
Interview guides for phases 1-3.
[DOCX File , 16 KB - mededu_v6i2e21639_app3.docx]

Multimedia Appendix 4
Patients’ satisfaction and suggestions regarding the content of the video.
[DOCX File , 140 KB - mededu_v6i2e21639_app4.docx]

Multimedia Appendix 5
The five videos.
[DOCX File , 13 KB - mededu_v6i2e21639_app5.docx]

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Abbreviations

IBD: inflammatory bowel disease

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Original Paper

Design and Printing of a Low-Cost 3D-Printed Nasal Osteotomy Training Model: Development and Feasibility Study

Michelle Ho[1], BSE; Jared Goldfarb[2], MD; Roxana Moayer[2], MD, MA; Uche Nwagu[2], BS; Rohan Ganti[2], MS, MPH; Howard Krein[2], MD, PhD; Ryan Heffelfinger[2], MD; Morgan Leigh Hutchinson[1], MD

[1]Health Design Lab, Thomas Jefferson University, Philadelphia, PA, United States

[2]Department of Otolaryngology, Thomas Jefferson University, Philadelphia, PA, United States

Corresponding Author:
Michelle Ho, BSE
Health Design Lab
Thomas Jefferson University
925 Chestnut St
Basement Vault
Philadelphia, PA, 19107
United States
Phone: 1 215 503 5822
Email: michelle.ho@jefferson.edu

Abstract

Background: Nasal osteotomy is a commonly performed procedure during rhinoplasty for both functional and cosmetic reasons. Teaching and learning this procedure proves difficult due to the reliance on nuanced tactile feedback. For surgical simulation, trainees are traditionally limited to cadaveric bones, which can be costly and difficult to obtain.

Objective: This study aimed to design and print a low-cost midface model for nasal osteotomy simulation.

Methods: A 3D reconstruction of the midface was modified using the free open-source design software Meshmixer (Autodesk Inc). The pyriform aperture was smoothed, and support rods were added to hold the fragments generated from the simulation in place. Several models with various infill densities were printed using a desktop 3D printer to determine which model best mimicked human facial bone.

Results: A midface simulation set was designed using a desktop 3D printer, polylactic acid filament, and easily accessible tools. A nasal osteotomy procedure was successfully simulated using the model.

Conclusions: 3D printing is a low-cost, accessible technology that can be used to create simulation models. With growing restrictions on trainee duty hours, the simulation set can be used by programs to augment surgical training.

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KEYWORDS

3D printing; nasal osteotomy; simulation; education; low-cost

Introduction

Background

The use of simulation is increasing in postgraduate medical education. Driving this change is the need to expose residents to procedures within the confines of resident duty hours and attention to patient safety. The benefits of simulation have been reported widely in the literature. Systematic reviews and meta-analyses have reported that simulation training is associated with positive outcomes, such as knowledge and procedural skills [1,2].

Traditionally, cadaveric bones are used by surgical residents for simulation to learn about anatomy and surgical techniques. Benefits of cadaveric bones include high fidelity to in vivo anatomy and opportunity for simulation with tactile feedback. Drawbacks, however, include limited supply, high cost, and lack of pathology [3]. The use of virtual reality (VR) simulators is also growing. In their review of VR training in laparoscopic surgery, Alaker et al [4] suggested that VR in combination with haptic feedback is the most effective way to deliver VR training. Similar to cadaveric models, however, high cost of acquisition can be a barrier to utilizing VR [5].

Within medicine, advances in technology and affordability have expanded the use of 3D models. This technology utilizes postprocessing of computed tomography (CT) and magnetic resonance imaging (MRI) data coupled with 3D printers to create unique models that are used for patient education, presurgical planning, and trainee education. Due to the complexity of procedures and similarity of bones to 3D printing material, facial plastics and otolaryngology simulators have been widely explored. VanKoevering and Malloy [6] reported a variety of simulators, including auricular reconstruction, endoscopic endonasal skull base drilling, and laryngeal simulators. Previously, Zabaneh et al [7] reported the design and fabrication of a training model for rhinoplasty simulation. This model used various molds to simulate tissue and skin layers and was printed in acrylonitrile butadiene styrene (ABS) on an inkjet 3D printer, significantly increasing the cost and accessibility of the model.

Rhinoplasty is among the most commonly performed facial plastic procedures in the United States and one of the most challenging [8,9]. During a rhinoplasty, nasal osteotomies—which involve applying high force energy to cut into a bone using osteotomes—may be performed to straighten the nasal vault to improve cosmesis and correct nasal obstruction. In a rhinoplasty procedure, nasal bone osteotomy is a particularly challenging and potentially dangerous maneuver [8]. The procedure relies largely on tactile feedback rather than direct visualization; therefore, this procedure is difficult to teach and learn.

Objective

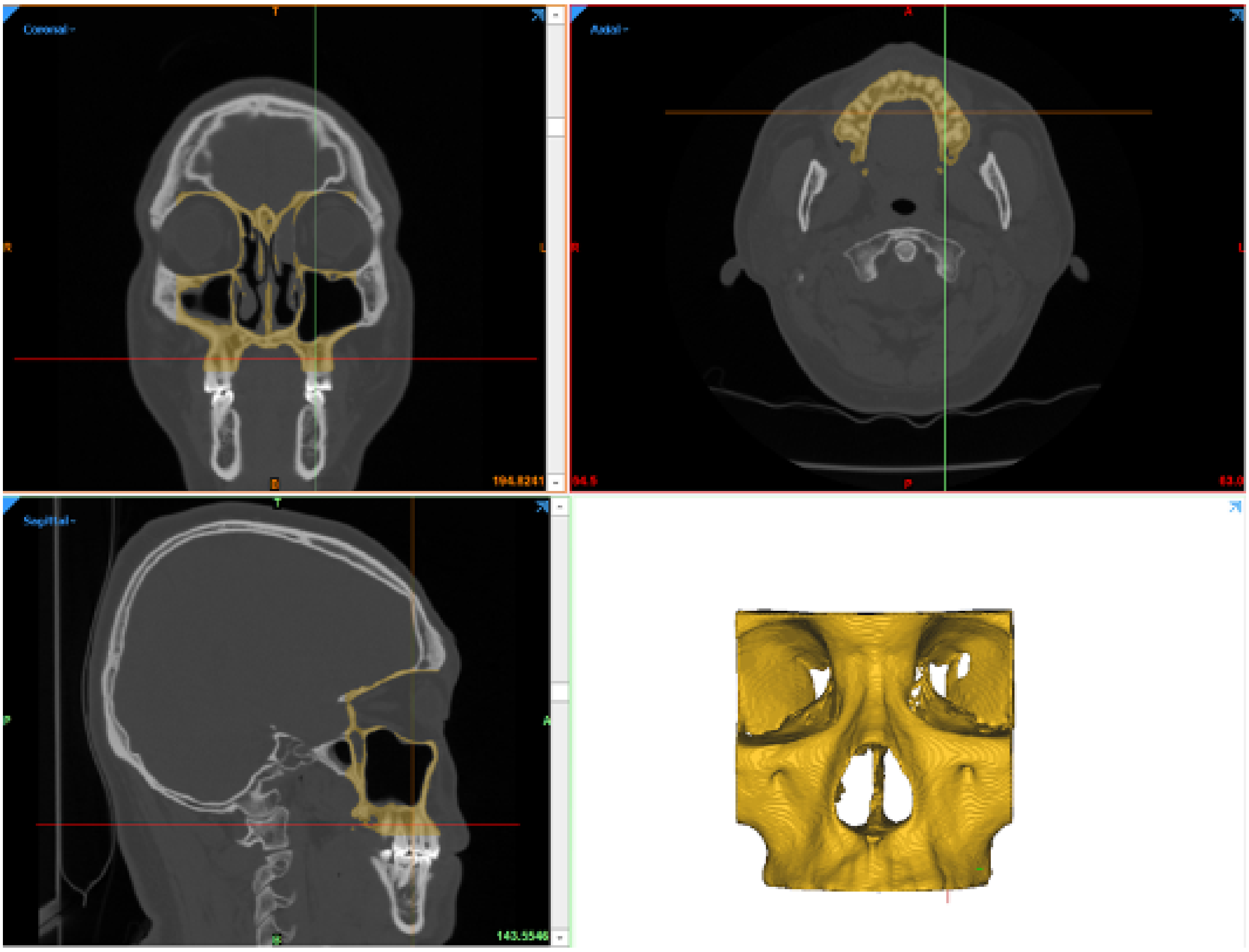
The objective of this study was to develop an accessible, low-cost 3D training model for nasal osteotomy.

Methods

Image Segmentation

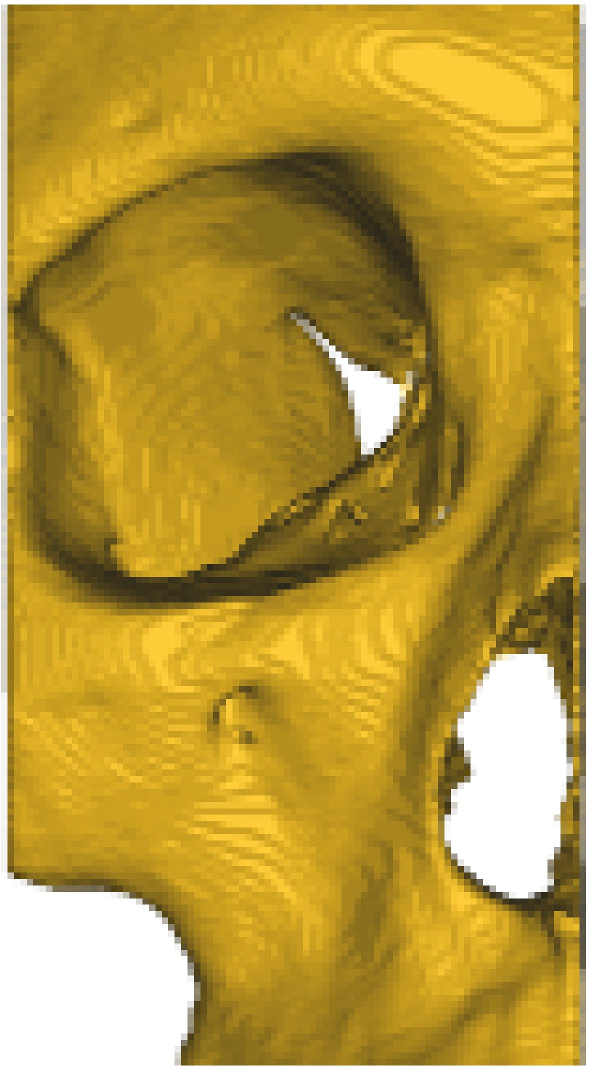
Routine diagnostic CT imaging was obtained from patients undergoing treatment of head and neck malignancy under a protocol approved by the institutional review board at Thomas Jefferson University. Original image data, in the file format of digital imaging and communications in medicine (DICOM), were reviewed by otolaryngologists to identify the presence of suitable anatomic features, regions of interest, and absence of dental artifacts. Imaging was performed using a LightSpeed Pro(16) CT scanner (GE Medical Systems) at 0.625 mm. The DICOM image data were subsequently deidentified and imported into processing software (Mimics Innovation Suite, Materialise NV). The data were processed to reduce image noise, and thresholding was used to isolate the midface (Figure 1).

Figure 1. Thresholding and segmentation of midface.



The software was then used to create a 3D reconstruction of the midface. Using the cropping tool, the midface was then split at the middle of the nasal septum (Figure 2). After segmentation and cropping, the model was exported as a surface tessellation language (STL) file.

Figure 2. Cropping of midface.



Design

The STL file was imported into the open-source software Meshmixer (Autodesk Inc) for postprocessing, design, and repair of mesh surface for printability. Using the sculpt brush tools, the nasal pyriform aperture was smoothed (Figure 3).

Additionally, internal bones from the frontal and sphenoid bones (that were not adjacent to the nasal prominence) were removed. The smoothed model was then mirrored to create a symmetrical midface model (Figure 4).

Bilateral support rods (3 mm diameter) extending from the base of the nasal spine to the deep aspect of the nasal bones were added to the model to mimic the support normally provided by soft tissue during a nasal osteotomy (Figure 5).

Figure 3. Anterior view of midface before and after smoothing of nasal prominence.

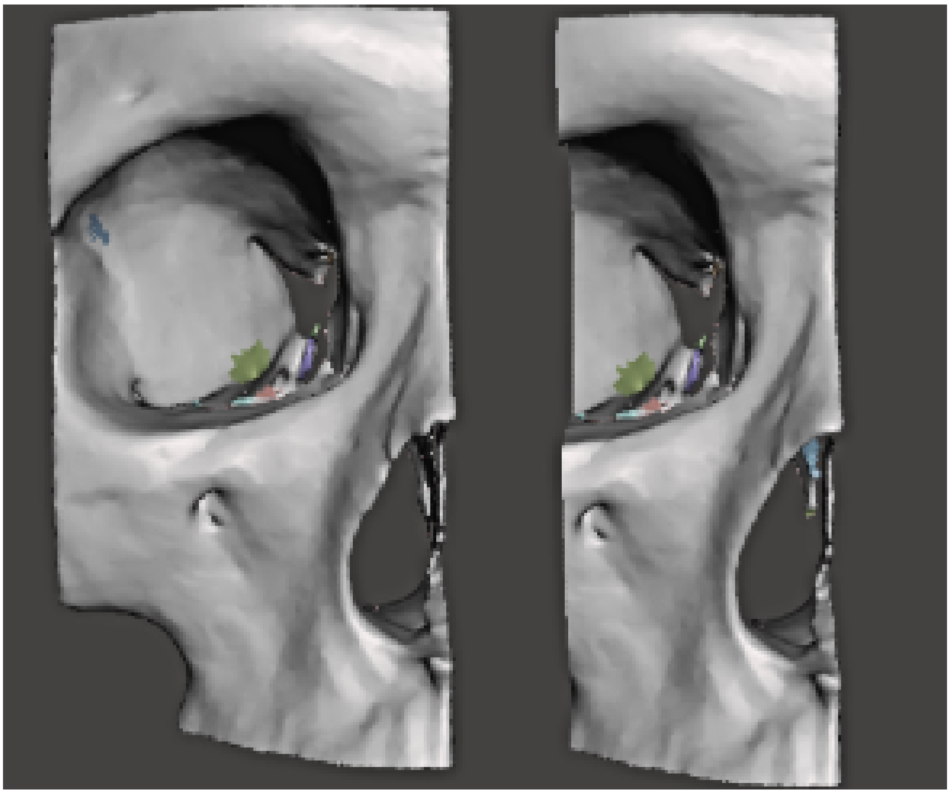


Figure 4. Original (yellow) and mirrored (silver) midface model.

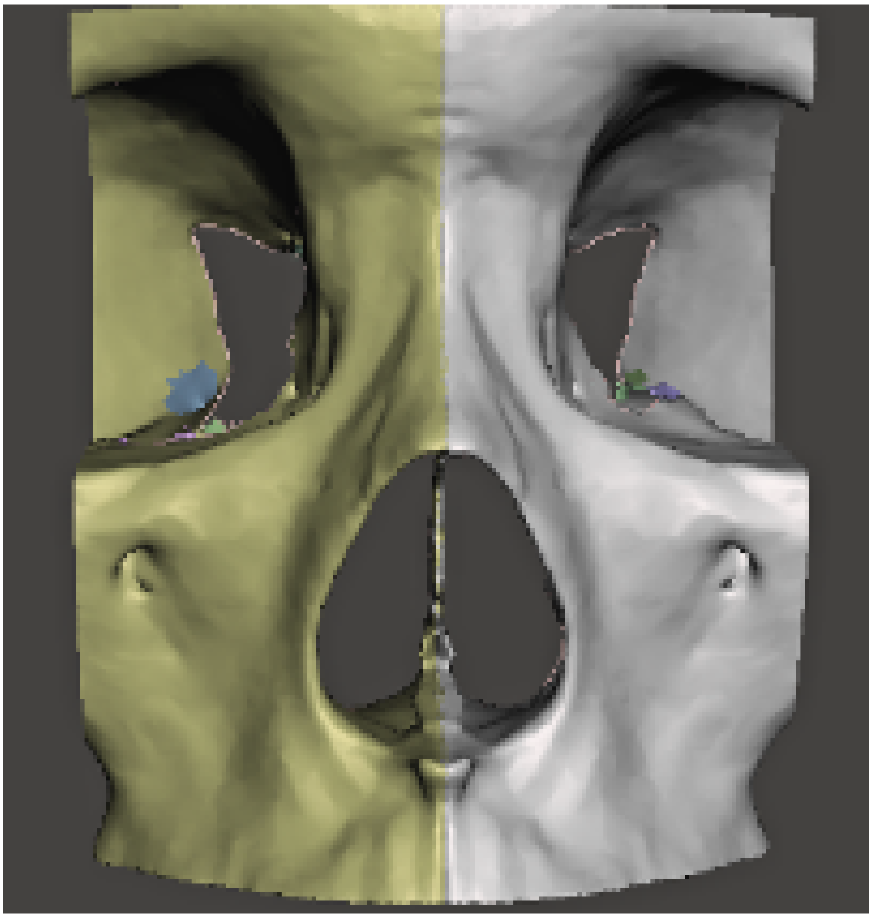
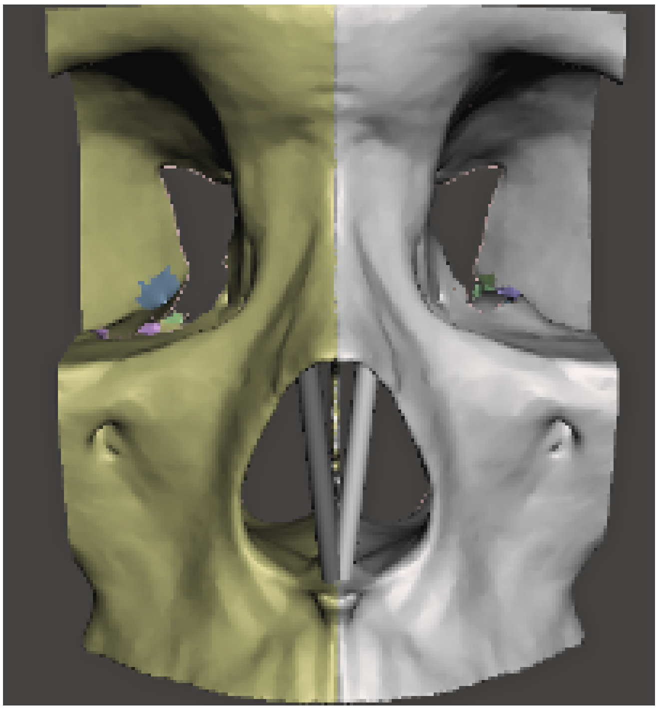


Figure 5. Addition of bilateral support rods.



Printing

The STL file of the midface model was uploaded to Ultimaker Cura (Ultimaker), an open-source 3D printer slicing application, for preprinting, processing, and generation of a UFP file. The following parameters were set in the Ultimaker Cura application: 0.4 mm printer nozzle and layer height of 0.04 mm. Models were printed with one of the following infill densities: 5%, 10%, 15%, 20%, 50%, and 80%. All models were printed using fused deposition modeling (FDM) on an Ultimaker S5 3D printer (Ultimaker) with polylactic acid (PLA) filament and polyvinyl acetate (PVA) filament for supports.

Assembly

To mimic the skin surface, a training tattoo skin mask was cut and placed over the midface model. The mask was secured to the model using Velcro ties. The model was held in place using a 12-inch bar clamp (Figure 6).

Figure 6. Simulation set with tools, model, and accessories.

Results

Printing the Model

A total of 6 models with different infill densities were printed. Each model used approximately 55 g of PLA filament and 54 g of PVA filament. The total printing time was approximately 18 hours for each model. After printing, each model was submerged in tap water until the PVA support material was completely dissolved (approximately 12 hours). Total cost for 1 simulation set was approximately US $37.49 (PLA filament: US $3.85, PVA filament: US $8.10, mask: US $8.99, and bar clamp: US $16.55) [10,11].

Evaluation of Models

The model was evaluated by 2 attending facial plastic surgeons and 1 facial plastic surgery fellow to determine its accuracy in simulating human facial bones. The evaluators used osteotomes and hammers to simulate a nasal osteotomy procedure (Figure 7). All evaluators “strongly agreed” that the model with 10% infill density mimicked human bone better than the models with other infill densities.

Figure 7. Use of simulation set.

Discussion

Principal Findings

To our knowledge, this is the first reported nasal model for rhinoplasty simulation that is printed on a desktop 3D printer. Osteotomies are considered by many to be a complex surgical technique. As a result, residents and other trainees often have limited opportunities to perform the technique intraoperatively. In this study, our objective was to develop a low-cost, accessible model for trainees to simulate nasal osteotomies.

3D printing is an innovative technology that allows for rapid prototyping of ideas. Moreover, a variety of materials can be printed in different colors, densities, and specifications to simulate an anatomical equivalent. In this study, we used FDM technology and a dual extruder 3D printer. Among 3D printing technology, FDM is the most widespread technique, and it is also cost-effective [12]. PLA was chosen for the model, as it is one of the most popular materials for 3D printing and is biocompatible, nontoxic, and biodegradable [13]. Use of support material was necessary to print overhangs, intricate details, and internal cavities (within and surrounding the nasal cavity) that would otherwise be impossible to print due to gravity. PVA was chosen over other support materials, as it completely dissolves away when submerged in water and leaves behind a smooth surface.

The cost per simulation model was US $11.95, and the simulation accessories cost US $25.54. The model was printed using a desktop dual extruder FDM 3D printer. This type of printer is available at prices starting at US $600. Thus, compared to existing resources, this simulation model is low-cost and accessible, especially for residency training programs that already have access to 3D printing machines.

Limitations

The 3D-printed midface model was used for surgical simulation and education for otolaryngology residents. However, a few limitations were noted during the production and use of this model. As no objective tool exists to evaluate the fidelity of 3D-printed models for surgical simulation, the team relied on the expertise and experience of facial plastic surgeons to determine which model provided the best simulation experience. During simulation, some users noted that the model appeared to delaminate between the printed layers instead of in the direction of force. Finally, since this model uses forceps to hold the model in place, at least 3 people are needed for each simulation. However, given the limited number of available surgical tool sets, working in groups did not increase the simulation time. Additionally, group members were able to observe and provide feedback to each other.

Future Direction

Given the rapid advancement of technology in 3D printing, many potential improvements can be made in the model described in this study. In this iteration, the study team focused on determining the infill density that would most closely mimic facial bones. In future studies, other parameters, such as layer height and shell thickness, can be assessed. Blinded comparison will also be used to evaluate the 3D-printed models against other types of simulation models. Finally, in this study, we utilized FDM technology to print our model. In the future, we plan to print our model using different technologies, such as stereolithography (SLA) and material jetting 3D printers, and assess their fidelity to facial bone. In contrast to FDM printing, SLA and material jetting technology use ultraviolet radiation to cure resins into 3D models. SLA printers use an open pool of liquid resin to print models, while material jetting printers use a print head to deposit liquid resin onto a built platform. Additionally, SLA and material jetting 3D printers can print thinner layers (up to 25 microns and 16 microns, respectively) compared to FDM printing. These qualities may allow the models to more closely mimic facial bones.

Conclusion

In this study, we demonstrated the feasibility of designing and printing a midface model for simulation of medial and lateral osteotomy for rhinoplasty surgery. For residency training programs with access to a 3D printer, this low-cost model can be used for surgical education and simulation.

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Conflicts of Interest

None declared.

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Abbreviations

ABS: acrylonitrile butadiene styrene
CT: computed tomography
DICOM: digital imaging and communications in medicine
FDM: fused deposition modeling
MRI: magnetic resonance imaging
PLA: polylactic acid

PVA: polyvinyl acetate
SLA: stereolithography
STL: surface tessellation language
VR: virtual reality

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Original Paper

Development and Implementation of a Web-Based Learning Environment for an Inpatient Internal Medicine Team: Questionnaire Study

Thaddeus Y Carson[1], MD, FACP; Christos Hatzigeorgiou[1], MPH, DO, FACP; Tasha R Wyatt[1], PhD; Sarah Egan[1], MS; Sary O Beidas[2], MD, FACP

[1]Augusta University, Augusta, GA, United States

[2]Sarasota Memorial Health Care System, Sarasota, FL, United States

Corresponding Author:
Thaddeus Y Carson, MD, FACP
Augusta University
1120 15th St
Augusta, GA, 30912
United States
Phone: 1 7067214078
Email: ThCarson@augusta.edu

Abstract

Background: The notion of anytime, anyplace communication is characteristic of the current generation of learners. Such communications have facilitated the growth and integration of a blended or hybrid learning platform in multiple educational settings. However, there are limited reports on the use of an anytime, anyplace communication platform in clinical inpatient medical education.

Objective: The setting of a high-demand inpatient clinical rotation is ideal for the use of collaborative software, and this integration is expected to positively influence medical education. The purpose of this study is to evaluate medical students' and residents' educational experiences with incorporating a simple, web-based content management and file sharing platform into an internal medicine inpatient rotation.

Methods: During an inpatient internal medicine rotation, faculty and learners jointly used collaborative software for educational purposes, and a postrotation survey tool was used to measure the educational influence of the software.

Results: Based on the results of the postrotation survey, the integration of a collaborative software application during clinical rotations improved the learning experience. Learning climate, the communication of rotation goals, and self-directed learning all scored favorably, but feedback from the survey participants was mixed. The learners enthusiastically accepted the practical use of this tool for both communication and information sharing.

Conclusions: This generation of learners is accustomed to frequent electronic communication. Based on our survey, these learners appear to be highly receptive to this web-based intervention design for improving clinical education during active patient care. Adding effective blended learning features to a traditional clinical setting is achievable.

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KEYWORDS

inpatient internal medicine; academic hospitalist; medical education; blended learning environment; social media; online education; internal medicine ward; internal medicine education

Introduction

Bedside teaching is a fundamental component of medical training in the United States [1]. At the bedside, attending physicians are able to model clinical skills related to effective patient communication, clinical reasoning, and professional behavior. Although recent studies have indicated that bedside teaching may be on the decline [2,3] due to limitations with physicians' time [4], this form of teaching remains an important part of medical training. Furthermore, although studies have investigated care providers' perspectives on bedside teaching [5], learners' perspectives are not often taken into account [6].

It is known that learners desire great flexibility in learning the critical skills, attitudes, and behaviors expected of physicians [1], in part because the notion of anytime, anyplace web-based communication is an expectation of the current generation of learners. Web-based communication allows team members to communicate in ways that are not always possible due to busy clinical schedules. Although the incorporation of such web-based spaces into in-service rounds appears to be a feasible solution for augmenting the inpatient teaching and learning environment, the integration of web-based spaces into clinical rotations is not well reported in the literature [1].

The purpose of this study is to evaluate medical students' and residents' educational experiences with incorporating a simple, web-based content management and file sharing platform into an internal medicine inpatient rotation. We hypothesized that by incorporating a web-based content management and file sharing platform into the rotation, learners would be better oriented to the expectations in the rotation, communication among team members would be streamlined, and learners would take more ownership over their educational processes.

Methods

Augusta University [7] uses multiple learning systems to manage content and resources for different groups of learners. The use of several learning management systems ensures that no system is able to combine learners into a single clinical team or group. In an effort to overcome this challenge and improve the learning environment of the inpatient internal medicine ward teams, the authors integrated the institution's software, Box, into internal medicine inpatient rotations.

Box is a cloud-based content management and file sharing service for businesses, and it is used by many medical schools for file sharing [8]. Several other platforms were initially considered, including the institution's Learning Management System, Desire to Learn, a Share-Point site, and a departmental hard drive. However, the limitations of Desire to Learn were well recognized in the institution, largely because it was treated as a repository of content that was highly cumbersome for learners and not user-friendly. Additionally, the Share-Point site and institutional hard drive could not address issues related to the timely enrolling and unenrolling of learners, as these processes were managed at a departmental level.

The best option appeared to be Box, because it provided a means to share updated content and resources in an asynchronous learning environment within a group of invited users. It also afforded the opportunity for educators to manage various learner groups and provided institutional and user protection for protected health information. At the beginning of each rotation, all team members, including attending physicians, residents, interns, pharmacists, and third-year and fourth-year medical students, were enrolled into the Box folder. This study was designed to evaluate the strengths and weaknesses of this platform based on the perspectives of learners who participated in the rotation. These data were obtained using a qualitative survey questionnaire.

On the first day of the rotation, students and residents were oriented to the features of Box, including the creation of folders to share resources with others on the ward team. Learners were also oriented to the attending physicians' specific expectations for the rotation. Learners were instructed on where to store their presentations and where to find handouts for various disease and treatment processes that the attending physicians developed. Figure 1 and Figure 2 show the Box folders from the first day of the rotation. Other folders included a place for sharing patient information, such as interesting physical exam findings. This feature was useful for capturing important information when the time for bedside teaching was attenuated.

Learners were also oriented to the "Box notes" feature, which was used to communicate personalized feedback. The physicians created individual notes for each student and provided students with formative feedback on their presentations and patient write-ups. Learners were also oriented to the ability to leave "comments" in Box. This feature was used to create ongoing discussions on a particular topic, such as learners' patient observations and evidence provided in uploaded journal articles or discussions on why medications were changed, in an asynchronous environment. These discussions could then be accessed by the team on their own time.

To evaluate learners' perceptions on the efficacy and utility of Box, a short 15-item survey was created. This survey asked about learners' experiences with using the web-based space provided by Box for collaboration. Items were written to assess learner attitudes toward Box, the use of Box as a learning platform, and the influence that Box has on the learning climate. The items also asked about whether Box assisted learners with understanding rotation expectations, promoted learner feedback, and encouraged self-directed learning. At the end of the survey, an open-response space was provided for additional comments.

The survey was electronically distributed to 67 students and residents via Qualtrics [9] at the end of 13 clinical rotations. Of the 67 surveys sent out, 44 were completed, providing a 66% response rate for survey completion. Data were then analyzed using descriptive statistics. A conventional content analysis was performed to categorize open-text responses into related comment groups [10]. Conventional content analyses are useful for when researchers are only interested in gaining an overall view of the present themes in textual data instead of applying a conceptual or theoretical framework to the study.

Figure 1. Screenshot of a Box folder from the first day of rotation. This screenshot displays the content that can be found in the "Red Med Jan 2018" section. Each Box note can only be accessed by the attending physician and the individual learner for private feedback and discussion.

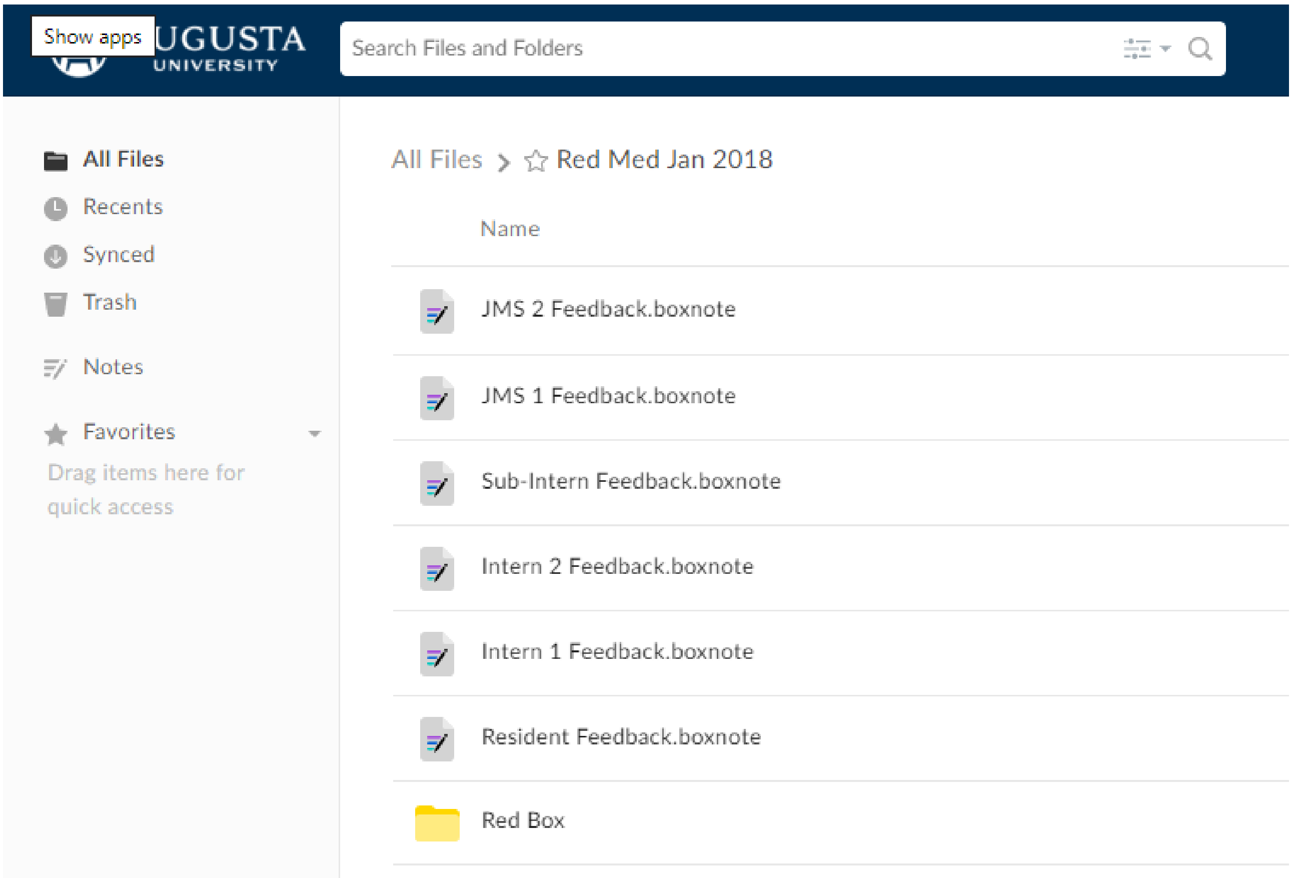
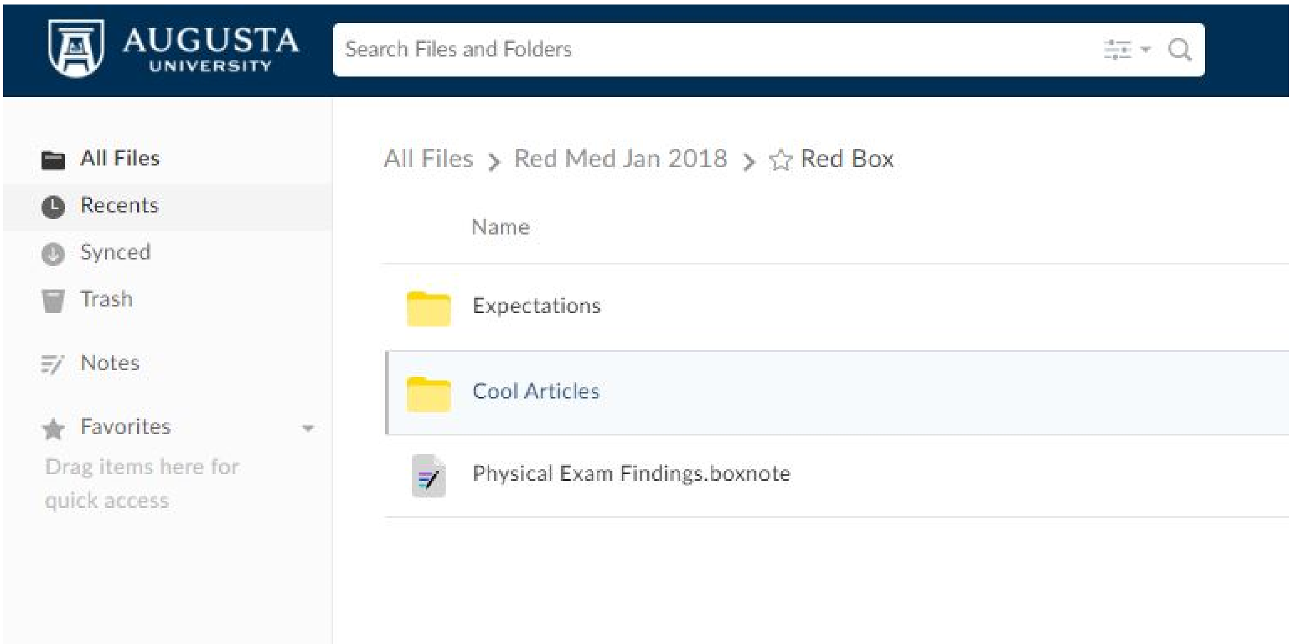


Figure 2. Screenshot of a Box folder from the first day of rotation. This screenshot displays the content of the "Red Box" section and is accessible to all learners.

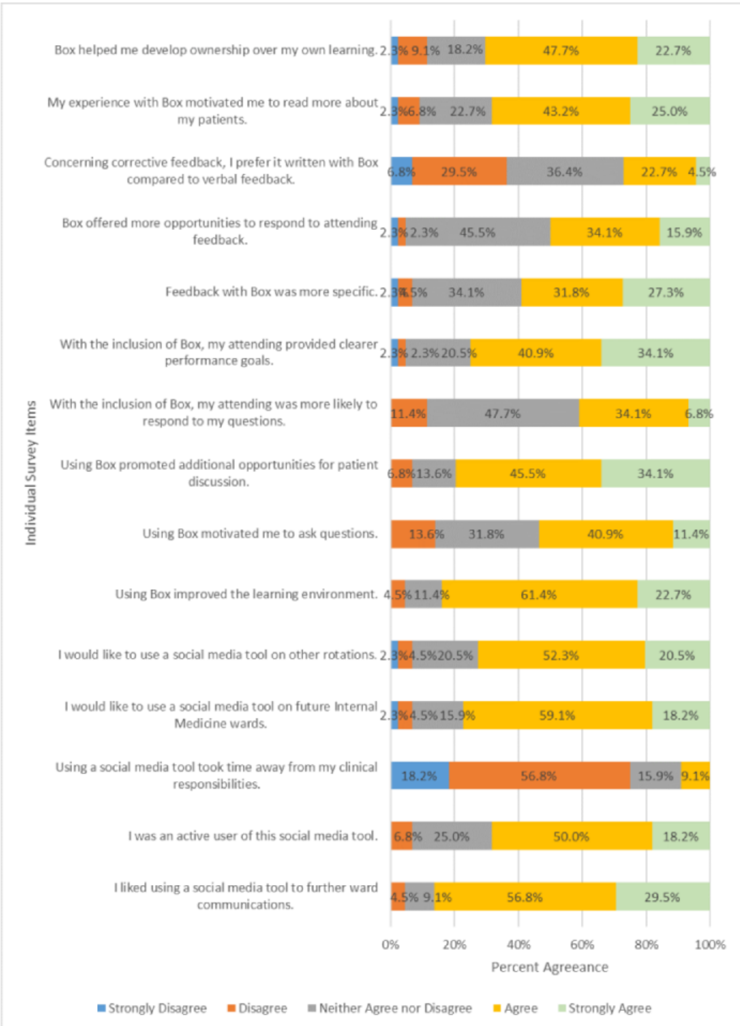


Results

Of the 44 participants who completed the study, 19 (43%) indicated that they were medical students, 12 (27%) indicated that they were residents, and 13 (30%) did not provide their role. There was no statistical difference between the number of medical students and residents across the different clinical groups across the following 4 subscales: the use of the tool (*P*=.31), the learning environment (*P*=.91), feedback (*P*=.91), and self-directed learning (*P*=.70). Overall, learners rated the use of Box within the internal medicine rotation with favorable responses for the following domains: attitudes toward the tool, the improvement of the learning environment, understanding expectations, receiving feedback, and self-directed learning (Figure 3).

The end-of-survey comments indicated that students and residents found the cloud-based collaborative tool useful for creating a web-based community and sharing resources with the team. The following is a comment from a student that represents the perspectives that were shared in the open-text response area: “This is an effective and more efficient means for feedback and focused education through group discussion and readings. All Internal Medicine rotations should use this tool.” However, some comments indicated that participants had the desire for even more feedback on presentations, such as the following: “Would have appreciated [more] feedback on presentations posted to the Box; good resource for team unity.” Surprisingly, there was only 1 negative comment made by a resident, who suggested that the use of Box could become an expectation and would add to residents’ growing areas of responsibility. The resident stated, “I would like to have to Box available as a resource, but there is a risk that there will be an unwritten expectation to keep up to date with the material placed in the Box. I believe this social site would best function in the background of the team and not in the center of the team.”

Figure 3. Postexperience survey tool responses.



Discussion

Based on the postrotation survey, the integration of a collaborative software application during a clinical rotation improved the learning experience. Learning climate (n=37, 84% agreeance), the communication of goals (n=33, 75% agreeance), and self-directed learning (n=31, 71% agreeance) all scored favorably, but feedback from the survey participants was mixed. The learners accepted the practical use (n=38, 86% agreeance) and feasibility (n=30, 68% agreeance) of this communication tool, and the supplemental process of information sharing (n=35, 80% agreeance). The mixed feelings in participant feedback could be explained by learners not understanding the intended meaning behind providing feedback in this context. Learners may have also believed that feedback needs to be delivered face-to-face [11].

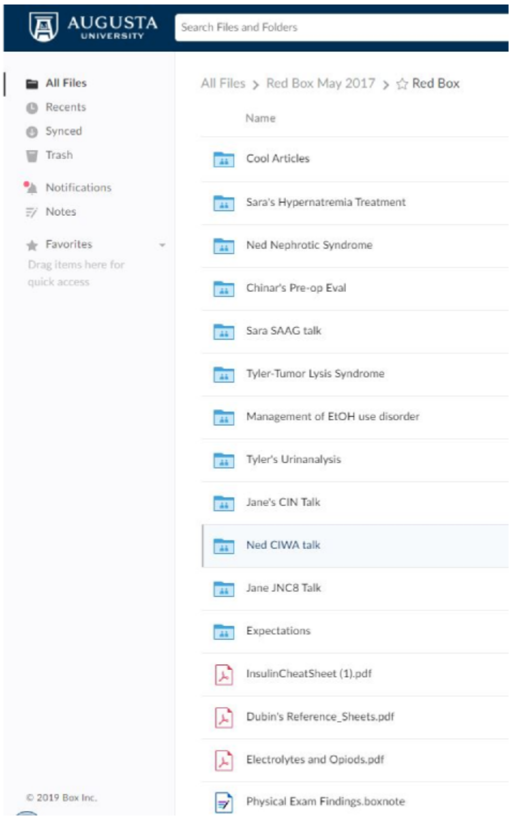
To our knowledge, this is the first study to examine the value of using a software application to supplement and enhance the learning environment during clinical inpatient rotations. Published literature that describes the use of collaborative applications in nonclinical education, such as wikis and other web-based applications in medical education, are abundant [12]. However, using these tools in clinical rotations to complement the face-to-face learning and administrative functions of a clinical team has not been studied before [1,13,14].

In this study, we emphasize the importance of using real patients that learners are connected and currently engaged with while providing medical care. This approach differs from other learning platforms that use simulated or virtual patients [1]. We were also able to capture salient learning events and documentation on learning activities within the team. Due to the constraints of resident availability (eg, days off, patient admissions, or other obligations), learners were able to access the application at their own convenience and participate in a myriad of ways, including posting discussions, engaging in reading related to patients, receiving feedback, and reflecting on their clinical performance. Figure 4 shows an example of what the Box folder looks like at the end of a rotation. We believe that by using Box, we were able to simplify the rotation environment and address what researchers refer to as “opening the black box” of the dissonance between what learners need and what educators deliver [15].

Overall, we believe that this generation of learners expect electronic communication. Based on our survey, these learners seemed to be highly receptive to this web-based intervention as a means of improving clinical education during active patient care. Additionally, we discovered that by referencing the Box entries, we were able to enrich the learners’ final evaluations with objective data for their formal evaluation and provide substantive comments for learners’ next steps. Future studies should focus on assessment strategies for capturing learner gains in terms of knowledge, skills, attitudes and behaviors.

We acknowledge that this study has several limitations. First, the survey was developed by the study team and was not assessed for validity evidence [16]. Future studies should consider collecting data to examine the survey for content, criterion, and construct validity. Second, response bias [17] from participants may have influenced participant responses. However, this would be challenging to assess unless the study was carried out with a different team that did not attend to respondents.

Figure 4. Screenshot that shows an example of what the Box folder looks like at the end of a rotation.



Conflicts of Interest

None declared.

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Original Paper

Medical Student Utilization of a Novel Web-Based Platform (Psy-Q) for Question-Based Learning in Psychiatry: Pilot Questionnaire Study

John Torous[1], MD; Zev Nakamura[2], MD; Jordan Rosen[3], MD; Pochu Ho[3], MD; Christine Pelic[4], MD; Larkin Elderon Kao[5,6], MD; David Kasick[7], MD; Joseph Witowsky[1], MSc; Fremonta Meyer[8], MD

[1]Beth Israel Deaconess Medical Center, Boston, MA, United States
[2]University of North Carolina, Chapel Hill, NC, United States
[3]Yale School of Medicine, New Haven, CT, United States
[4]Ralph H Johnson Veterans Administration Medical Center, Charleston, SC, United States
[5]Boston University School of Medicine, Boston, MA, United States
[6]VA Boston Healthcare System, Boston, MA, United States
[7]Ohio State University Wexner Medical Center, Columbus, OH, United States
[8]Brigham & Women's Hospital, Boston, MA, United States

Corresponding Author:
John Torous, MD
Beth Israel Deaconess Medical Center
330 Brookline Avenue
Boston, MA, 02215
United States
Phone: 1 7143359858
Email: jtorous@bidmc.harvard.edu

Abstract

Background: Medical students are turning to new and expanding web-based resources for learning during their psychiatry clerkships; however, there have not been concomitant efforts by educators to utilize web-based tools to promote innovative teaching.

Objective: Utilizing a free learning platform (Psy-Q) created by our team, we sought to explore how digital technology may engage medical student learners, promote colearning between educators and medical students, and support sustainability of web-based platforms through crowdsourcing.

Methods: Between 2017 and 2019, seven medical schools offered access to the platform during medical students' psychiatry clerkships. Use of the web-based platform was voluntary and not monitored or related to clerkship evaluation. Medical students completed a paper and pencil assessment of the platform at the end of their clerkship. Anonymous and aggregated website use data were gathered in accordance with institutional review board approval.

Results: A total of 203 medical students across seven distinct psychiatry clerkships completed the survey. Of these students, 123 (60.6%) reported using the platform and reported accessing a mean of 45 questions. The most common device used to access the platform was a laptop and the second most common was a smartphone. The most common location to access the platform was home and the second most common was the hospital. Although few students contributed new questions, website utilization data suggested that all rated the quality and difficulty of the questions. Higher quality questions were medical students' main suggestion for further improvement.

Conclusions: Our results suggest the feasibility and potential of educator- and learner-created web-based platforms to augment psychiatry education and develop relevant accessible resources in the digital sphere. Future work should focus on measuring objective educational outcomes of question taking and writing, as well as optimizing technology and exploring sustainable trainee-faculty partnership models for the creation and curation of content.

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KEYWORDS

medical students; education; psychiatry

Introduction

Although web-based learning resources for medical student education in psychiatry offer enormous potential benefits, there persists a "digital divide" between learners and psychiatry educators. Increasingly, medical students are foregoing printed material, such as books, in favor of web-based and digital resources of more heterogeneous quality. Our team previously created a free web-based platform Psy-Q [1,2] in the hopes of bridging this digital divide and engaging both students and educators in collaborative learning with digital tools. In this follow-up report, we assessed medical student uptake and satisfaction with the platform across seven psychiatry clerkships.

There is a clear unmet need for high-quality web-based resources in psychiatry education. Survey research involving medical students rotating on psychiatry clerkships suggests that 90% want more educational smartphone apps [3] and that only a minority currently use printed material like text books or review books [4]. Increasingly, medical students are utilizing question banks [5] and are even creating their own in some instances [6]. Yet, many medical student question banks are expensive [7], and their content is often of unknown quality. Psy-Q offers a free, mobile-compatible, web-based question bank having high-quality questions, with each question requiring a reference from the medical literature and vetting by educators.

Psychiatry educators have also recently realized the potential of technology. As Hilty and DeJong aptly write in Academic Psychiatry, "the profession has to consider new applications of technology as instrumental, rather than supplemental, to practice and teaching" [8]. E-learning platforms can offer flexible tools to psychiatry educators but are most powerful when utilized for collaboration and engagement, rather than as static resources [9]. Although it can be useful for psychiatry educators to be aware of popular web-based resources [10], cocreating such resources with learners and educators may offer a more engaging and higher quality alternative. In designing the Psy-Q platform, we sought to remove technical barriers for educators to create content on a multimedia web-based platform and facilitate learning directly with their students.

Realizing the challenges faced by web-based question banks, we created the platform to foster collaboration and curation [1]. Psy-Q allows students and educators to easily submit their own questions, but all student questions must be approved by an educator who can send the question back to the student for rounds of revision. In teaching students how to write questions, the platform offers didactic benefits not present in traditional question banks. As a further quality measure, students and educators are able to rate questions so that poor-quality questions are flagged for educators to review and potentially remove.

Understanding medical students' use and perception of the Psy-Q platform is important to assess web-based resource utilization patterns and ultimately improve the quality of learner and educator collaboration. Therefore, we designed a survey to capture on what devices and in what settings medical students reported using the platform, as well as their engagement in taking and creating questions. At the time the survey was administered, the website contained approximately 170 questions collaboratively written by a combination of psychiatry trainees and faculty. We hypothesized that a majority of students would access the platform, use the platform most often on smartphone devices at home, and use the platform more for responding to questions than for writing original questions.

Methods

Medical students completing their core psychiatry clerkship were introduced to the platform via flyers or a brief orientation by a faculty member. It was strongly emphasized that use of the platform and participation in the follow-up survey were both entirely voluntary and would not impact clerkship evaluations. At the conclusion of the clerkship, an 11-item survey (Multimedia Appendix 1) was administered to the students. Institutional review board exemption was obtained by Harvard Medical School followed by all other sites.

The study was conducted at a total of seven medical schools (Harvard Medical School, University of Virginia, Yale School of Medicine, University of North Carolina, Medical University of South Carolina, Ohio State University, and Boston University School of Medicine) and eight unique psychiatry clerkships (including two separate clerkship sites within Harvard Medical School; data were pooled into a single site for the purpose of analysis by the medical school) that each collected data for 6 months between 2017 and 2019. The study authors FM, DK, CP, ZN, LK, PH, and JR were consultation-liaison psychiatry rotation directors or supervisors at seven of the eight study sites.

Analysis was conducted using descriptive statistics (frequencies or percentages). The associations between study variables were assessed using chi-square or Fisher exact tests. All data analyses were conducted with R using the *dplyr* package (version 3.5.3, R Foundation for Statistical Computing). Screenshots of the Psy-Q platform as accessed from a computer and mobile phone are shown in Figure 1.

Figure 1. Screenshots of Psy-Q on multiple platforms. Multiple platforms can be used to access Psy-Q.

Results

Overall, 203 students across seven distinct psychiatry clerkships completed the survey. Sites differed in the number of students participating in the survey, the number of students accessing the Psy-Q platform, and the average number of questions completed (Table 1).

Of 203 students, 146 (71.9%) reported utilizing mainly web-based resources for psychiatry learning during their clerkship. Additionally, of 203 students, 123 (60.6%) reported accessing the platform, with students reporting having responded to an average of 45 questions each (total of 5535). Based on anonymous website use data involving both students in the study and those using the website outside of the study at other sites, 9126 total questions were taken, suggesting that students outside of the study may have accessed and utilized the Psy-Q platform as well. Additionally, based on the anonymous website data, the mean number of questions taken across all users was 42, similar to that reported by students in the study. Although the study does not enable direct linkage of individual medical students to their web-based activity on the Psy-Q platform, the data offer a window into how the platform is utilized.

Anonymous website data indicated that users offered 735 “thumbs up” votes, 209 neutral votes, and 126 “thumbs down” votes regarding their opinions of both the questions and the subsequent answer explanations. Of 9126 questions, 6278 (68.79%) were correctly answered on the first attempt. The average user spent 34 minutes taking questions, and the most common platform for accessing the Psy-Q website was a personal computer.

According to self-reports, only two questions were added to the website during the study. The most commonly used combination involved a laptop at home, although students could use multiple devices to access the platform from multiple locations, making specific assessment challenging. Of the 121 students who answered the question about the most commonly used device, 74 (61.2%) reported accessing the platform via a laptop, 21 (17.4%) reported accessing via a smartphone, 16 (13.2%) reported accessing via a tablet, and 10 (8.3%) reported accessing via a desktop computer. Of the 117 students who answered the question about location, 72 (61.5%) reported home as the site of access, 32 (27.4%) reported hospital, 9 (7.7%) reported library, and 5 (4.3%) reported transportation during the commute to school.

Of the 123 students who accessed the platform, the mean rating of usefulness was 6.7 out of 10, with 10 being most helpful. The mean utility rating did not significantly differ by the number of questions taken (P=.17), study site (P=.41), device (P=.09), or access setting (P=.52). Of the 123 respondents, 109 (88.6%) reported that they would recommend the platform to other students.

Of the 123 students who responded to the question about areas for possible improvement, 28 (22.8%) cited quality of the questions and answers, followed by ease of use of the platform (20 students, 16.3%), difficulty of the questions (16 students, 13.0%), and esthetics (11 students, 8.9%). The survey did not assess potential concerns with question volume. There was no association between any single area of improvement and overall satisfaction with the platform.

Table 1. Data from the seven study sites, their engagement with the survey, and reported use of the Psy-Q platform.

Site	Clerkship length (weeks)	Shelf exam (yes/no)	Students partaking in the study and response rate if available, n (%)	Students reporting accessing the Psy-Q platform, n (%)	Average number of reported questions taken
1	4	Yes	24 (80%)	17 (70%)	68
2	4	Yes	42 (93%)	32 (76%)	48
3	6	No	28	17 (60%)	45
4	5	Yes	66 (79%)	38 (58%)	44
5	6	Yes	27	12 (44%)	18
6	6	Yes	11 (100%)	4 (36%)	43
7	16 (combined with neurology and internal medicine)	Yes	5 (30%)	5 (100%)	17

Discussion

Principal Findings

Our results indicate that medical students across seven distinct psychiatry clerkships found the Psy-Q platform useful (61% utilization rate; mean rating of 6.7/10) and accessed over 5500 questions during the study period. Notably, this was strongly framed as a voluntary resource; psychiatry clerkships included many other required assignments and educational activities during the brief study period, as well as several other question bank resources from which to choose (eg, USMLE World and AMBOSS). In this context, the utilization rate of 61% is quite high and supports the merits of offering a free faculty-reviewed question bank. It is consistent with a prior study that found question banks to be the top-ranked medical student resource for revision of previously learned content [5].

Overall, medical students utilized the platform, although in different settings and with different devices than hypothesized. Perceived utility did not significantly differ across the seven clerkship sites, suggesting that the results were not biased by any one site. In part, the platform was built to support smartphone-based use in response to previous feedback from students who reported that they wished to access question banks on their phones during their commute and when in the hospital. Although the platform was designed for smartphone use to facilitate learning at all times and settings, students mainly accessed the platform via its web version on their laptops at home. These results offer implications for educators in terms of implementing e-learning tools, understanding medical student use of these tools, and assessing their impact. Currently, the Psy-Q platform is optimized for smartphone web use but is not a native app, and an important next step is to explore whether further optimization of the technology will improve utility.

Students were willing to rate questions, with website data recording over 1000 votes on questions. This feedback from students offers a means of quality control and curation of questions, which is a unique strength of web-based learning platforms. Educators could use the Psy-Q platform in the future to understand what types of questions students find useful, as well as access reports on which topics may require more attention, based on the percentages of correct and incorrect answers.

The lack of utilization of a collaborative feature to write questions with educator feedback highlights one challenge for the platform. Although a total of 5535 questions were taken, only two were added by students. This is unfortunately consistent with a prior study that found low acceptability of multiple-choice question writing among students, despite evidence that the task did promote deeper learning [6]. Although our study is not designed to assess the reasons for the low use of this feature, we believe that further training in best practices for writing quality multiple-choice questions and a more extended introduction to the platform for both students and educators may be necessary. This would also offer benefits, as it would address the top reported area for improvement (students reported wanting questions of high quality). Although this study was not designed as an implementation study, the importance of such a study as the next step is clear. Future work should also clarify whether students who take more questions outperform their peers in shelf exams and other objective measures of knowledge (eg, oral exams). In the absence of this information, it is difficult to interpret the relevance of the platform's 89% satisfaction rate. Objective data could support more structured implementation of the Psy-Q platform in routine clerkship learning (eg, directors assigning a specific number of questions to be completed or written per week).

The finding that more questions were taken according to platform data than reported on the survey suggests that other learners are likely accessing and using the Psy-Q platform. Given that the project's goal was to create a free, open, and accessible learning tool, we are excited about such use, although our study was not designed to explore the identities of these additional users or their motivation for engaging with the platform. Conceivably, residents or students could revisit the website when preparing for USMLE Step I-III and PRITE examinations, which we were unable to measure in the context of this survey design. The finding that the average user spent over 30 minutes on the platform suggests that students are finding value in this resource. Of note, given that busy faculty are unlikely to receive adequate incentives to write and curate questions, training and then engaging senior medical students and residents as near peer mentors for question writing could be useful in creating a model with long-term sustainability. Thus, the new partnership with the Academy of Consultation Liaison Psychiatry has been helpful in engaging both faculty and trainee members in question writing, and there are plans for additional partnerships with organizations and student groups such as PsychSIGN.

Although our study featured variable site response rates and an inability to directly link student self-reports of the Psy-Q platform to their actual activities, our results still appear valid and reflect real-world usage. The concordance between students reporting taking a mean of 45 questions and web-based data for all users being 42 suggests good concordance between reported and actual use. Not linking survey results to web-based use also offered the benefit of ensuring user privacy and not needing to track student behavior over the internet, which is an ethically challenging space. Finally, our study offers the unique benefit that the Psy-Q platform remains accessible over the internet and active today, meaning that anyone can replicate our results or use these results to expand or augment their own efforts.

Conclusions

The Psy-Q platform represents an educator- and learner-created platform to augment psychiatry education and develop relevant accessible resources in the digital sphere. Initial results suggest a bright potential for digital tools in psychiatric education and the potential for academic psychiatry to bring leadership, expertise, and value to new learning modalities.

Acknowledgments

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Conflicts of Interest

None declared.

Multimedia Appendix 1
Survey.
[DOCX File , 15 KB - mededu_v6i2e18340_app1.docx]

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Original Paper

Identification of Informed Consent in Patient Videos on Social Media: Prospective Study

Jane O'Sullivan[1], MBBS; Cathleen McCarrick[2], MBBS, MPhil; Paul Tierney[3], MBBS, PhD; Donal B O'Connor[4], MBBS, MD; Jack Collins[1], MBBS; Robert Franklin[1], MBBS

[1]Department of Anaesthesia, Letterkenny University Hospital, Donegal, Ireland
[2]Department of Surgery, Tallaght University Hospital, Dublin, Ireland
[3]Department of Anatomy, Trinity College Dublin, Dublin, Ireland
[4]Professorial Surgical Unit, Tallaght University Hospital & Trinity College Dublin, Dublin, Ireland

Corresponding Author:
Cathleen McCarrick, MBBS, MPhil
Department of Surgery
Tallaght University Hospital
Tallaght
Dublin, D24 NR04
Ireland
Phone: 353 1 414 2000
Email: cathleen.mccarrick@gmail.com

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Abstract

Background: The American Medical Association Code of Medical Ethics states that any clinical image taken for public education forms part of the patient's records. Hence, a patient's informed consent is required to collect, share, and distribute their image. Patients must be informed of the intended use of the clinical image and the intended audience as part of the informed consent.

Objective: This paper aimed to determine whether a random selection of instructional videos containing footage of central venous catheter insertion on real patients on YouTube (Google LLC) would mention the presence of informed consent to post the video on social media.

Methods: We performed a prospective evaluation by 2 separate researchers of the first 125 videos on YouTube with the search term "central line insertion." After duplicates were deleted and exclusion criteria applied, 41 videos of patients undergoing central line insertion were searched for reference to patient consent. In the case of videos of indeterminate consent status, the posters were contacted privately through YouTube to clarify the status of consent to both film and disseminate the video on social media. A period of 2 months was provided to respond to initial contact. Furthermore, YouTube was contacted to clarify company policy. The primary outcome was to determine if videos on YouTube were amended to include details of consent at 2 months postcontact. The secondary outcome was a response to the initial email at 2 months.

Results: The researchers compiled 143 videos. Of 41 videos that contained footage of patient procedures, 41 were of indeterminate consent status and 23 contained identifiable patient footage. From the 41 posters that were contacted, 3 responded to initial contact and none amended the video to document consent status. Response from YouTube is pending.

Conclusions: There are instructional videos for clinicians on social media that contain footage of patients undergoing medical procedures and do not have any verification of informed consent. While this study investigated a small sample of available videos, the problem appears ubiquitous and should be studied more extensively.

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KEYWORDS

social media; patient consent; patient footage; ethics; YouTube; patient video; medical education

Introduction

The primacy of YouTube (Google LLC) as a learning tool used by health care professionals cannot be overestimated. In a study published in 2016 by Rapp et al [1], a survey was distributed to surgical consultants and trainees, which established that 90% of all respondents reported using videos as a learning resource prior to performing a surgical procedure. Of those that used videos, 86% reported using YouTube as the resource. Medical practitioners have a duty to ensure that the information made available for use on YouTube has been sourced in an ethical fashion.

The American Medical Association (AMA) Code of Medical Ethics states that any clinical image taken for public education forms part of the patient's record. Hence, a patient's informed consent is required to collect, share, and distribute their image. Patients must be informed of the intended use of the clinical image and the intended audience as part of the informed consent [2]. Therefore, it is not sufficient to obtain permission to use the videos for educational purposes. A critical component of informed consent must include explaining to the patient that the video will be posted on YouTube.

The purpose of this study is to determine if a random selection of step-by-step instructional, procedural videos involving patients and posted on YouTube indicate the patient's consent. Furthermore, in the case of an indeterminate consent status, it seeks to clarify whether the poster or trainer obtained informed consent for the production and dissemination online of the video. The overall objective is to determine if there is an issue with patient consent status on these YouTube videos. It serves to provide insight into a potential problem that indeed may be widespread.

Methods

A common clinical procedure was selected for the purpose of the study: central line insertion. On 2 separate occasions, 2 independent researchers searched the term "central line insertion" on YouTube. Each researcher formulated a list of the first 125 videos for the search term. The lists were then collated, and any video duplicates were deleted.

Each researcher separately analyzed every video included on the list, extracting the necessary details. The included videos were instructional in nature, giving a step-by-step account of how to insert a central line. For the purpose of this study, the following exclusion criteria were applied: non–English-speaking videos, simulation procedures, animated procedures, blogs, animal procedures, and any videos that did not show the actual procedures being performed. All English language videos of patients undergoing central line insertion were included.

For those videos meeting the inclusion criteria, each was searched for any reference to patient consent. They were additionally analyzed to determine if the patient was identifiable. Patients were deemed identifiable if the face anterior to the tragus of the external ear was visible. Finally, the video was evaluated for any details pertaining to that patient's care.

In the case of videos of indeterminate consent status, the posters were contacted privately through YouTube. Furthermore, the videos were analyzed for any contact details for the trainer. An email was sent to them, including a brief introduction and an inquiry as to whether consent was obtained to film this video and post it on social media. A period of 15 days was allowed to elapse before checking the videos again to determine if they had been updated to include information regarding the patient's consent. The primary outcome of the study was to determine whether the YouTube posters included details about patients' consent to post the video on social media. The secondary outcome was whether the poster responded to the private message and amended their videos to clarify the consent status of the patient. The videos were re-examined after a further period of 2 months to determine if they had been updated to include information regarding the consent status of the patient displayed in the video.

The following email was sent to each of the posters:

> *Hi, We are a group of researchers from Ireland. We are completing a project on consent for YouTube videos involving patients. We hoped that we could ask you several brief questions. Did you receive patient consent prior to the production and distribution of this video? If so, what was the form of the consent? Are you aware of any guidelines that govern the consent process for posting patient videos on YouTube? If you have consent, would you consider mentioning the consent on the video following this email? Thank you very much for taking the time to read this.*

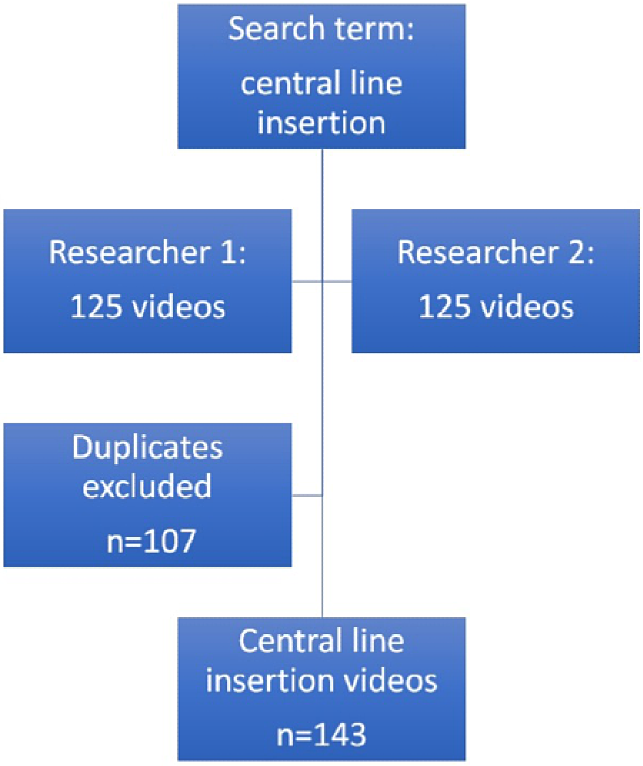
Finally, contact was made with YouTube regarding its policy surrounding patient consent. The email to YouTube highlighted the list of patient videos of indeterminate consent status. It noted the AMA guidelines and requested that YouTube clarify the matter. The following email was sent to YouTube:

> *Dear YouTube, My colleagues and I are medical doctors in Ireland. We are currently undertaking a research project on patient consent on social media. We noticed that a number of videos posted contain footage of real patients undergoing medical procedures in healthcare facilities. We have examples of videos which contain identifiable and non-identifiable imagery of the patients. The British General Medical Council state that any person posting videos containing real patient procedures must seek prior written consent, regardless of whether the patient is identifiable. We have made a large database of videos that contravene these guidelines. We contacted the posters of these videos and gave them a two-week period to respond. There was minimal response to our queries. We would be obliged if you could clarify your stance on allowing videos with indeterminate consent to be posted on YouTube, in terms of your current policy.*

Results

The search term "central line insertion" was input into the YouTube search engine. Both researchers separately identified the first 125 videos for this search term. When the researchers' lists were combined, there were 104 duplicate entries. After duplicates were removed and the researchers' results were combined, there were 143 videos of central line insertion in total. This process can be seen in Figure 1.

Figure 1. Search results on YouTube for the search term "central line insertion." Each researcher performed a separate search on different days using the defined search term.



The remaining YouTube videos were scrutinized to determine if they fulfilled the inclusion criteria, as seen in Figure 2. A total of 102 of these videos failed to meet the inclusion criteria for various reasons, as discussed in the "Methods" section. After excluding these videos, the researchers were left with 41 videos in total of clinician-led video entries detailing a central line insertion on a real patient.

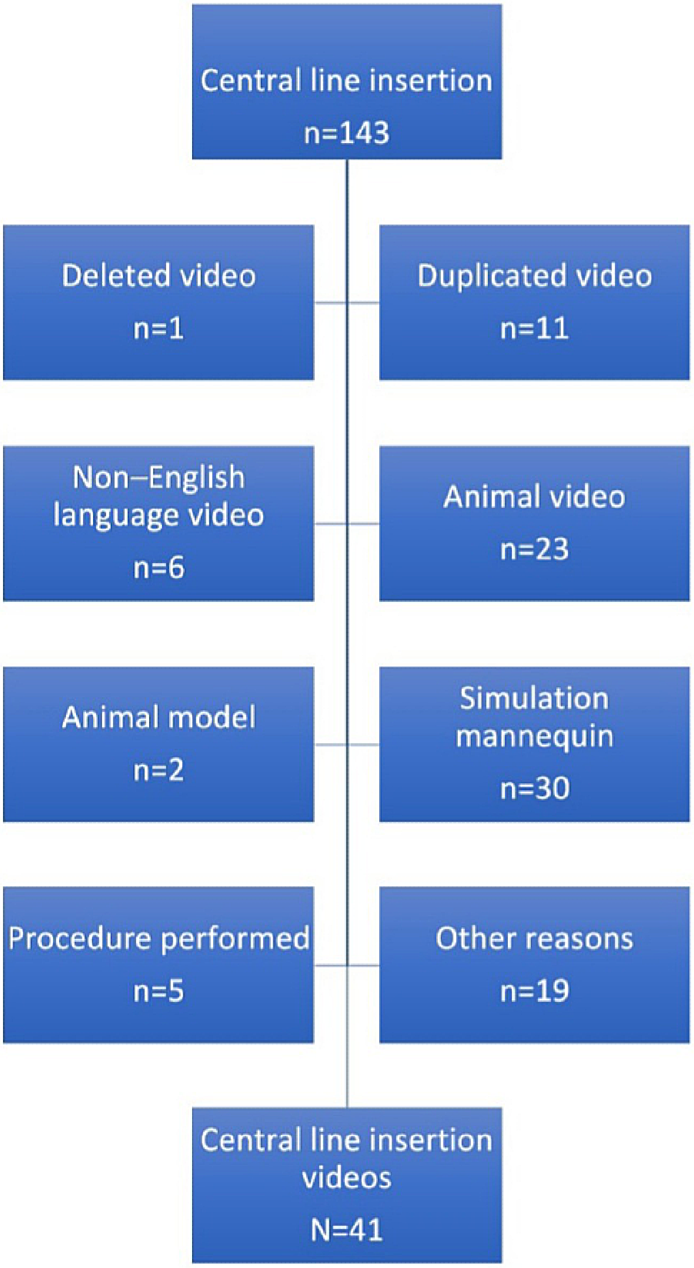
Each of the 41 clinicians who posted a video on YouTube was contacted via the private message function on YouTube. Only 3 of the 41 posters responded to the email. Following reanalysis of the videos 2 months postcontact, 0 of the 41 posters amended the original video to state whether there was any patient consent obtained prior to posting the video on YouTube. Additionally, 0 of the 41 videos mentioned the original trainer.

All 3 posters who responded were clinicians. One of the respondents stated that written consent was obtained to use the video for educational purposes. This respondent failed to state whether informed consent was obtained for uploading the video onto social media. Another poster stated that the particular institution he worked at did not mandate informed consent for the production and posting of videos on social media as long as there were no patient identifiers. The third poster stated that verbal consent was obtained to post the video on YouTube.

Of these 41 videos, the anterior face was visible in 56% (23/41) of the YouTube videos. Anterior face was defined as any part of the face anterior to the tragus. Anterior face was taken as a surrogate marker for identifiable patients.

YouTube has yet to respond to the email aiming to clarify the company's policy on the posting of patient-containing footage.

Figure 2. Final compilation of central line insertion videos after exclusion of videos based on the exclusion criteria.



Discussion

This study examined a random selection of videos (n=41) of a common clinical procedure that contained real patient footage of indeterminate consent status. Of these, 56% (23/41) showed potentially identifiable patient footage. Only 3 posters responded to the email designed to clarify the consent status of the published video. All 3 posters were physicians.

For the purpose of this study, any image showing the face anterior to the tragus of the external ear was deemed identifiable. Stieber et al [3] specified an identifiable patient image as any patient image that contains sufficient information to enable a non–medically trained individual to correctly identify the patient or that is readily identifiable to the patient themself. Although each institution may have its own specified standards as to what constitutes an identifiable image, a nonidentifiable image must not meet either of the above criteria, which casts doubt on the legal validity of individual institutional standards.

Informed consent may be defined as "autonomous authorization by a patient or subject" [4]. There are different levels of patient consent. While a patient may agree to allow an image to be recorded for the purpose of their medical notes, they may not necessarily agree for this image to be disseminated on social media [5]. The concept of consent must continue to evolve to encapsulate all the challenges posed by modern technology. The videos included in the study contained reference to neither the patient's consent to undergo the procedure nor to their consent to the publication of these videos on social media platforms.

Social media is defined as a website or application that allows users to generate or upload content or to engage in social networking. The differentiating factor between social media and a website is the ability of a user to use and redistribute the uploaded material freely on social media. Generally, content on a website is restricted due to copyright considerations. Furthermore, content uploaded onto a social media platform is usually shared instantaneously with viewers or followers. Finally, social media engenders interactive participation and discussion of the material [6]. As a consequence, patient information posted to social media spreads a lot more rapidly and widely than content on a website.

There are several pitfalls associated with the use of social media in health care. The posting clinician forfeits sole control and ownership of the material posted on social media and the ability to delete material once posted. Such issues need to be discussed with the patient prior to obtaining informed consent. Furthermore, in normal circumstances, informed consent is a dynamic process. Consequently, the patient has the right to withdraw this informed consent at any stage in the process. However, in the case of social media it is virtually impossible to remove images and hence, informed consent is invalidated [7]. There are no regulatory mechanisms to ensure that the images are not widely viewed, disseminated, or misused [5]. In order to meet the definition of informed consent, the patient should be made aware of such risks. It is not enough to obtain consent from them to record a video. The patient needs to be made aware of potential consequences relating to the publication of a video on social media. Not only does this paper fail to clarify if patients consented to the recording of procedural footage, it fails to determine in all videos posted if patients were informed of potentially negative outcomes of broadcasting a video on social media.

Physicians are under obligation to inform patients about any procedure being contemplated. In the legal domain, when informed consent is breached, the breach must satisfy the following 4 criteria in order to be deemed negligent: (1) the physician must fail to disclose this information about the procedure to the patient, (2) there must be consequences for the patient that causes the patient to be worse off, (3) the adverse outcome is a consequence of the physician's failure to disclose the information to the patient regarding the procedure, and (4) had the patient been aware of the risk, they would not have consented to the procedure [4]. In the case of videos containing identifiable patient material in the absence of consent to publish on social media, all 4 of the above criteria are satisfied if harm is defined in terms of psychological damage. Thus, it would be possible to argue malpractice in instances of foregoing consent where identifying features are present.

The World Medical Association Declaration of Lisbon on the Rights of the Patient states that irrespective of geographical location, all patients have the right to information and self-determination [8]. Despite this guideline, there is considerable cultural variation in both the practice of informed consent and the salience of informed consent with respect to patient autonomy. Cultural differences, however, should not abrogate the need for informed consent [9]. Irrespective of patient location, basic ethical benchmarks should apply to patients of all jurisdictions and circumstances. Furthermore, this footage is being used by practicing clinicians in jurisdictions where there are ethical concerns regarding the filming of patients. These clinicians should ensure that their educational materials are ethically sourced.

The source of the video material is not always identifiable. In a recent study by Pitcher and Amendolo [10] that analyzed videos of common femoral artery access published on YouTube, 40% (13/33) of videos were published by unknown practitioners. For the majority of the videos included in this study, it was not possible to determine the source of the information, which emphasizes the poster's loss of control of material uploaded onto social media platforms.

Bezner and colleagues [11] examined the first 40 English language videos of 4 different pediatric diagnoses published on YouTube. The researchers noted that a limiting factor to the use of YouTube for accessing patient videos was the absence of information surrounding the patient's consent to film and distribute the video on social media. None of the videos included in their study specified this consent. Similarly, in this study, prior to contacting the posters, no video referred to the patient's informed consent to film the procedure. Following contact with the posters, the consent status was available for only 3 videos. The remainder of the videos were indeterminate as to consent status.

Following the results of this study, it is clear that contacting those who have posted videos on YouTube is an ineffective way of obtaining the consent status of the video. The emails sent to the users yielded poor results. The vast majority (38/41) of the central line insertion videos remain of unknown consent status. Thus, videos that are viewed every day by medical practitioners may not meet sufficiently rigorous ethical criteria. It would seem necessary that those posting videos on YouTube need to ensure that their patients have given informed consent, as in the case of medical journals, and that this consent is specified in the uploaded material. Such solutions would require governance by an external body, however. It may be necessary to establish a clinical governance group to monitor social media content in collaboration with YouTube. Following the submission of this paper for publication, the authors are still awaiting a response on YouTube's policy.

A limitation of the present study is that a small selection of videos (n=143) was examined for a single procedure. One cautions against extrapolating the present results to other fields. However, the purpose of this study was to highlight a potential ethical issue of posting videos of patients undergoing procedures on social media. Further work is needed to elucidate whether this is problematic on a wider scale and how this problem can be overcome.

In conclusion, the present study serves to highlight the indeterminate consent status of randomly selected, patient-containing footage on YouTube.

Conflicts of Interest

None declared.

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Abbreviations

AMA: American Medical Association.

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Viewpoint

The Present and Future Applications of Technology in Adapting Medical Education Amidst the COVID-19 Pandemic

Ridhaa Remtulla[1]

Birmingham Medical School, College of Medical and Dental Sciences, University of Birmingham, Birmingham, United Kingdom

Corresponding Author:
Ridhaa Remtulla
Birmingham Medical School
College of Medical and Dental Sciences
University of Birmingham
Birmingham Medical School, College of Medical and Dental Sciences
Edgbaston
Birmingham, B15 2TT
United Kingdom
Phone: 44 7436 719660
Email: rxr529@student.bham.ac.uk

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Abstract

The coronavirus disease (COVID-19) pandemic has not only been catastrophic toward patient health but has also proven to be incredibly disruptive to several industries and sectors, including medical education. However, many medical schools have employed various technological solutions in order to minimize the disruption to medical education during this unpredictable time. This viewpoint reviews the various current and potential applications of technology in order to adapt medical education amidst a global pandemic.

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KEYWORDS

medical education; technology; coronavirus; medical students; COVID-19; pandemic; online lecture; virtual reality

Introduction

The global emergency of coronavirus disease (COVID-19) has been exceptionally disruptive for several industries and sectors, including medical education. Abrupt university closures across the world have posed significant challenges for medical schools on an international scale, with a considerable number of universities graduating their final year medical students in haste in order to contribute to national workforces, whilst other more junior medical students have faced premature ends to their academic year [1].

Despite the unexpected imposition of lockdowns, universities were able to leverage technological solutions to ensure continuity of their courses. Nevertheless, more difficult decisions lie ahead for medical schools. Educational institutions were nearing the end of the academic year when countries entered lockdown phases. Thus, establishments must consider how medical education, both preclinical and clinical, will be delivered with the commencement of the new academic year.

This paper aims to identify the various technological solutions that are allowing for the adaptation of medical education in these unpredictable times, and how more novel digital solutions may be used in the future to enable students to seamlessly progress through medical school in the age of the COVID-19 pandemic.

Online Lectures

Following national lockdowns, numerous universities rapidly switched to delivering live or prerecorded online lectures. Third-party organizations have also been holding online lectures and podcast series to help ensure medical students continue to receive their education. This is not a novel application of technology, as medical schools frequently record their lectures to allow students to access learning materials at later points. Online lectures are a highly familiar method of teaching, and multimedia resources are regularly used by medical students to supplement their learning. Indeed, studies have demonstrated that online lectures can increase the speed of knowledge acquisition, allow students to manage stress better, and most importantly, they can improve learning outcomes from the course when compared to in-person lectures [2,3].

One study of 222 medical and dental students found that 66% of students between years 2 and 4 felt physical lectures should not be a compulsory component of their medical education, highlighting newer student preferences and raising the argument that traditional lectures may indeed be an outdated method of teaching [4]. It should be considered that based on this data, students may be preferring the current norm of online lectures to conventional lectures. Online lectures are also exceptionally customizable to a student's specific learning needs, for example, by allowing individuals to increase or reduce the speed of the lecture to suit their personal pace. Considering this in combination with the fact that this educational medium has been shown to result in better outcomes for students, perhaps online lectures will become a permanent alteration in many medical courses.

Interactive Technologies to Replace Hands-on Learning

Digital tools for learning practical medicine have been used for some time now, a prime example being the Anatomage table—a large interactive screen that students can use to virtually dissect the human body and observe its structures [5]. Similar software programs have also emerged that allow students to access these facilities in a portable manner (eg, mobile or laptop applications that enable individuals to study anatomy via 3D computer models). These portable solutions could act as viable replacements for the dissection and prosection aspects of most medical programs.

In order to allow for the increased demand that COVID-19 will bring, many hospitals postponed elective surgeries, and the impact of this on training surgeons must be considered. Alternatives such as Touch Surgery, an innovative surgical simulation app, may be used by trainee surgeons in order to maintain their practice [6]. In recent years, some surgeons have also chosen to live stream their operations, and this has been achieved through various modalities. Live streaming of surgeries with a camera alone can be thought of as cutting-edge, but some surgeons have employed even more novel methods (eg, streaming surgeries through the use of wearable devices such as Snapchat glasses [7]). Live streaming surgeries through any viable medium has tremendous utility in the age of COVID-19, since it allows for the continuity of medical education in a time where being physically present in the operating room may not be possible. The fact that there has been a relatively extensive practice of live streaming in the past suggests that this technology may well become the status quo in the case of canceled clinical placements or clerkships.

Online Examinations

For institutions that continued to hold final year examinations for their students, remote online examination systems were used, demonstrating that remote testing can be employed in case of future disruption. The Situational Judgement Test (SJT) is a national exam sat by all British medical students in their final year. This had been switched from paper to online examinations for the upcoming academic year, prior to the outbreak of COVID-19. Students can choose to take the SJT as an online examination at either a local testing center or from their own home computer; this highlights that it is certainly possible to hold remote, online examinations in case restrictive social distancing measures are in place during the exam period.

Another potential solution may be to conduct remote, online open book examinations (OBEs). As a result of the COVID-19 outbreak, Imperial College London held high-stakes, final year medical examinations in this manner. Interestingly, the median mark for the OBEs were equivalent to the median marks of the previous 3 years prior to the COVID-19 pandemic [8]. Due to the nature of the questions, which mainly focused on applying knowledge as opposed to basic recall, students were not provided an unfair advantage by making the examination open book [8].

Alternatively, if institutions wish to conform to the traditional closed-book examinations, there are technologies available in order to maintain appropriate levels of invigilation. All medical schools have a zero-tolerance policy to inappropriate academic conduct, necessitating the use of precautionary measures to prevent unethical behavior concerning examinations. This may be tackled through the use of technologies that track eye movements, keystrokes, and background noises to recognize potential cheating behavior [9].

Telemedicine

Telemedicine, which is the use of technology in order to deliver health care remotely, is becoming increasingly important in medical service delivery. However, its applications could also be extended to medical education, and the current COVID-19 crisis is evidence of this. Doctors have resorted to simple yet effective "webcams on wheels," enabling them to conduct virtual ward rounds remotely whilst a staff member who is physically present at the hospital maneuvers a computer with a camera around the ward using a trolley [10]. By allowing groups of medical students to connect to similar devices, for example, through a video conference call, students would be able to continue participating in ward rounds as they usually do during their clinical clerkships.

Additionally, a pilot study investigated the use of telemedicine technology toward building a formative and remote objective structured clinical examination (OSCE) [11]. The "teleOSCE" involved medical students speaking to a patient actor over video conferencing. This was found to be economically feasible and was positively received by participating students [11]. Thus, an additional use of telemedicine could also be for summative practical examinations, which would otherwise require canceling.

Virtual Reality

Although the use of virtual reality (VR) is not as widespread when compared to other devices such as touchscreen tablets or smartphones, the challenges posed by COVID-19 could potentially be a turning point for this technology. Medical schools may be forced to cancel clinical placements in the coming months to protect their students from undue exposure to COVID-19. Through the use of VR, there is potential to digitally reconstruct aspects of the clinical environment and simulate clinical learning. Oxford Medical Simulation is a company offering a VR medical education platform where students are able to examine, diagnose, treat, and take histories from digitally simulated patients within a virtual clinical environment [12]. These interactive and immersive scenarios will adapt based on the actions of the student, thus closely mimicking what students would learn in real life. One scoping review identified 21 papers in which VR had been used in medical training. Of these 21 papers, 74% found improved learning using VR. Doctors who were trained through VR were also reported to have a higher level of accuracy in their medical practice, indicating that this is an effective method for teaching in a medical context [13].

With the vast majority of clinical schools canceling OSCEs for the 2019/20 academic year due to COVID-19, perhaps VR technology also acts as a more novel solution to ensure the continuation of practical examinations. Companies such as Medical Realities do offer VR OSCE practice sessions, demonstrating that this is certainly within the grasp of current technological capabilities [14]. In combination with the aforementioned telemedical solutions, recreating a realistic summative OSCE that tests both practical skills and communication abilities is very possible.

Key Challenges

It is clear that the golden age of technology aids in minimizing the disruption to medical education in these current times, with online resources and lectures playing a key role in the current continuation of medical education. However, it is crucial to identify those who may fall through the cracks during this period of time, especially individuals who may have difficulty accessing high-speed internet—for example, those training in less developed parts of the world. Additionally, some of the technologies discussed—particularly VR—are costly and may not be economically feasible at their present prices. Microsoft HoloLens, for example, costs $3500 per device [15].

Conclusion

There is no question that the coming academic year will be a challenge for both medical students and medical schools. However, health care professionals have always been recognized and respected for their resilience, and universities are already using technology to ensure the seamless progression of their students through medical school. If nothing else, the adaptations toward remote education solutions in the era of COVID-19 may lead to further innovation in the field, and a potential revolution in the way medical education is delivered through novel technologies.

Conflicts of Interest

None declared.

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Abbreviations

COVID-19: coronavirus disease
OBE: online open book examination
OSCE: objective structured clinical examination
SJT: Situational Judgement Test
VR: virtual reality

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Viewpoint

The United States Medical Licensing Examination Step 1 Is Changing—US Medical Curricula Should Too

Benjamin Liu[1], BMedSci

Medical College of Wisconsin, Wawautosa, WI, United States

Corresponding Author:
Benjamin Liu, BMedSci
Medical College of Wisconsin
8701 W Watertown Plank Rd
Wawautosa, WI, 53226
United States
Phone: 1 414 397 1602
Email: beliu@mcw.edu

Abstract

In recent years, US medical students have been increasingly absent from medical school classrooms. They do so to maximize their competitiveness for a good residency program, by achieving high scores on the United States Medical Licensing Examination (USMLE) Step 1. As a US medical student, I know that most of these class-skipping students are utilizing external learning resources, which are perceived to be more efficient than traditional lectures. Now that the USMLE Step 1 is adopting a pass/fail grading system, it may be tempting to expect students to return to traditional basic science lectures. Unfortunately, my experiences tell me this will not happen. Instead, US medical schools must adapt their curricula. These new curricula should focus on clinical decision making, team-based learning, and new medical decision technologies, while leveraging the validated ability of these external resources to teach the basic sciences. In doing so, faculty will not only increase student engagement but also modernize the curricula to meet new standards on effective medical learning.

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KEYWORDS

USMLE; US medical students; USMLE pass/fail; new curricula; medical education; medical learning; medical school

For US medical students, 2020 has been a wild year. In addition to the pandemic and an increasing number of zero tuition medical schools, the United States Medical Licensing Examination (USMLE) Step 1 has adopted a pass/fail grading system. The percentile students scored on this test has historically been one of the most important determinants of which residency program or even which area of medicine students could apply to. Now that it is pass/fail, doing anything more than just passing has no effect on a student's residency competitiveness. While I agree with most of the reasons for this change, the glaring question remains: what will the medical school curriculum look like now that Step 1 has become pass/fail? As a second-year medical student attending a typical mid-west US medical school, I believe I can offer a first-hand perspective on student engagement with the traditional, lecture-based medical curriculum, and the major changes that should occur as students shift their focus away from scoring a 230+ on Step 1.

Historically, US medical schools have had a heavy emphasis on memorization, a matter exemplified by the 2 years of traditional lectures dedicated for the basic science–heavy Step 1. However, in the modern era, we acknowledge that medical knowledge has proliferated to the point where it is impossible to memorize everything. Nevertheless, the heavy emphasis on Step 1 scores for residency admissions leads medical students to devote significant time and energy to maximize their scores. According to the 2019 Medical School Year Two Questionnaire administered by the Association of American Medical Colleges, US medical students have been largely absent in traditional, lecture-based classes, and over one-third (34.9%) of medical students "never" or "occasionally" attend virtual classes [1]. Instead, an increasing number of students—including myself—pursue a "parallel curriculum" of dedicated Step 1 preparation [1-3]. This involves external medical resources (eg, Pathoma, boards, etc) that feature short and concise lectures (playable at double speed), with accompanying spaced repetition "Anki" flashcards. These resources have provided a basic medical science learning platform that students are flocking to instead of traditional lectures [1-3]. Unfortunately, this has resulted in empty medical classrooms, faculty frustration with students, and decreased faculty enthusiasm for teaching [4].

Since the driving force for these behaviors are Step 1 mediated, you may wonder if students will re-engage with traditional basic science lecture formats now that Step 1 is pass/fail. I believe the answer will be no. Even without the pressures of Step 1, students will not attend if they feel they are not efficiently using their time. Many articles have been published showing that the amount of content covered in traditional medical lectures overwhelms the brain's ability to learn [5]. As for the information that does get across, students often only understand it at a superficial level [5]. Given that students still need to choose between doing research, extracurriculars, and learning the basic science to pass Step 1, students will always pick a 10-15–minute video at double speed over a 1-hour in-person lecture [1,3,6]. To remain relevant, I believe that the current medical curriculum must undergo significant re-evaluation and transformation. With this change, faculty should leverage external resources to help their in-person classes focus on teaching the loftier aspects of medicine: clinical decision making, effective utilization of technologies, and most importantly, working effectively in a team-based environment.

In the past, both faculty and students have focused less on clinical decision making and interprofessional education in favor of Step 1 performance, resulting in students with limited practical skills before clerkship. With Step 1 becoming pass/fail, future curricula have an opportunity to fully embrace teaching these skills through a flipped classroom model. Schools have already recognized the value of the flipped classroom model, and several have implemented them on a consistent basis. This relatively new classroom style involves students learning the material beforehand, as directed by assigned readings or video modules, and then applying it in classroom-based clinical scenarios. It addresses student's preferences for self-paced basic science learning, teaches critical thinking and team-based collaboration, and leads to improved outcomes for medical student learning compared to traditional lectures [7]. As described by one perspective published in the *New England Journal of Medicine*, flipped classrooms allow concepts to be "stickier" by making a student actively apply the content to a relevant and interesting scenario soon after learning it [8]. This reinforces the value of the knowledge, making it more understandable and memorable than passively learning a dry and complex biochemical pathway for an hour [5,8]. Moreover, as one of my preceptors told me, "real medicine is not a test. It involves gathering information from everyone in the room and coming up with a list of the best possible explanations before investigating each one." In hindsight, a well-designed collaborative flipped classroom appears to be the exact formula for real medicine.

Finally, the historical focus on rote memorization is not well adapted to today's age where all minute details can be discovered with the click of a button. As a second-year student, I would have appreciated formal training in utilizing current medical technologies to supplement our memory. Now that students will no longer be pressured by Step 1 into memorizing everything, future curricula can go beyond simply mentioning clinical decision-making tools (CDMTs) such as UpToDate and ASCVD Risk Estimator Plus. Students should be consistently taught to engage with these technologies via clinical cases. This will lead to familiarity, and therefore more effective use of these technologies, which have already been proven to lead to better patient outcomes when used appropriately [9]. Curricula that incorporate effective utilization of CDMTs can also help eliminate the stigma against using them in clinical practice [9,10]. From the patient's perspective, this stigma is unfounded [9,10]. Effective use of CDMTs is appreciated by patients—who increasingly understand that physicians cannot be expected to memorize every little detail—so long as the physician communicates what they are doing. For physicians, this stigma comes from the perceived interference these technologies have on their face-to-face interactions with the patient, as well as a perception that reliance on such technologies suggests decreased medical ability. While the latter point likely has its roots in metrics that overly prioritized memorization (eg, Step 1), the first point is a very valid point against electronic health records. However, CDMTs are different and can be an opportunity to build rapport with patients by demonstrating engagement with the patient's concern as well as providing trusted resources for the patients to read more about. Therefore, training future physicians to be comfortable with CDMTs, with the caveat of also training them to effectively incorporate CDMTs in their face-to-face interactions (eg, turning the screen toward the patient), is a critical change that medical curricula must make.

In conclusion, schools should not fall back on traditional, lecture-based curricula in response to the Step 1 changes. They must modernize their curricula by promoting active, team-based learning that incorporates the many technologies that have and will continue to revolutionize the field of medicine. After all, we change our medical practices based on new evidence and guidelines. We should do the same for medical education.

Conflicts of Interest

None declared.

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Abbreviations

CDMT: clinical decision-making tool
USMLE: United States Medical Licensing Examination

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Viewpoint

Medical Students' Corner: Lessons From COVID-19 in Equity, Adaptability, and Community for the Future of Medical Education

Simran Mann[1], BSc; Shonnelly Novintan[1], BSc; Yasmin Hazemi-Jebelli[1], BSc; Daniel Faehndrich[1], BSc

School of Medicine, Imperial College London, London, United Kingdom

Corresponding Author:
Simran Mann, BSc
School of Medicine
Imperial College London
Kensington
London
United Kingdom
Phone: 44 7964965972
Email: sm6015@ic.ac.uk

Abstract

As UK medical students, we recently completed 3 months of remote learning due to the COVID-19 pandemic, before taking online end-of-the-year exams. We are now entering our final year of medical school. Based on our experiences and our understanding of others' experiences, we believe that three key lessons have been universal for medical students around the world. The lessons learned throughout this process address the need for a fair system for medical students, the importance of adaptability in all aspects of medical education, and the value of a strong medical school community. These lessons can be applied in the years to come to improve medical education as we know it.

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KEYWORDS

medical education; COVID-19; student equity; community; adaptability; medical student

Introduction

Medical education and future careers are sometimes colloquially referred to as a conveyor belt: they involve a set pathway with a known structure of assessments at each key step, and as a medical student, your focus is on continuously moving forward. While medicine itself is unpredictable by nature, medical education follows a familiar structure. This is why the impact of COVID-19 has been so explosive. For the first time, our placements, our annual exams, and our subsequent progression through the medical degree have all been canceled, delayed, or altered significantly.

As UK medical students, we recently completed 3 months of remote learning, before sitting end-of-the-year exams online, and we are now entering our final year of medical school. Our remote learning mostly consisted of online lectures delivered by clinicians from various hospital sites. Based on our experiences and our understanding of others' experiences, we believe that three key lessons have been universal for medical students around the world.

Equity: A Fair System for All Students

In recent months, medical schools have had to provide remote teaching that is accessible and appropriate for all students. This has included a range of media outlets for online lectures, tutorials, and virtual clinics [1-4]. However, this shift to online learning has uncovered an "equity gap" within medical schools, as it has become apparent that many students lack access to adequate technology or working space.

In many medical schools, including our own, all teaching has been conducted remotely, and online assessments have replaced the traditional "exam hall" assessment [5]. Executing this has highlighted the disparity in access to devices, reliable Wi-Fi, and suitable working spaces at home. For example, some students are not equipped with a quiet space at home or a reliable device with a webcam and microphone, limiting their ability to partake in videoconferencing. Furthermore, many students have inadequate Wi-Fi, which makes video calls slow or "glitchy" and impedes learning.

Unfortunately, the impact of the pandemic on medical education has been far harsher on low-income students, and universities have scrambled to mitigate this. In our medical school, students regularly use institution-provided mobile devices [6], which has reduced the inequity between students during remote learning, but many would argue that they still desperately need a physical library space and campus Wi-Fi. Our campus libraries have been closed in response to the pandemic, which has been problematic for students with limited working space at home.

We must also address the fact that these adversities already affected year-round studying—even before medical schools felt the impact of the COVID-19 pandemic. A campus library with a computer is vital for a student from a low-income background, as there is often no alternative working space at home. At our medical school, the educational experience of students who rely on library facilities is already disproportionately affected by factors such as restricted library opening hours, limited availability of computers, or insufficient working space. Thus, as campuses are reopening, universities should re-evaluate the accessibility of studying facilities throughout the academic year.

The pandemic may open a wider conversation about resource availability for medical students. Following the disruption to regular teaching, many students bought access to compensatory resources such as textbooks, flashcards, and educational websites. Learning is streamlined by comprehensive, "all-in-one" resources in which content is updated alongside emerging evidence and changing guidelines. Here, individual-guided learning during COVID-19 has confirmed the academic advantages of wealth: if you can afford these subscriptions, you can mitigate adverse circumstances and optimize your remote learning.

Addressing this deep-rooted inequity is difficult but important. Perhaps universities should strive to keep their "free" resources as updated and comprehensive as privately available resources. The strain of the pandemic has also been greater in students who rely on part-time jobs; thus, COVID-19 has reminded universities of the importance of financial safeguards for working students. This strain can be minimized through means-tested bursaries, which reduce the need for part-time jobs and may also help students to afford valuable, private learning resources.

Ultimately, the obvious inequities in assessment and education must not be treated as a discrete issue but should be addressed outside of the context of COVID-19. The pandemic has illustrated the usefulness of technology for remote learning, but now we risk overlooking the need for physical working spaces. Campus libraries must be kept open throughout the year, with social distancing measures as necessary, to accommodate students with no working space or reliable Wi-Fi at home. Furthermore, universities must strive to mitigate inequalities between students, with fully accessible academic resources and means-tested bursaries.

The first lesson from medical education in the times of COVID-19 is a need for a fair system. Hopefully, the renewed focus on equal resources for learning and assessments will prompt us to tackle the insidious causes of inequity amongst medical students.

Adaptability: Our Responsiveness in Unprecedented Times

COVID-19 has required us to rapidly re-evaluate how we learn and assess within medical education. This has relied on the adaptability of individuals, resources, and the assessments themselves.

For years, many medical schools, including our own, have been recording lectures and making them available for students online—a style of teaching that has been proven popular and effective since it allows students to learn at their own pace and in their own time [7,8]. As remote teaching has become the norm, students in medical schools such as ours can adapt more readily, as we are already familiar with the platforms and format of recorded lectures. In the context of canceled lectures, it is also easy to make online banks of prerecorded lectures accessible for students who are learning remotely.

Similarly, many teaching hospitals already implement "virtual multidisciplinary teams" (MDTs) over video conferencing software [9,10]. The existing infrastructure has made it easier for these institutions to adapt their teaching by having medical students attend MDTs virtually. The same principle of an adaptable infrastructure can be applied to the role of virtual clinics [11,12] in medical education. History-taking skills can be practiced with simulated patients or even real patients, as more health care providers begin to use video and phone consultations.

While we can shift lectures, MDTs, and some clinics into a remote format, our ability to develop clinical skills has suffered. Canceled placements and reduced patient contact have made it harder to practice physical exams and clinical procedures. This was a necessary step to minimize risks of COVID-19 transmission, but now we risk inadequate training for this generation of future doctors. History-taking can be practiced during online, small-group teaching, but the practicalities of an abdominal examination or peripheral venous cannulation are more difficult to simulate.

Some virtual tools have been used, with varying results. Barriers to using virtual reality and computer-generated patients include access to technology, organizational culture, and real-life applicability of the simulated environment [13-15]. The fact that many medical schools do not routinely use these tools has limited our ability to quickly implement them as a substitute for clinical practice. However, as these tools become more necessary to medical education, they can be refined and incorporated into regular use. Our medical school has never used such tools, but the faculty is beginning to trial "virtual ward rounds" and may use them regularly in the future.

A key step in improving our adaptability will involve the integration of virtual tools into our medical school curricula. This can ensure an adequate standard of clinical education, even in situations with minimal patient contact.

Community: Peer-to-Peer Support

A wide range of virtual platforms have been used by faculty and clinicians to support remote learning for medical students. Personally, however, we have found that much of our adaptation to virtual learning has been centered around peer-to-peer support.

Close interaction between teachers and students is fundamental in medical education. To understand a condition, students must discuss and question each step in the patient journey, and this is facilitated by individual-level teaching. Usually, we experience this during placements as doctors discuss specific cases with us and encourage us to take histories or examine patients. Small-group teaching can be substituted for this, but to provide a regular program of remote, small-group teaching for students year-round would require pre-existing infrastructure. Our faculty has succeeded in providing remote lessons for large groups, but small-group teaching has not been rolled out.

After placements were suspended, we struggled to find a substitute for the discussions that we normally experience during a placement. Therefore, peer-to-peer teaching has guided our adaptation to remote learning.

Our medical school community has responded to COVID-19 with a strong sense of unity. Within extracurricular clubs and social groups, many students have independently divided their curricula into topics and led informal group tutorials using video conferencing software. Furthermore, many senior students ran informal, virtual tutorials for students in earlier years on content that we have previously covered and have been examined on. Students also benefited from similar informal tutorials run by alumni who have studied the course and are now practicing clinicians. Thus, our networks throughout medical school have facilitated peer-to-peer support across different stages of medical education.

The opportunity to invest a significant amount of time into student-led tutorials has been pivotal in our education this year. We confirmed that students' understanding is improved when taught by somebody at a close stage in their medical career, who instinctively pitches content at our level of knowledge [16]. Furthermore, teaching and being questioned by our peers consolidate our own knowledge. Finally, our teaching skills have developed through feedback from peers.

Each tutorial was organized within a student-run, nonacademic club or society. The nature of student societies is ideal for virtual learning, as small groups form naturally, and friendships facilitate relaxed discussion. There are obvious limitations to students attempting to fulfil professional teaching roles. However, in these circumstances, peer-to-peer teaching has been a safety net for many of us, preventing us from falling behind in our learning. We believe that student-led learning could be better supported by all medical schools, including our own, by encouraging tutorial groups and perhaps providing suggested tutorial frameworks for students who have never taken on a teaching role before.

The pandemic has broadened our understanding of the value of a strong medical school community. Having a peer network is fundamental for coping with the emotional demands of medicine, particularly in the context of COVID-19 [17,18]. Regarding academic demands, we have learned that students will support each other in unprecedented circumstances, when it is needed most.

Conclusion

The COVID-19 pandemic has forced us to re-evaluate key aspects of medical education. The lessons learned throughout this process address the need for a fair system for medical students, the importance of adaptability in all aspects of medical education, and the value of a strong medical school community. These lessons can be applied in the years to come to improve medical education as we know it.

Conflicts of Interest

None declared.

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Abbreviations

MDT: virtual multidisciplinary team

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Viewpoint

Integration of Technology in Medical Education on Primary Care During the COVID-19 Pandemic: Students' Viewpoint

Nadine Paul[1*], BA; Sae Kohara[1*], BSc; Gursharan Kaur Khera[1*], MPharm; Ramith Gunawardena[1*], BSc, MSc

King's College London, London, United Kingdom

[*]all authors contributed equally

Corresponding Author:
Nadine Paul, BA
King's College London
Faculty of Life Sciences & Medicine
King's College London School of Medical Education
London, SE1 1UL
United Kingdom
Phone: 44 7871593154
Email: nadine.paul@kcl.ac.uk

Abstract

The COVID-19 pandemic has forced medical schools and clinicians to transition swiftly to working online, where possible. During this time, final-year medical students at King's College London, England, have received some of their general practice teachings in the form of virtual tutor groups. The predominant feature of such groups is online patient simulations, which provide students a valuable experience to help gain insight into current clinical practice amid the pandemic and inform how their practices as incoming junior doctors would continue. Even in the absence of face-to-face teaching and clinical placements, students have been able to hone their medical knowledge and soft skills through these virtual, simulated consultations. They have been exposed to a new consultation style while in a safe and collaborative learning space. Here, we explore how medical students have benefited from these virtual tutor groups and how similar small-group online teaching opportunities can add value to the medical curriculum in the future.

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KEYWORDS

clinical education; curriculum development; personal characteristics; physician/patient relationship; professional development; education; medical student; telemedicine; simulation; COVID-19

Introduction

The upward trend in the use of digital health consultation applications has been greatly accelerated by the current COVID-19 pandemic [1]. This has compelled general practitioners, in particular, to rapidly shift from face-to-face consultations to telephone or video interactions wherever possible [2]. In many cases, this transition has been swift, and many health care professionals have experienced a steep learning curve. As final-year medical students at King's College London, England, our general practice teaching has also transitioned to a web-based format. In particular, virtual tutor groups (VTGs) have been introduced as a key component of the new online learning format. VTGs consist of small-group teaching sessions organized weekly that are supervised by an experienced general practice tutor. Students meet via a web-based video conferencing application such as Microsoft Teams (Microsoft Corporation) for interactive scenario- or simulation-based teaching. Students are required to manage patient cases via virtual consultations in a manner similar to how many general practitioners are currently practicing; these consultations are followed by feedback, discussion, and teaching. We have been using the VTG format for several months, and our positive experiences have given us a strong reason to believe that the benefit of these online group sessions span far beyond continuity in teaching. VTGs have given us the opportunity to practice consultation skills within a supervised and supportive environment while abiding social distancing guidelines. As we face a potential resurgence of COVID-19, the value of these skills is now more pertinent than ever.

Using Technology to Supplement Clinical Experience

In addition to bridging the gaps in teaching in primary care, VTGs have become an extremely useful and novel format for engagement during our time away from clinical placements. Patients are not physically present during the consultation; therefore, it becomes essential to perform a structured assessment of how unwell a patient is, merely through an audio or video-based interaction. We are encouraged to think laterally about how to perform a physical examination and use equipment that the patient may already have in their homes to aid diagnosis, such as home-based blood pressure monitors, peak flow meters, and oxygen saturation probes. Furthermore, we are often challenged to optimize our verbal communication in order to effectively lead a virtual consultation in the absence of physical interaction and non-verbal cues. This prompts reflection and, subsequently, adaptation to these new consultation styles. During all consultations, we are required to cover certain essential components such as addressing the patients' concerns, sharing a management plan, and providing adequate safety nets.

Key Challenges

As the prevalence of online consultations grows, the challenges associated with this style of practice also become apparent. Shaw et al [3] dispelled a common trope that despite technical difficulties, clinicians and patients can work collaboratively to find means to overcome them. Guidance is provided to aid clinicians to be able to evaluate whether remote patient examination is suitable and appropriate [4]. As students, we have found it challenging to determine whether inviting a patient to examine them in person would actually alter our management plan or whether they could be directed by virtual consultation to either be managed at home with safety netting or referred directly to secondary care; this challenge has been further compounded by our limited clinical exposure in recent times. Furthermore, an issue that we, as students, discovered was the lack of guidance for respecting patient exposure during virtual examinations and assessments; this was particularly true with regard to data protection and patient confidentiality. In order to safeguard patient privacy and maintain a positive physician-patient relationship, medical professionals must utilize medical software and video-conferencing applications with appropriate integrated security systems. The importance of data protection and privacy should be highlighted as part of the curriculum when guiding students through telemedicine training. This has led to productive discussions for different cases among our groups, with guidance from our general practice tutors.

Soft Skills and Teleconsultations

With reference to soft skills, we have received positive feedback from patients participating in our online simulated consultations. These patients mentioned that students consulting them expressed a great amount of empathy and were clear in their communication, despite the physical and technological barriers. We have found that reflecting, and subsequently, adapting our communication styles to suit telephone and video consultations proves to be a valuable learning experience, and one which we will draw upon often in the future. For example, over video consultations, verbal cues can be disruptive to the conversation; hence, the emphasis is on the importance of communicative facial expressions and body language. In contrast, means of non-verbal communication such as nodding or other silent methods of active listening are futile in telephone conversations. In the latter case, we must place greater emphasis on verbal acknowledgement without affecting the flow of conversation.

Group Learning

In addition to equipping students with essential skills in virtual consultations, we have found that VTGs create a strong sense of community among peers. The close-knit and collaborative learning environment has been especially welcomed in a time where didactic online teaching has largely been an isolating experience. Apart from conducting the simulated consultations ourselves, it has been an enriching experience to observe our peers navigate through complex scenarios. Giving and receiving feedback has also been confidence-inducing. The VTGs have allowed us the opportunity to develop our communication skills as well as share and integrate varied communication styles among us. This has allowed us to feel well prepared and enthusiastic for our return to the clinical environment, albeit somewhat virtually.

Conclusions

The role of technology in health care is undoubtedly expanding at a rapid pace, and this is especially true in the COVID-19 era, where noncontact solutions to health care needs have become essential. As final-year medical students, we believe that it is crucial that we are equipped to adapt to different formats of remote working and to address any associated challenges that may present in the future. There have been several technological adaptations to global medical curricula during the past months, such as the transition of physical lectures to web-based formats; however, many other aspects of medical teaching have been paused until face-to-face teaching can safely be resumed. We believe that by integrating simulated remote consultations through VTGs, students can continue to develop their communication skills and clinical acumen, and this should be considered as a permanent inclusion in the post–COVID-19 medical curricula.

Conflicts of Interest

None declared.

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Abbreviations

VTG: virtual tutor groups

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Viewpoint

Informal and Formal Peer Teaching in the Medical School Ecosystem: Perspectives From a Student-Teacher Team

Anson Hei Ka Tong[1]; Christopher See[2], MB BChir, MA, PGCE, PhD

[1]Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong, China (Hong Kong)

[2]School of Biomedical Sciences, Faculty of Medicine, The Chinese University of Hong Kong, Hong Kong, China (Hong Kong)

Corresponding Author:
Christopher See, MB BChir, MA, PGCE, PhD
School of Biomedical Sciences
Faculty of Medicine
The Chinese University of Hong Kong
610S, Choh-Ming Li Basic Medical Sciences Building
The Chinese University of Hong Kong, Shatin, N.T.
Hong Kong
China (Hong Kong)
Phone: 852 39430465
Email: christophersee@cuhk.edu.hk

Abstract

These personal views, drawn from the experiences of a medical student and a medical school lecturer, advocate caution of the current trend for formal adoption of peer teaching into medical school curricula. Using a metaphor from physics, we highlight the need for cautious deeper exploration of the informal world of peer-teaching in medical schools, which is a complex part of the educational ecosystem, prior to incorporating such activities into faculty-led initiatives. We support a measured approach to the introduction of compulsory peer-teaching activities given the recognized theoretical and pedagogical benefits.

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KEYWORDS

Peer learning; medical education; peer teaching; peer-led learning; peer; education

Introduction

In physics, the observer effect describes a situation involving a subatomic particle such as an electron, which has a certain momentum and position [1]. If one makes an attempt to measure the momentum of the electron, the very act of doing so will affect its position. Therefore, it is not possible to directly instrument such particles without altering the system that one wishes to observe.

Many peer-to-peer teaching moments in medical education might similarly be thought to exist in a kind of subatomic plane, or at least in one that is not always visible to faculty members. From the perspectives of a medical student and lecturer, we set out the impressive range of peer-led teaching that occurs in informal settings. We recognize the potential benefits of peer-led teaching in either informal or formal settings, including improved social and cognitive congruence between peer-teachers and students [2] and improved communication skills and teaching ability for participants [3]; however, we make the case that, despite these benefits, instrumenting the existing ecosystem of informal peer-teaching activities and incorporating them formally into faculty practices and curricula would be difficult to achieve without altering them fundamentally. The current trend in medical education literature of constructing formal peer-led medical education interventions and comparing improvements [4] is exactly the kind of instrumentation that should be considered carefully.

A Student's Perspective

Upon entering my university's medicine course, I was randomly assigned by the faculty into a *small group* consisting of around 15 students. Initially, these groups were designed to serve a social rather than academic purpose. But what started off as a mere attempt by the faculty to promote a friendly setting for students slowly developed into a superb environment to cultivate student-initiated peer education.

The beauty of this small group system is the freedom to coordinate peer education both horizontally, allowing students of the same year to learn from one another, and vertically, with senior students teaching junior students. It has been a tradition for seniors to give advice and resources to juniors in the same small group; some seniors may even initiate study sessions. When I was in year 2 studying anatomy of the thorax and abdomen, a couple of year-3 students kindly organized such a study session for our group. They broke down complex concepts into simple language, arranged tedious details into mnemonics, and gave advice on how to order study topics when revising.

When I encountered the widely feared anatomy of the pelvis, there were a series of files created by a senior student being circulated within our class. Expecting to hear the familiar groans that come with the end of every perplexing pelvis lecture, I was surprised to instead hear everyone gushing over how amazing these materials were. Upon observation, these peer-made documents were excellent, simply because they were specifically curated for us, our curriculum, our examination, and our way of understanding. These beautifully color-coded notes spotlighted the most important concepts to know and included links to external videos or reference websites, hand-drawn diagrams, exam tips, and more.

In this curious underworld of peer education, learning comes in many forms—it is this multifaceted nature of peer education that demonstrates the imperceptible range of student learning practices. Yet, this closely networked form of peer education is not simply another study method. From a learner's perspective, both formal and informal education serve key functions in the learning experience as a whole, forming what, I believe, is a symbiotic relationship between teaching from the official curriculum and student-led teaching.

To me, informal peer-education can provide additional learning experiences that formal education cannot provide. In addition to benefits such as higher engagement levels in smaller, casual environments, my experience with peer education is particularly treasured because I knew that my peer teacher had experiences similar to my own. I found it easier to digest certain explanations when presented in simple Cantonese with relatable analogies, compared to those presented in scholastic, jargon-heavy English. I felt that, in a very visceral way, I had a safety net for formal education in the form of this peer education network.

There is no single textbook able to provide all the information needed for a surgeon to practice well, and similarly, any one lecturer's words alone are not sufficient to provide a student with a well-rounded understanding of a topic—this is a gap in formal education that informal education can fill.

A Teacher's Perspective

Several vivid embarrassments as a lecturer have given me limited insight into the invisible role of peer teaching. After making a key point in a lecture, imagine seeing a pair of students chatting in the third row. I was rather displeased at this, and politely but firmly asked what private discussion was so important. With very red faces, the students were not forthcoming, so I went over to their seats. I was astonished to find a video of Michael Jackson doing his famous Moonwalk, his feet perfectly alternating in plantarflexion and dorsiflexion as I had described. "Is this what you mean?" one asked. It was my turn to turn extremely red. In my teaching, I had chosen a reference that was as iconic as I could imagine, but to 18-year-old students in Hong Kong, it was as alien as could be. Surely a peer would be able to communicate this point in a more culturally appropriate manner.

I was also astonished to discover that an alternative version of my lecture notes was in circulation. Senior students had taken to the PowerPoint slides with highlighter and pen, inserting English explanations and Cantonese characters, drawings, internet links, emojis, and practice questions. My lecture now lives in a student-only accessible cloud, together with edited versions of every other lecture in the course in a file known evocatively as the "God Disk." With such a title, its significance to the student body may be hard to overestimate.

I was both offended and relieved at this discovery. Peer teaching in this form, it seems to me, was a kind of calibration and curation by students for students. Looking around further, informal peer teaching seemed to manifest in so many forms: microteaching moments between one student asking a question of another in the library, partners stalking a practical laboratory and solving problems in lockstep, or seniors and peers from school alumni groups, church groups, and beyond providing informal sharing. Peer teaching can range from the tiny to the enormous. It is my distinct feeling that I have just scratched the surface of what really goes on in a medical student's education.

I have had other encounters where my experience in teaching was no match for the clarity of a peer-teaching moment. (Who knew that a macula hole in the retina looks like a specific kind of local dim sum known as a *Siu Mai*?) At times, I wondered if my role could be replaced by a well-trained army of peer teachers. On the other hand, students are not able to draw on clinical experiences of the emergency department late at night or of variant and unusual cadavers to illustrate learning points. A complex relationship exists where teacher-led and peer-led teaching together lay the path for the learning journey of medical school.

Considerations For Educators

Medical education literature demonstrates a proliferation of peer-led teaching studies of varying sizes and designs [5,6]. Medical faculty members increasingly recognize the benefits of peer teaching, such as creating a safe learning space, teaching at a similar cognitive level [7], and allowing students themselves to learn the art of teaching. However, we believe that the choice to instrument a phenomenon occurring in a complex and potentially fragile system is not a trivial one. Student-led teaching already occurs in medical schools outside of the view of faculty members. Many educators are asking—How can we harness its potential? How can we incorporate it into the curriculum?—but, in our opinion, the question that comes before is—Should we?

A deep scholarly understanding of what occurs in peer-led teaching, including the motivation behind the individuals teaching, the nature of the interactions, and the learning processes involved must precede integration into formal curricular settings. An appreciation of the symbolism and meaning of teaching given by students to students, which occurs outside of faculty oversight, can ground such teaching in the culture of student practices. Such an exploration may be undertaken by qualitative studies such as ethnography or even peer ethnography, whereby members of the cohort to be studied are trained as researchers.

To us, the student ecosystem of education is a complex and multilayered system integrating formal and informal teaching from faculty members, peers, seniors, and outside resources. We believe that there is great pedagogical power in the peer-led learning aspect but also that it is precious. We suggest that before peer-led teaching is systematized, quantified, and introduced as a compulsory part of medical school, a deep exploration of givers and receivers of such education must be elicited. If not, faculty members may become part of the instrumentation which fundamentally alters an invisible system, casting the subatomic particle of peer teaching into an unknown trajectory.

Conflicts of Interest

None declared.

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Viewpoint

Medical Students' Corner: Barriers to Communication During the COVID-19 Pandemic

M Olabisi Ogunbiyi[1], BSc (Hons); Emma Obiri-Darko[1], BSc (Hons)

[1]University College London Medical School, London, United Kingdom

Corresponding Author:
M Olabisi Ogunbiyi, BSc (Hons)
University College London Medical School
74 Huntley Street
London
United Kingdom
Phone: 44 7483126613
Email: zchamoo@ucl.ac.uk

Abstract

The COVID-19 pandemic has inspired us, as medical students, to reflect upon the communication training we have received in medical school and the obstacles we have faced in the clinic due to COVID-19. We hold the view that our communication training is inadequate; this view is driven by our limited exposure to patients, a situation that is currently being exacerbated by the pandemic. The medical curriculum must be inclusive of all groups and take into account the new challenges arising during the COVID-19 pandemic.

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KEYWORDS

COVID-19; medical education; education; student; communication; perspective; medical student; barrier; culture

Communication is vital in improving health outcomes, especially in marginalized communities such as non-English speakers and people with impaired hearing. Indeed, patients from these groups have lower satisfaction and outcomes in most health care settings [1,2]. Currently, medical education is lacking in providing students with the necessary skills to facilitate adequate care for people in these communities. These skills include verbal and nonverbal communication, cultural sensitivity, adapting the clinical environment, and accessing medical translation facilities. Our medical training does not include any consultation models geared specifically towards patients who are deaf or who are not fluent in English. We also do not receive simulation training on how to communicate with these patients or on how to access translation or sign language services during placements. In our own experience, we often feel unable to take a complete history, and we often wonder if the patient fully understands our advice.

The use of masks is now widespread in every health care setting. This can be an unsettling communication barrier, especially for people with hearing impairment or limited English language skills [3,4]. The use of face masks also has a detrimental effect on information exchange, shared decision-making, and patient adherence to medical advice [5]. Although masks help reduce disease transmission, little consideration is given to patients who rely on nonverbal communication to navigate their health care. We have found that with masks, it is difficult to gauge the patient's emotions, and it is even more difficult for the patient to understand us. We propose the introduction of simulation training with people with impaired hearing to develop the skills necessary to provide an adequate consultation. In addition, transparent surgical masks should be made available in every health care setting for this purpose [3]. Medical sign language could also be offered as an extracurricular component in medical schools.

To minimize infection exposure, the use of telephone consultations in primary care has increased dramatically [5]. General practitioners are advised to reserve face-to-face appointments for acutely ill patients only. This approach poses several barriers to people with language difficulties. First, in our experience, many patients opt out of or refuse video consultations, which minimizes the use of visual aids, gestures, and drawings—techniques we are encouraged to use in our medical school training. Indeed, as medical students, we feel ill-equipped to conduct telephone consultations with people who are not fluent in English, as we cannot use visual cues or body language to communicate. We have found that we are often misunderstood by patients during telephone consultations; also, patients are often too embarrassed to tell us they do not understand. These challenges will continue to be present during the pandemic as the number of telephone consultations continues to increase and as such consultations become a more permanent fixture in many health care settings. This exemplifies the need for simulation training on both remote consulting and consulting with people with limited proficiency in English. Additionally, video consultations should be enforced where necessary for adequate communication.

Due to the new challenges posed by the COVID-19 pandemic, already ill-equipped students are encountering more challenges. It should also be noted that many medical students were away from the clinical setting for almost 6 months, further reducing their ability to practice and develop communication skills. Our current curriculum only includes a few simulation sessions in the entire course; these sessions feature monolingual English-speaking actors with unimpaired hearing. Based on student feedback, we encourage medical schools to provide more virtual sessions to teach communication and also to introduce teaching tailored to consider mask-wearing and language barriers. We hope this will become a core facet of the medical school curriculum. We believe that establishing this form of teaching has the potential to shape a generation of medical students who are skilled at communicating with a diverse range of people. If this gap in health care is not urgently addressed, it will only widen.

Conflicts of Interest

None declared.

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Original Paper

Awareness and Preparedness of Field Epidemiology Training Program Graduates to Respond to COVID-19 in the Eastern Mediterranean Region: Cross-Sectional Study

Mohannad Al Nsour[1], PhD; Yousef Khader[2], SCD; Abdulwahed Al Serouri[3], PhD; Haitham Bashier[1], PhD; Shahd Osman[4], MSc

[1]Global Health Development/Eastern Mediterranean Public Health Network, Amman, Jordan

[2]Jordan University of Science and Technology, Irbid, Jordan

[3]Yemen Field Epidemiology Training Program, Sana'a, Yemen

[4]Sudan Field Epidemiology Training Program, Khartoum, Sudan

Corresponding Author:
Yousef Khader, SCD
Jordan University of Science and Technology
Alramtha-Amman Street
Irbid, 22110
Jordan
Phone: 962 796802040
Fax: 962 796802040
Email: yskhader@just.edu.jo

Abstract

Background: The Field Epidemiology Training Program (FETP) is a 2-year training program in applied epidemiology. FETP graduates have contributed significantly to improvements in surveillance systems, control of infectious diseases, and outbreak investigations in the Eastern Mediterranean Region (EMR).

Objective: Considering the instrumental roles of FETP graduates during the coronavirus disease (COVID-19) crisis, this study aimed to assess their awareness and preparedness to respond to the COVID-19 pandemic in three EMR countries.

Methods: An online survey was sent to FETP graduates in the EMR in March 2020. The FETP graduates were contacted by email and requested to fill out an online survey. Sufficient number of responses were received from only three countries—Jordan, Sudan, and Yemen. A few responses were received from other countries, and therefore, they were excluded from the analysis. The questionnaire comprised a series of questions pertaining to sociodemographic characteristics, knowledge of the epidemiology of COVID-19, and preparedness to respond to COVID-19.

Results: This study included a total of 57 FETP graduates (20 from Jordan, 13 from Sudan, and 24 from Yemen). A total of 31 (54%) graduates had attended training on COVID-19, 29 (51%) were members of a rapid response team against COVID-19, and 54 (95%) had previous experience in response to disease outbreaks or health emergencies. The vast majority were aware of the main symptoms, mode of transmission, high-risk groups, and how to use personal protective equipment. A total of 46 (81%) respondents considered themselves well prepared for the COVID-19 outbreak, and 40 (70%) reported that they currently have a role in supporting the country's efforts in the management of COVID-19 outbreak.

Conclusions: The FETP graduates in Jordan, Sudan, and Yemen were fully aware of the epidemiology of COVID-19 and the safety measures required, and they are well positioned to investigate and respond to the COVID-19 pandemic. Therefore, they should be properly and efficiently utilized by the Ministries of Health to investigate and respond to the current COVID-19 crisis where the needs are vastly growing and access to outside experts is becoming limited.

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KEYWORDS

COVID-19; infection; preparedness; awareness; Jordan; Yemen; Sudan

Introduction

In 2014, the Global Health Security Agenda was launched to accelerate progress toward implementation of the International Health Regulations (IHR) 2005, so that all countries are able to rapidly detect, respond to, and control public health emergencies [1,2]. This emphasized the role of Field Epidemiology Training Programs (FETP) to ensure global health security [3]. FETP is originally a 2-year training program in applied epidemiology that is established to produce well-trained multidisciplinary public health professionals who are competent in health surveillance systems, outbreak detection and response to health threats, and management of emerging and re-emerging diseases [4,5]. In recent years, the Ministries of Health in some countries have recognized the importance of strengthening the capacity of the public health workforce at all levels of the public health system. In response, a three-tiered "pyramid" model of training (ie, advanced: 2 years, intermediate: 9 months, and basic: 3 months) was adopted. However, only few countries had achieved the Joint External Evaluation target of having 1 trained field epidemiologist (or equivalent) per 200,000 people [6].

The current coronavirus disease (COVID-19) and the previous outbreak of severe acute respiratory syndrome raised concerns about the continued global vulnerability to infectious disease threats and the poor preparedness to respond to such threats [2,7]. This vulnerability underscores the need for field epidemiology workforce and capacity in all countries of the world at all levels of the health care and public health system.

The Eastern Mediterranean Public Health Network (EMPHNET) has helped to launch, establish, and support several FETPs in many countries in the Eastern Mediterranean Region (EMR). As service-based training programs implementing competency-based training under the supervision of qualified mentors/supervisors, FETPs are focused on building workforce capacity in public health surveillance, outbreak investigations, epidemiological methods, laboratory and biosafety, risk communications, health-related surveys, and evaluation of the impact of prevention and control programs. The programs are established within the Ministries of Health and have access to technical assistance from the Centers for Disease Control and Prevention.

In the EMR, FETP residents and graduates have contributed significantly to improvements in surveillance systems, control of infectious diseases, and outbreak investigations [8] and have been instrumental in controlling many past epidemics including Middle East respiratory syndrome (MERS) [9,10] and dengue fever outbreak [11]. During the current emergency, the FETP graduates played a key role in actions responding to COVID-19 including developing preparedness plans, supporting and evaluating the surveillance system to identify the gaps and needs, assessing the needs in health facilities for isolation rooms, case investigations, points of entry/arrivals screening and follow-up, quarantine and isolation protocols, transferring cases, risk communication, and training on infection control. FETP graduates in many EMR countries are currently members of different technical, advisory, and coordination committees that manage the COVID-19 threats in the region. Moreover, they are involved in developing/adapting local guidelines, protocols, and case definitions for health professionals to implement various interventions. Considering their instrumental roles during the COVID-19 crisis, this study aimed to assess the awareness and preparedness of FETP graduates in three EMR countries to respond to the COVID-19 pandemic.

Methods

Study Population

The study population consisted of advanced FETP graduates in three countries—Jordan, Sudan, and Yemen. An online questionnaire was sent to FETP graduates in the EMR in March 2020. The email addresses of the graduates were extracted from the FETP database at EMPHNET. The FETP database includes contact information and identifying information on the FETP residents and graduates in the region. The FETP graduates were contacted by email and requested to fill an online survey. The purpose of the study was explained to all contacted persons; they were informed that their participation is voluntary and were assured of confidentiality and privacy. Ethical approval was obtained from the Institutional Review Board at Jordan University of Science and Technology. A sufficient number of responses were received from only three countries—Jordan, Sudan, and Yemen. Few responses were received from other countries, and therefore, they were excluded from the analysis.

Study Questionnaire

An online questionnaire was developed using PollDaddy (Automaticc Inc) to collect the data. The questionnaire was anonymous to maintain the privacy and confidentiality of all information collected in the study. Questions of the survey were developed after reviewing pertinent literature and the international guidelines. The questionnaire was designed in English and comprised a series of questions pertaining to sociodemographic characteristics; knowledge of FETP graduates about the epidemiology of COVID-19; and their attitude, preparedness, and perception of COVID-19. The respondents were requested to answer questions on incubation period, symptoms of the disease, mode of transmission of the COVID-19, infection control measures for preventing COVID-19, high-risk groups, and diagnostic tests. Other questions were added to assess their preparedness to respond to COVID-19. The questionnaire was pilot tested on 10 FETP graduates in Jordan.

Data Analysis

Data were analyzed using IBM SPSS version 24 (IBM Corp). Descriptive statistical analysis was used to describe items included in the survey. Means and standard deviations were used to describe the continuous variables, and percentages were used to describe the categorical data.

Results

Participant Characteristics

This study included a total of 57 FETP graduates (20 from Jordan, 13 from Sudan, and 24 from Yemen) from the three studied countries. Table 1 shows the characteristics of the respondents. Almost three-quarters (n=40, 70%) of the participants were male, 30 (53%) were aged <40 years (mean 39.2, SD 8.1 years), and 24 (42%) had ≥10 years of work experience (mean 10.2, SD 8.2 years). Of all participants, 46 (80.7%) were employed by the Ministry of Health. A total of 31 (54%) graduates had attended training on COVID-19, 29 (51%) were members of a rapid response team against COVID-19, and 54 (95%) had previous experience in response to disease outbreaks or health emergencies. The FETP graduates in Jordan were more likely to be in the response team against COVID-19 than their counterparts in Sudan and Yemen.

Table 1. The characteristics of 57 Field Epidemiology Training Program graduates in Jordan, Sudan, and Yemen.

Variable	Country			
	Jordan (n=20), n (%)	Sudan (n=13), n (%)	Yemen (n=24), n (%)	Total (N=57), n (%)
Gender				
Female	5 (25)	8 (62)	4 (17)	17 (30)
Male	15 (75)	5 (38)	20 (83)	40 (70)
Age (years)				
<40	14 (70)	9 (69)	7 (29)	30 (53)
≥40	6 (30)	4 (31)	17 (71)	27 (47)
Work experience (years)				
<10	14 (70)	7 (54)	11 (46)	32 (56)
≥10	5 (25)	6 (46)	13 (54)	24 (42)
Attended training on COVID-19[a]	15 (75)	6 (46)	10 (42)	31 (54)
A member of a rapid response team against COVID 19	17 (85)	7 (54)	5 (21)	29 (51)
Previous experience in response to disease outbreaks or health emergencies	18 (90)	13 (100)	23 (96)	54 (95)

[a]COVID-19: coronavirus disease.

Awareness of the Epidemiology of COVID-19 Infection

Table 2 shows the FETP graduates' awareness of the epidemiology of COVID-19 infection. All respondents were aware that the incubation period is between 1 and 14 days and that the main symptoms of the COVID-19 infection include fever and cough. The majority (n=56, 98%) reported shortness of breath, 44 (77%) reported sore throat, 38 (67%) reported runny nose, and 38 (67%) reported that COVID-19 may present with no symptoms. All were aware that the mode of transmission of COVID-19 includes coughing and sneezing, and the majority reported knowledge of transmission through hand shaking (n=50, 88%) and touching surfaces such as doorknobs and tables (n=51, 89%). The majority (n=56, 98%) reported that real-time polymerase chain reaction (PCR) with respiratory material is the diagnostic test for COVID-19. When they were asked about what should be considered to identify patients at risk of COVID-19, 55 (96%) reported history of travel to areas with transmission of COVID-19, 51 (89%) reported history of contact with possibly infected patients, 46 (81%) reported the presence of symptoms of a respiratory infection, and 2 (4%) reported the presence of symptoms of diarrhea. The majority were aware of high-risk groups such as people with immune system deficiency (n=55, 96%), people with chronic diseases (n=55, 96%), and health care providers (n=52, 91%).

Table 2. The Field Epidemiology Training Program graduates' awareness of the epidemiology of COVID-19 infection.

Variable	Country			
	Jordan (n=20), n (%)	Sudan (n=13), n (%)	Yemen (n=24), n (%)	Total (N=57), n (%)
Symptoms of the COVID-19[a] infection				
Fever	20 (100)	13 (100)	24 (100)	57 (100)
Cough	20 (100)	13 (100)	24 (100)	57 (100)
Shortness of breath	20 (100)	12 (92)	24 (100)	56 (98)
Sore throat	19 (95)	6 (46)	19 (79)	44 (77)
Runny nose	13 (65)	6 (46)	19 (79)	38 (67)
None	13 (65)	8 (62)	17 (71)	38 (67)
Joint/muscle pain	10 (50)	8 (62)	14 (58)	32 (56)
Diarrhea	12 (60)	2 (15)	10 (42)	24 (42)
Red eyes	2 (10)	2 (15)	4 (17)	8 (14)
Rash	0 (0)	2 (15)	0 (0)	2 (4)
Mode of transmission				
Coughing and sneezing	20 (100)	13 (100)	24 (100)	57 (100)
Hand shaking	16 (80)	12 (92)	22 (92)	50 (88)
Touching surfaces	16 (80)	13 (100)	22 (92)	51 (89)
Diagnostic test: real-time polymerase chain reaction with respiratory material	20 (100)	13 (100)	23 (96)	56 (98)
Criteria to identify patients at risk of COVID-19				
History of travel to areas experiencing transmission of COVID-19	20 (100)	13 (100)	22 (92)	55 (96)
History of contact with possible infected patients	17	13 (100)	21 (88)	51 (89)
Respiratory infection symptoms	16	13	17 (71)	46 (81)
Diarrhea symptoms	0 (0)	1 (8)	1 (4)	2 (4)

[a]COVID-19: coronavirus disease.

Awareness of Safety Measures and Preparedness to Respond to COVID-19

Table 3 shows the FETP graduates' awareness of safety measures and their preparedness to respond to COVID-19. All FETP graduates reported that they know how to use personal protective equipment and 50 (88%) reported that they know how to perform isolation procedures to minimize chances for exposure. More than half (n=33, 58%) reported that they are highly confident to handle suspected COVID-19 patients. All reported that they do not mind working in a place where patients with COVID-19 are treated. The majority (n=53, 93%) reported that they are up to date on safety measures for COVID-19. A total of 46 (81%) respondents considered themselves well prepared for the COVID-19 outbreak and 40 (70%) reported that they currently have a role in supporting the country efforts in the management of COVID-19 outbreak. Almost half (total: n=26, 46% [Jordan: 12, 60%; Sudan: 3, 23%; Yemen: 11, 46%]) reported that they think that their countries are prepared for the management of the COVID-19. However, only 11 of 26 persons (42%) reported that they are satisfied with the preparedness of their countries to respond to the COVID-19 pandemic. All reported that they know whom to contact in a situation where there has been an unprotected exposure to a known or suspected COVID-19 patient.

Table 3. The Field Epidemiology Training Program graduates' awareness of safety measures and their preparedness to respond to COVID-19.

Variable	Country			
	Jordan (n=20), n (%)	Sudan (n=13), n (%)	Yemen (n=24), n (%)	Total (N=57), n (%)
Know how to use personal protective equipment	20 (100)	13 (100)	24 (100)	57 (100)
Know how to perform isolation procedures	17 (85)	13 (100)	20 (83)	50 (88)
Level of confidence in handling suspected COVID-19[a] patients				
High	8 (40)	9 (69)	17 (71)	34 (60)
Low	12 (60)	1 (8)	7 (29)	20 (35)
Not confident	0 (0)	3 (23)	0 (0)	3 (5)
Have the contact of the International Health Regulations focal point in the country	14 (70)	9 (69)	16 (67)	39 (68)
Up to date on safety measures for COVID-19	18 (90)	11 (85)	24 (100)	53 (93)
Do not mind dealing with and handling patients with COVID-19	20 (100)	12 (92)	24 (100)	56 (98)

[a]COVID-19: coronavirus disease.

Perception of COVID-19

The majority (n=53, 93%) perceived COVID-19 as moderately dangerous to very dangerous, 30 (53%) reported that it is more dangerous than severe acute respiratory syndrome, and 33 (58%) reported that it is more dangerous than MERS-CoV (coronavirus). About one-tenth (n=7, 12.3%) believed that COVID-19 is not currently a serious public health issue. A total of 31 (54%) respondents were aware of that COVID-19 symptoms often resolve with time.

Sources of Information About COVID-19

The majority of FETP graduates reported multiple sources for the information they receive about COVID-19 including the Ministry of Health (n=53, 93%), television and radio (n=32, 56%), Epishares (n=32, 56%), and social media (n=32, 56%).

Discussion

This survey provides insight on the preparedness of FETP graduates from three EMR countries and their level of awareness of COVID-19 epidemiology at the time of the COVID-19 pandemic. The three programs had different durations since their establishment. The FETP graduates in Jordan were more likely to be in the response team against COVID-19 than their counterparts in Sudan and Yemen. This might be explained by the fact that both Sudan and Yemen were not reporting cases at the time of data collection. However, the FETP graduates were involved in preparedness activities for COVID-19. Males were predominant in the sample, which can be explained by the higher percentages of males who were enrolled in these program.

To conduct and respond to an infectious disease outbreak such as COVID-19, the FETP graduates should be aware of the basics of infectious disease including agents and hosts, mode of transmission, signs and symptoms, and control measures [12].

Knowing the COVID-19 incubation period is crucial for FETP graduates to protect themselves from the subclinical infection [13]. All respondents identified the correct incubation period of 1-14 days [14]. Almost all respondents were able to identify cough and fever as the main symptoms of COVID-19 [15].

Although the majority of respondents perceived COVID-19 as a dangerous infection, all reported that they have no problem with handling patients with COVID-19. This reflects the positive attitudes of FETP graduates toward patients with COVID-19 and their willingness to control the pandemic. This is not surprising because FETP residents and graduates are trained to conduct outbreak investigation and respond to public health threats. Moreover, this reflects their high level of confidence in dealing with patients with COVID-19 because all were aware of how to use personal protective equipment and perform isolation procedures on patients to minimize chances for exposure.

This study showed that the majority of respondents receive information about COVID-19 from the Ministries of Health. Reliance on the Ministry of Health data and reports reflects that the information they gain is credible. Therefore, Ministries of Health need to make sure that all essential information and educational materials are posted on the ministries' website during the outbreak.

Half of the respondents gained information on COVID-19 from television and radio, Epishares, and social media. It is worth mentioning the EpiShares was identified as a source of information by many of the FETP graduates. Epishares is a networking platform powered by Global Health Development/EMPHNET [16]. The Epishares platform offers a space for public health professionals from the region and beyond to exchange ideas, discuss issues, share experiences, and share documents of interest. It functions like other social media channels, thus offering the ability to create pages and groups as well as share posts videos, photos, polls, documents, and more. Throughout the COVID-19 pandemic, the platform was used as a hub for news and knowledge and to provide regular updates from credible news sources about the pandemic. These updates are shared via a page on this platform dedicated to this purpose and titled "COVID-19 Updates." Furthermore, the platform holds a group dedicated to FETP. The group serves as a private space for FETP directors, advisors, and support teams to share guidelines, reports, practices, and exchange ideas in the fight against this pandemic.

Conclusions

The FETP graduates in Jordan, Sudan, and Yemen were fully aware of the epidemiology of COVID-19 and the safety measures. In addition, they are well positioned to investigate and respond to COVID-19 pandemic. Therefore, they should be properly and efficiently utilized by the Ministries of Health to investigate and respond to the current COVID-19 crisis where the needs are vastly growing and access to outside experts is becoming limited. Moreover, the current pandemic revealed the increased demand for more FETP graduates, and thus, there is a need to maintain and continue to improve the quality and reach of FETPs by expanding the number of countries with access to these programs and expanding the FETP tiered training approach (advanced, intermediate, and basic), especially in countries with similar health workforce challenges.

Conflicts of Interest

None declared.

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Abbreviations

COVID-19: coronavirus disease
EMPHNET: Eastern Mediterranean Public Health Network
FETP: Field Epidemiology Training Program
IHR: International Health Regulations
MERS: Middle East respiratory syndrome
PCR: polymerase chain reaction

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Original Paper

Understanding Medical Students' Attitudes Toward Learning eHealth: Questionnaire Study

Kjeld Vossen[1], MD; Jan-Joost Rethans[2], PhD; Sander M J van Kuijk[3], PhD; Cees P van der Vleuten[4], PhD; Pieter L Kubben[5], MD, PhD

[1]Maastricht University Medical Center, Maastricht, Netherlands
[2]Skillslab, Maastricht University Medical Center, Maastricht, Netherlands
[3]Department of Clinical Epidemiology and Medical Technology Assessment, Maastricht University Medical Center, Maastricht, Netherlands
[4]Department of Educational Development and Research, Maastricht University Medical Center, Maastricht, Netherlands
[5]Department of Neurosurgery, Maastricht University Medical Center, Maastricht, Netherlands

Corresponding Author:
Kjeld Vossen, MD
Maastricht University Medical Center
P. Debyelaan 25
Maastricht
Netherlands
Phone: 31 628091727
Email: kjeldvossen@hotmail.com

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Abstract

Background: Several publications on research into eHealth demonstrate promising results. Prior researchers indicated that the current generation of doctors is not trained to take advantage of eHealth in clinical practice. Therefore, training and education for everyone using eHealth are key factors to its successful implementation. We set out to review whether medical students feel prepared to take advantage of eHealth innovations in medicine.

Objective: Our objective was to evaluate whether medical students desire a dedicated eHealth curriculum during their medical studies.

Methods: A questionnaire assessing current education, the need for education about eHealth topics, and the didactical forms for teaching these topics was developed. Questionnaire items were scored on a scale from 1 (fully disagree with a topic) to 10 (fully agree with a topic). This questionnaire was distributed among 1468 medical students of Maastricht University in the Netherlands. R version 3.5.0 (The R Foundation) was used for all statistical procedures.

Results: A total of 303 students out of 1468, representing a response rate of 20.64%, replied to our questionnaire. The aggregate statement "I feel prepared to take advantage of the technological developments within the medical field" was scored at a mean value of 4.8 out of 10. Mean scores regarding the need for education about eHealth topics ranged from 6.4 to 7.3. Medical students did not favor creating their own health apps or mobile apps; the mean score was 4.9 for this topic. The most popular didactical option, with a mean score 7.2, was to remotely follow a real-life patient under the supervision of a doctor.

Conclusions: To the best of our knowledge, this is the largest evaluation of students' opinions on eHealth training in a medical undergraduate curriculum. We found that medical students have positives attitudes toward incorporating eHealth into the medical curriculum.

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KEYWORDS

eHealth; student opinion; mHealth; medical education; students; medicine; curriculum; digital skills

Introduction

According to the World Health Organization (WHO) definition, eHealth is the use of information and communications technology (ICT) to provide enhanced health services to communities [1]. eHealth services are defined as telehealth, electronic health records, mobile health, social media, and big data [1]. Several articles show promising results when eHealth is being used in medical fields [2-11]. For instance, it has been shown that eHealth interventions help to improve medication adherence [4], glycemic control in diabetes patients [6], and self-care among heart failure patients as well as improve the outcomes of cardiac rehabilitation among coronary heart disease patients [7,8] and improve mental health [9,10]. Teleconsultation by general practitioners has been proven as an alternative to face-to-face consultations in certain situations [11]. A review of 58 systematic reviews showed that overall eHealth provides beneficial results in a wide variety of medical applications [12]. These developments improve the quality of care or maintain the current standard and reduce health care costs [13-15]. These studies indicate that eHealth would allow for a change clinical practice for the better by using technology. However, this requires a workforce that is prepared to practice medicine in a way where eHealth is integrated into clinical practice.

Literature about educating medical students in the field of eHealth is scarce [16]. Due to this scarcity, we concluded that the implementation of eHealth education into the medical curriculum is limited. A recent assessment of medical curricula in Sweden showed that only one university had concrete plans about implementing eHealth into their medical curriculum [17]. Another trial in Australia showed that none of the universities had established an eHealth program [18]. In addition, the European Health Parliament found that current health professionals do not feel adequately trained in eHealth and found that formal eHealth training is lacking from an early stage in the training of medical professionals [19]. Universities and their executives are aware of the lack of formal eHealth education, but the medical curriculum is already crowded and priorities are given to other subjects [18].

Studies with composite student groups show that including eHealth courses in curricula increases knowledge and awareness about the topic [20,21]. There are several studies focusing solely on medical students where specific eHealth topics were tested; for example, app development or telehealth consultation skills [21-24]. These studies all show that a course, or even just one class, enhances the knowledge about specific topics and is appreciated by students. All this research assumes the top-down idea that eHealth education is important and necessary [16-27].

It may seem logical to incorporate eHealth into the medical curriculum; however, we do not know students' perceptions about this. In fact, we could not find any articles that attempted to find out where students stand with regard to eHealth education. It might be that students are unaware of the lack of eHealth training and, therefore, do not feel the need for additional education. If students feel that education about eHealth is unnecessary, a different approach to teaching them is needed, compared to when students feel like they need more education about eHealth. The goal of our study is to evaluate whether medical students feel prepared to take advantage of eHealth innovation in medicine.

Methods

Setting

The following study was conducted at the medical school of Maastricht University in the Netherlands between February and May 2018. During the 6-year-long undergraduate medical curriculum—the duration of the bachelor and master programs are 3 years each—there is no formal education about eHealth. The most likely way students might encounter eHealth is through their medical rotations.

Ethics Approval and Consent to Participate

This study was not submitted nor approved by an institutional ethics committee because we did not deem this necessary in accordance with Dutch law. Dutch ethical law states that ethical approval is only necessary in the case of medical research including human test subjects, as can be read in the Medical Research Involving Human Subjects Act (*Wet medisch-wetenschappelijk onderzoek met mensen*, in Dutch), paragraph 2 [28]. Our research was aimed at the improvement of education and training without submitting the participants to any medical intervention. Therefore, this was not deemed medical research but educational research. Consent to participate was obtained at the beginning of the questionnaire administration. When the participants opened the questionnaire online, they were met with a statement stating that participants consented to participate and the data could be used for research purposes.

Questionnaire

Overview

We were unable to find any pre-existing questionnaire that assessed students' attitudes toward learning eHealth; therefore, we decided to create our own questionnaire. To assess students' attitudes toward learning eHealth, we developed a Dutch questionnaire using Google Forms that was made accessible for the participants to fill out from February 2018 until May 2018. We chose this type of survey in order to reach as many students as possible and to increase the number of responses. Most of the students spend little time at the university and prefer to either work from home or spend their time learning at the hospital during their clinical rotations. The most effective way for us to reach these students was by using a format such as Google Docs.

We based the statements on the WHO definition of eHealth. We incorporated a question about every aspect of this definition in our questionnaire. Furthermore, we specified between the bachelor and master curricula to see if there were any significant differences between the two subgroups. Because there is currently no dedicated eHealth education course offered, we could not evaluate these topics; we could only assess whether or not our students would want access to education about the topics.

Excluding the personal questions, the questionnaire contained 18 or 20 statements, depending on the participants' study phase: bachelor or master program. The statements, which were translated into English for this paper, are listed in the Results section later in this article. The statements about current education and didactical options were piloted among 6 master students and 4 bachelor students, who found the statements clear and comprehensive. The master students' questionnaire contained two additional statements about the medical rotations and in-class education during the master program. The rest of the questionnaire was identical for both master and bachelor program students.

Characteristics

The first section of the questionnaire gathered participant characteristics (see Table 1). The answer given for the question *study level* routed participants to the next section. Bachelor students were routed to a form evaluating solely the bachelor education. Master students were routed to a form evaluating both the bachelor and master education. Participants could indicate how long ago they finished their medical education, choosing between *longer than 2 years ago* or *between 0 and 2 years ago*.

Table 1. Participant characteristics.

Characteristic	Value (N=303), n (%)
Gender	
Female	215 (71.0)
Male	88 (29.0)
Age (years)	
<20	38 (12.5)
20-25	226 (74.6)
>25	39 (12.9)
Technical skill level	
User	257 (84.8)
Advanced	43 (14.2)
Expert	3 (1.0)
Study level	
Bachelor	120 (39.6)
Master	183 (60.4)

Current Education

The second section reviewed current education. All questions about the current education and didactical options were answered using a 10-point Likert scale, ranging from 1 (fully disagree) to 10 (fully agree). We decided on a scale from 1 to 10 because our students are used to be graded using this scale, where a grade above 5.5 is considered satisfactory. Both the bachelor and master students' forms contained the following statement: "I feel prepared to take advantage of the technological developments within the medical field." This statement was included as an aggregate global judgment about the entire curriculum.

eHealth Topics and Didactical Format

After the section about the students' current education, the questionnaire was the same for every participant. The third section evaluated how students felt about different eHealth subjects in the medical curriculum. Topics listed were chosen based on the WHO definition of eHealth, namely, mobile apps, telemonitoring, applying modern technology in practice, data science, and machine learning. The last seven statements evaluated which didactical format the students preferred.

At the end of the survey, students had the option to give feedback or add explanations to their answers. It was not possible to skip questions or statements during the questionnaire; therefore, all questionnaires we received were complete.

Participants

A total of 316 medical students enroll at Maastricht University's medical school every year, resulting in a total of about 1896 students. We promoted the questionnaire via social media groups that are only accessible by our university medical students. The local medical student association allowed us to use their newsletter to promote the questionnaire. In addition to this, we reached out to medical students through their social media accounts by sending them a personal message about the questionnaire with a link to the Google Form. There was no incentive for students to fill out the form and there were no negative consequences if students did not fill out the form. The inclusion criterion was as follows: medical student actively studying at the time of the survey. The reason for applying this criterion was that all participants will have studied the same curriculum.

Statistical Analysis

Descriptive statistics consisting of the mean, standard deviation, 95% confidence interval, and Cronbach α were calculated, and box and whisker plots were drawn to give a graphic, representation of the results. R version 3.5.0 (The R Foundation) was used for all statistical procedures.

Results

Demographics

In total, 1468 invitations were sent to medical students to participate in the survey using social media, WhatsApp, and the platforms provided by the medical student association. There were 303 responses to the questionnaire, giving a response rate of 20.64% (303/1468). Characteristics of the participants are listed in Table 1. Most participants were female (215/303, 71.0%). The mean age was 22 years (range 20-25). This is comparable to the average age of medical students at our university. Master students were the largest subgroup, with a total of 183 participants out of 303 (60.4%). The other 120 participants were bachelor students (39.6%).

Results From the Survey

Table 2 shows how prepared the students feel to use eHealth in their future medical practice. The global aggregate statement "I feel prepared to take advantage of the technological developments within the medical field" scored a low value of 4.8 out of 10 (95% CI 4.6-5.0). Figure 1 shows the students' attitudes toward different topics upon which we questioned them. Students assigned positive values (ie, a score of 6 or higher) to all topics, meaning that they would like to receive more education about a given topic. The least popular topic was that of machine learning, which had a mean score of 6.4 (SD 1.8, 95% CI 6.2-6.9). The most popular topic was that of applying modern electronic technologies in health care, which had a mean score of 7.3 (SD 1.6, 95% CI 7.1-7.4). When comparing the results from the statements about the current curriculum with results from statements about the eHealth topics, there was a difference between the two. There was a discrepancy between eHealth-related content in current medical education and the amount of eHealth training that is considered useful by medical students.

Figure 1. Students' attitudes toward given topics in the medical curriculum (N=303). Scores range from 1 (fully disagree) to 10 (fully agree).

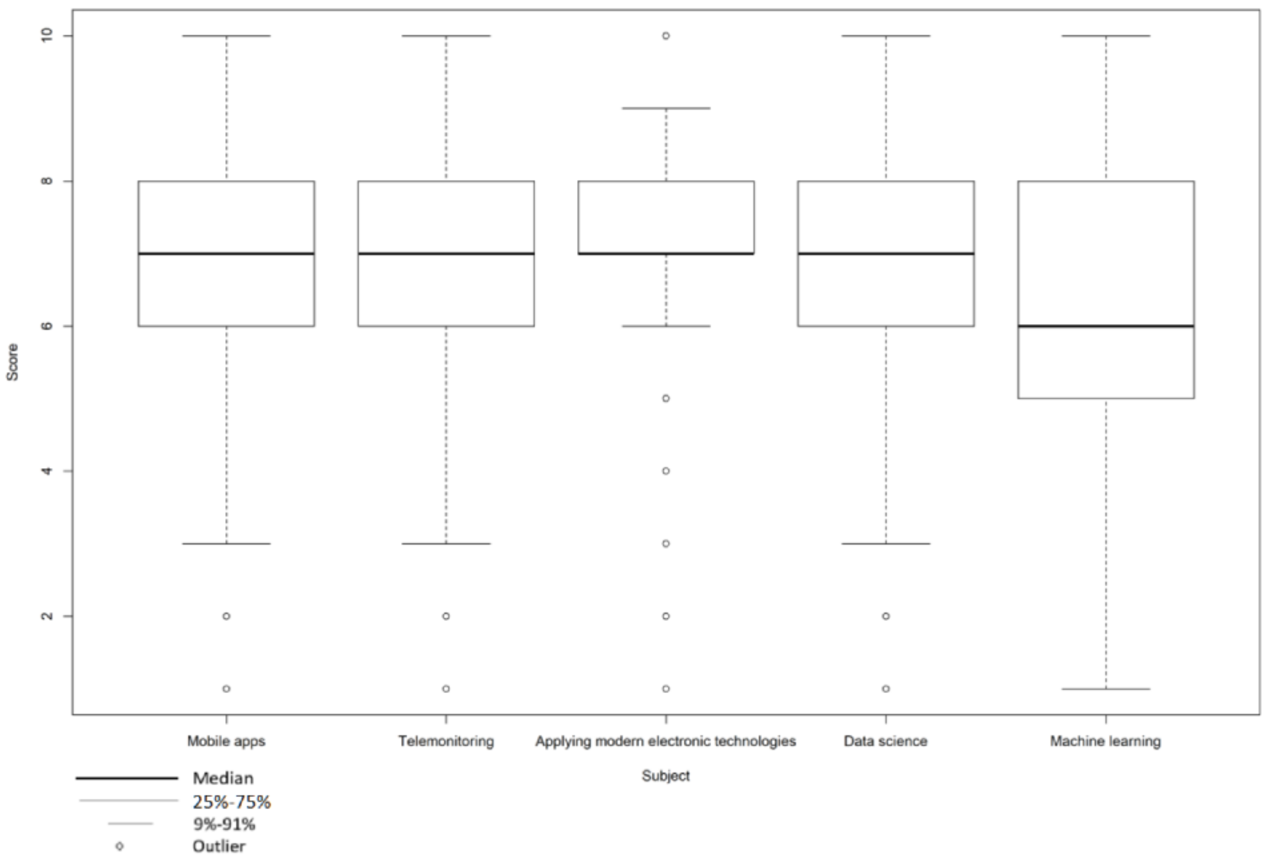
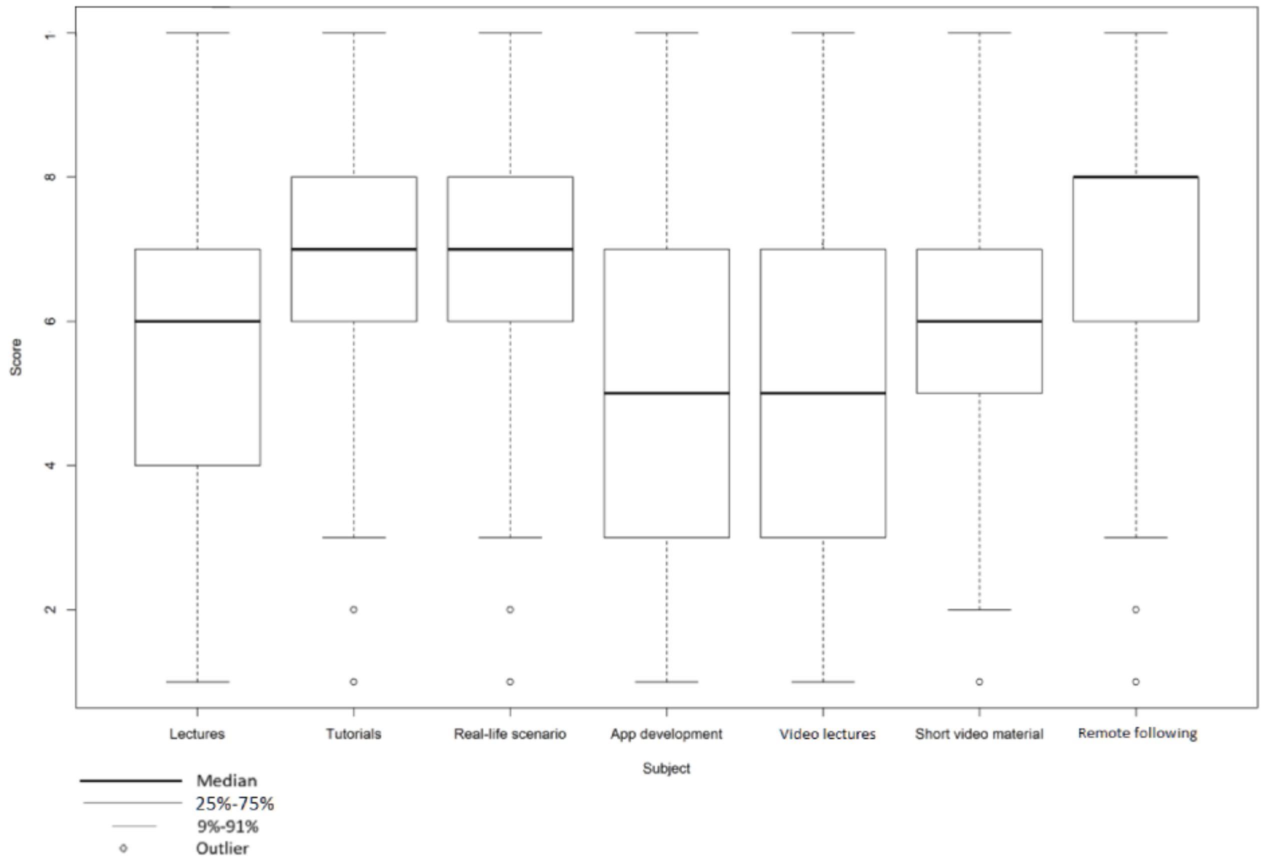


Table 2. Responses to statements regarding how prepared medical students feel with regard to eHealth and the education they would like to receive.

Category	Questionnaire statement	Score	
		Mean (SD)	95% CI
Type of student			
Bachelor student (n=120)			
	During the Bachelor of Medicine, there is enough education about the technological developments in medicine and eHealth.	4.9 (1.6)	4.7-5.1
	I feel prepared to take advantage of the technological developments within the medical field.	4.8 (1.6)	4.6-5.0
Master student (n=183)			
	During the Bachelor of Medicine, there is enough education about the technological developments in medicine and eHealth.	4.3 (1.8)	4.1-4.8
	During the Master of Medicine, there is enough education about the technological developments in medicine and eHealth.	4.6 (1.8)	4.4-4.8
	During my medical rotations, I increase my experience with eHealth and the use of technology within health care.	5.1 (1.8)	4.9-5.3
	I feel prepared to take advantage of the technological developments within the medical field.	4.8 (1.7)	4.6-5.0
Educational topics and didactical work format (N=303)			
Educational topics			
	During medical education, there should be more education about the use of mobile apps to support the treatment of a patient.	6.6 (1.7)	6.4-6.8
	During medical education, there should be more education about the use of telemonitoring of patients.	6.7 (1.7)	6.5-6.9
	During medical education, there should be more education about applying modern electronic technologies in health care.	7.3 (1.5)	7.1-7.4
	During medical education, there should be more education about using data science in medicine.	6.9 (1.8)	6.7-7.1
	During medical education, there should be more education about machine learning in medicine.	6.4 (1.9)	6.2-6.9
Didactical work format			
	I would like to receive education about technological developments in the form of lectures.	5.5 (2.1)	5.2-5.7
	I would like to receive education about technological developments in the form of tutorials.	6.7 (1.8)	6.5-6.9
	I would like to receive education about technological developments in the form of real-life scenarios and case descriptions.	6.8 (2.2)	6.6-7.1
	I would like to receive education about technological developments in the form of developing my own health app or mobile app.	4.9 (2.7)	4.6-5.2
	I would like to receive education about technological developments in the form of video lectures.	5.1 (2.3)	4.8-5.3
	I would like to receive education about technological developments in the form of short video material.	5.9 (2.2)	5.6-6.1
	I would like to receive education about technological developments in the form of remotely following a real-life patient under the supervision of a doctor.	7.2 (2.0)	7.0-7.5

Figure 2 lists the didactical format the students would prefer when learning about the given topics. The most popular format, with a mean score of 7.2 (SD 2.0), was to remotely follow a real patient under the supervision of a doctor. The least popular form of education was the development of a student's own health app or mobile app. This only received a mean score of 4.9 (SD 2.7).

Figure 2. Students' opinions about how they would like to receive education about eHealth topics (N=303). Scores range from 1 (fully disagree) to 10 (fully agree).



Discussion

Principal Findings

To the best of our knowledge, this is the largest evaluation of students' opinions on eHealth training in a medical undergraduate curriculum. We found that medical students have positive attitudes toward incorporating eHealth into the medical curriculum. This study showed that students do not feel well prepared to take advantage of eHealth in medical practice. The students scored an average of 4.8 out of a maximum of 10 when asked how prepared they felt to take advantage of eHealth in medical practice, while the need for education about the given topics scored a minimum of 6.4 and a maximum of 7.3. These results might provide a basis from which to continue a discussion regarding integrating eHealth into the medical curriculum.

eHealth has been proven to be effective in clinical practice [1-13,29,30]; however, eHealth has not yet been implemented into the working standards of many doctors [31-33]. Prior research indicates that training and education for all those involved with implementation and the use of eHealth is a key factor for the successful incorporation of eHealth [13-16,30]. There are various obstacles to implementing eHealth into clinical practice. The two biggest barriers to the use of eHealth in clinical practice are as follows: *technically challenged staff* (11%) and *resistance to change* (8%) [32].

Resistance to change is linked to several factors; lack of knowledge and skill obsolescence are major contributing factors [34]. Lack of eHealth skills and training is prevalent among the current medical workforce. This has been shown to be a major barrier to eHealth adoption [35-38]. This results from the fact that the workforce is not adequately trained to implement eHealth in medical practice [25-27,39]. Awareness and knowledge of what needs to change are essential in enabling change [40]. It has previously been shown that education can be used to overcome resistance to change [41,42]. Therefore, education about eHealth for those involved, in this case the undergraduate students, can lessen the barriers previously mentioned and help to create a workforce that is open and able to use eHealth in their daily practice. Many universities do not have dedicated eHealth training in the current curriculum, adding to the resistance to change [17,18]. Universities and their executives are aware that eHealth training is important, but due to the already overcrowded curricula with competing interests, implementation is lacking [18]. Our results suggest that we should dedicate more time to eHealth training, even though the curriculum is already overcrowded. This overcrowding can be overcome by changing education in the same way that clinical practice is being changed by eHealth. Case-based discussions that are based on a fictional patient can be replaced by cased-based discussions that are based on a real-life patient being remotely monitored in in a hospital, simulation patients can be replaced by teleconference simulation patients, and clinical rotations can incorporate remote care. eHealth education can be combined with the current subjects taught in the curriculum without taking up more time. By thinking of eHealth education the same way as eHealth implementation into clinical practice, it should be possible to incorporate this education into the medical curriculum. eHealth is not some added technology that takes up time; it should be an integrated aspect in clinical practice that improves the quality of care while reducing the workload. Showing students early on during their education that eHealth can be used in these ways might add to a certain digital mindset that is needed to use eHealth to its full extent as a clinician.

Medical students are not receiving enough education to prepare them for eHealth competency. The current workforce is not adequately trained to implement new technologies in working practice [17,18,25,26,34-39,43]. The data we gathered support this because the participants indicated they do not feel prepared to benefit from the technological developments in health care. This holds true for both the bachelor and master students. The master students gave the amount of eHealth training in the bachelor program a lower score, which might indicate that during their medical rotations they were confronted by the fact that their digital skills were lacking. The students indicated that during their rotations, they were not learning enough about eHealth and the use of technology within health care. This might be due to the fact that there is no mention of eHealth skills in the national Dutch framework, which states what competencies a future doctor needs. During these medical rotations, opportunities to develop digital skills are lacking. Their teachers make up the current workforce of doctors. We previously established that this workforce is not adequately prepared to take advantage of the possibilities offered by eHealth. Therefore, we cannot expect them to train the new generation of doctors to attain sufficient digital skills. It would be possible to integrate digital skills education during the medical rotations if taught by eHealth or ICT professionals. The skills could then be further developed during medical rotations, providing a solid foundation for the future workforce.

If eHealth education is implemented early in medical education, this might result in professionals being able to benefit from eHealth. Both bachelor and master students indicated that they feel a lack of this type of education. We concluded from this that it would be beneficial to start training the students during their bachelor phase. This would mean that they would be better prepared to use the skills they have learned during their medical rotations and, therefore, gain practical experience using their skills as soon as possible.

This study works as a basis to support the need for eHealth education among medical students. There is still a lot of work that needs to be done with regard to a framework that defines which eHealth competencies are needed by future doctors, what eHealth subjects should be prioritized, and how students should be taught these subjects.

Another factor that may cause insufficient attention with regard to eHealth training is the assumption that today's students are up to date with technological developments, including an understanding of eHealth, because of the widespread use of technology among this generation [20,44]. However, prior research demonstrates that undergraduate students do not have this knowledge [25-27]. It could mean that health care is missing out on some of the potential benefits of eHealth due to this assumption. Nevertheless, it is important to use the skills that students have already gathered in the digital age while training them for their professions as future doctors. We should, therefore, always invite student panels while creating a future eHealth curriculum.

Incorporating formal eHealth education into the medical curriculum may contribute to creating a necessary digital mindset [27,45]. This digital mindset means more than just the use of tools [31,32]; it would mean that medical professionals would start to think differently regarding how to provide health care. An example would be to think about how to change from traditional in-hospital care to future health care within patients' homes. We are increasingly able to gather large amounts of patient data and need medical staff that can think in creative ways in using this data [43]. We hope that by supporting the development of a digital mindset in future medical staff that they will see opportunities in techniques such as data science, machine learning, and deep learning.

Strengths and Limitations

The first limitation in this study is a low response rate amounting to 20.64% (303/1468). We used Google Forms to poll our students. This platform provides an easy and accessible way for participants to fill out forms. The downside was that it was impossible to make sure that people did not fill out the form multiple times. However, it seems unlikely that people filled out multiple forms. If duplicates had been filled out by certain individuals, this would change the demography of our sample. However, the demography of the participants matches the demography of our student population. Besides that, we checked the time stamps of all the forms to check if there were identical forms filled out in short succession. After checking time stamps and responses of each questionnaire, we found that there was no evidence that duplicate forms had been filled out.

Before we created the questionnaire, we looked for similar surveys, but we were not able to find any related to medical education. That is why we compiled our own questionnaire using the WHO definition for eHealth and recent literature. We took a pragmatic approach when creating our questionnaire, and the final questionnaire was not validated. All participants were from a single university in the Netherlands. This may limit the external validity of our results. During our research, we have noticed that there is a limited amount of literature about eHealth training for medical students and, therefore, we assume that most universities do not have a dedicated eHealth program. In this case, our results could inform other universities about the lack of eHealth training in their curriculum.

What This Paper Adds

The previous statements saying that eHealth education is necessary were top-down statements. This paper adds the students' views on eHealth and shows that students feel that they are not prepared to take advantage of the possibilities provided by eHealth. This paper shows that students want more education about eHealth topics.

Conclusions

This study demonstrates that students consider themselves insufficiently prepared for the digital aspect of their future medical practices and that they support greater attention to eHealth in the medical curriculum. This study indicates that the lack of eHealth education is not something that is experienced only by researchers who write about eHealth education but also by the medical students themselves.

Conflicts of Interest

None declared.

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Abbreviations

ICT: information and communications technology
WHO: World Health Organization

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Original Paper

The Quality of Instructional YouTube Videos for the Administration of Intranasal Spray: Observational Study

Marije M Peters-Geven[1], MD; Corine Rollema[2], MSc; Esther I Metting[3], MSc, PhD; Eric N van Roon[2,4], MSc, PhD; Tjalling W de Vries[5], MD, PhD

[1]Department of Neonatology, Isala, Zwolle, Netherlands

[2]Department of Clinical Pharmacy and Pharmacology, Medical Centre Leeuwarden, Leeuwarden, Netherlands

[3]Faculty of Economics and Business, University of Groningen, Groningen, Netherlands

[4]Groningen Research Institute of Pharmacy, Department of PharmacoTherapy, -Epidemiology and -Economy, University of Groningen, Groningen, Netherlands

[5]Department of Paediatrics, Medical Centre Leeuwarden, Leeuwarden, Netherlands

Corresponding Author:
Corine Rollema, MSc
Department of Clinical Pharmacy and Pharmacology
Medical Centre Leeuwarden
Henri Dunantweg 2
PO Box 888
Leeuwarden, 8901 BR
Netherlands
Phone: 31 58 286 3385
Email: corine.rollema@mcl.nl

Abstract

Background: Allergic rhinitis is a common disorder affecting both children and adults. Recommended treatment consists of intranasal corticosteroid spray administration, but only few patients administer the nasal spray in the correct technical manner. A wrong administration technique may result in side effects and affect the efficacy and adherence, thus making accurate administration instructions indispensable. Unfortunately, information about intranasal drug administration is generally not explained accurately, thereby leading to confusion among patients and inaccuracy in the self-administration of drugs.

Objective: In this study, we analyzed instructional videos available on YouTube for the administration of nasal sprays for allergic rhinitis. Our aim was to determine if the videos provided instructions in accordance with the standardized nationwide patient protocol in the Netherlands for intranasal spray administration.

Methods: Instructional videos for the administration of aqueous formulations of nasal spray for allergic rhinitis were found on YouTube. All videos were reviewed by 2 researchers and scored using the instructions from the Dutch standardized protocol. Correct instructions were given a score of 1, while incorrect or missing instructions were given a score of 0. The interrater reliability using Cohen κ was used to determine the differences in the scores between the researchers.

Results: We identified 33 YouTube videos made by different health care professionals and pharmaceutical companies around the world. None of the videos displayed all the steps correctly, while 5 of the 33 (15%) videos displayed over 75% of the steps correctly. The median score of the correctly displayed steps was 11 out of 19 (range 2-17, IQR 6). The interrater reliability using Cohen κ was statistically significant (range 0.872-1.00, P<.001). The steps “neutral position of the head,” “breathing out through the mouth,” and “periodically cleaning with water” scored the lowest and were incorrectly displayed in 28 (85%), 28 (85%), and 30 (91%) of the 33 videos, respectively.

Conclusions: The findings of our study revealed that only few instructional videos on YouTube provided correct instructions for the administration of nasal sprays to patients. The inaccuracy of the instructions for nasal spray administration in the majority of the videos may lead to confusion in patients and incorrect use of nasal sprays. In the future, it is important to make evidence-based instructional videos that show patients the correct technique of nasal spray administration.

Trial Registration: Not applicable

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KEYWORDS

allergic rhinitis; administration; intranasal spray; instruction videos; nasal; YouTube; educational video; corticosteroid; allergic; intranasal; allergy

Introduction

Allergic rhinitis is a common disorder affecting both children and adults [1,2]. The worldwide prevalence ranges from 5% to 32%, depending on age and geographics [2,3]. Although not life-threatening, this disorder has a major impact on patients' daily activities and quality of life [4-6]. When the symptoms are persistent, the recommended treatment for allergic rhinitis consists of administration of intranasal corticosteroid sprays [7-9]. It is important to administer the nasal spray in the correct technical manner. A recent study has shown that only 6% of the patients used the correct administration technique of intranasal corticosteroid sprays as described in the patient information leaflet [10]. However, administering the spray in the correct manner is essential because it appears to influence the side effects, efficacy, and adherence [11]. Patients may receive instructions regarding correct administration from their health care professional or the patient information leaflet or they can find information on the internet. However, it is suspected that patients do not receive this information correctly. Indeed, a recent study has shown that Dutch health care workers do not provide their patients with correct administration instructions. In addition, instructions in patient information leaflets for the administration of intranasal corticosteroid sprays are incomplete and nonuniform in both the Netherlands and the United Kingdom [12]. Because of the lack of easily accessible information on this topic, a standardized nationwide patient protocol for intranasal corticosteroid spray administration was introduced in the Netherlands in 2019 [13]. This guideline has been drawn up and checked by various experts and is therefore peer-reviewed. Because this is the only peer-reviewed protocol available, it is considered as standard in the Netherlands. Since 2019, this protocol has been used by health care providers in primary and outpatient care. For patients, an illustrated instruction chart has been published based on this protocol. Besides the protocol and the patient information leaflets, different providers have posted web-based instructional videos for nasal spray administration to inform patients and health care providers. In this observational study, we investigated which instructions for the administration of nasal sprays are given in the videos that can be found on YouTube, and we compared these instructions with the Dutch protocol to see if the given instructions are correct.

Methods

Recruitment

Instructional videos on YouTube were found by using the keywords "How to use nasal spray," "How do you use nasal spray," "Usage nasal spray," "Nasal spray instruction," "Nasal spray technique," "How to use nasal corticosteroids," "How do you use nasal steroid spray," "How do you use nasal steroids," and "How do you use nasal corticosteroid sprays." Brand names were included as keywords in an extensive search strategy. It turned out that these videos were already included, because publishers of these videos used the keyword "nasal spray" in their videos. Further, the same keywords were used on Google, but all pages were redirected to the already included YouTube videos.

All videos with English instructions for the nasal administration of an aqueous formulation with saline, antihistamines, and corticosteroids in a normal spray pump device were included. These sprays are all comparable with the spray pump devices that are available for patients in the Netherlands and need to be administered in the same way. Videos with other devices for nasal drug administration (such as nasal drops, nasal lavage, and spray pump devices with different user instructions compared to the normal spray pump device) and videos with nasal sprays for other indications (eg, naloxone) were excluded. Videos that provided only textual instructions were also excluded. No distinction was made between the creators of the instructional videos. All videos were collected and saved on the same day (October 24, 2019). The data collection flowchart is shown in Multimedia Appendix 1.

Statistical Analysis

Scoring

All instructions in the videos were reviewed by 2 researchers (MMPG and CR) and scored using the instructions as described in the Dutch standardized protocol as mentioned before (Textbox 1). The protocol consists of 19 steps comprising the preparation, administration, and cleaning of the spray. Each step was scored. When a correct instruction was given, the score was 1; an incorrect or missing instruction was scored as 0. In the analysis, descriptive statistics were used to determine which instructions for the administration of nasal sprays are given in the YouTube videos.

Textbox 1. Assessed steps for administration of intranasal sprays based on the steps in the standardized Dutch protocol.

Steps for priming

- Shake the spray.
- Remove the dust cap.
- Place thumb under the bottle and place index and middle fingers around the nozzle.
- Point the nozzle away.
- Squirt a few sprays in the air.

Steps for daily use

- Blow the nose.
- Shake the spray.
- Remove the dust cap.
- Place thumb under the bottle and place index and middle fingers around the nozzle.
- Keep the head straight.
- Close the other nostril.
- Point the end of the nozzle slightly outwards, away from the septum.
- Use contralateral hand position.
- Squirt a spray of mist while breathing in gently.
- Breathe out through the mouth.
- Repeat for the other nostril.
- Wipe the nozzle with a tissue.
- Replace the dust cap.
- Clean the nozzle once a week with warm water and let dry.

Assessment of Reliability

The interrater reliability using Cohen κ was used to determine the differences in the scores between the researchers. When differences in the scores were detected, the researchers reanalyzed the video and together determined the final score.

Results

Recruitment

A total of 33 videos were found and analyzed (details of the videos can be found in Table 1 and an overview of the included videos is shown in Multimedia Appendix 2). Most of the videos were made by physicians (20/33, 61%) from the United States (19/33, 58%) and were created for adults (30/33, 91%) by using intranasal corticosteroids (17/33, 52%).

Table 1. Characteristics of the analyzed YouTube videos (N=33).

Characteristics	n (%)
Professionals who created the videos	
Pharmacist	3 (9)
Physician	20 (61)
Pharmaceutical company	6 (18)
Other/unknown	4 (12)
Instruction for children	
Yes	3 (9)
No	30 (91)
Date of publication on YouTube	
<6 months before analysis	2 (6)
6-12 months before analysis	0 (0)
>12 months before analysis	31 (94)
Medication type	
General	15 (46)
Corticosteroids	17 (52)
Antihistamines	1 (3)
Video type	
Recorded with image and sound	29 (88)
Animation with spoken instructions	4 (12)
Origin	
United Kingdom	3 (9)
United States	19 (58)
Australia	4 (12)
India	2 (6)
Canada	1 (3)
Other/unknown	4 (12)

Statistical Analysis

Scoring

There was no video that showed all the steps correctly. The 3 videos with the highest score displayed 17 of the 19 steps correctly. Only 5 out of 33 (15%) videos displayed over 75% of the steps correctly. The median of the correctly displayed steps was 11, with a range between 2 and 17 and an interquartile range of 6. Instructions regarding removing the dust cap, the correct hand position, and repeating for the other nostril were correctly displayed most of the time, that is, in 32 (97%), 29 (88%), and 27 (82%) of the 33 videos, respectively. Keeping the head straight, breathing out through the mouth after spraying, and periodically cleaning the nozzle with water scored the lowest. These steps were incorrectly displayed in 28 (85%), 28 (85%), and 30 (91%) of the 33 videos, respectively. The results for each step are shown in Table 2.

Assessment of Reliability

There was a high degree of agreement in the scores between the 2 researchers, and the majority of the Cohen κ values were equal to 1 (lowest Cohen κ=0.872, Table 2).

Table 2. Number of steps carried out correctly and incorrectly in the analyzed videos, based on the steps in the standardized Dutch protocol (N=33).

Steps in instructional videos	Instruction carried out (Researcher 1), n (%)	Instruction carried out (Researcher 2), n (%)	Interrater reliability, Cohen κ	*P* value	Instruction carried out (conclusion), n (%)	Instruction not carried out (conclusion), n (%)
Steps for priming						
Shake the spray	17 (52)	17 (52)	1.00	<.001	17 (52)	16 (48)
Remove the dust cap	23 (70)	23 (70)	1.00	<.001	23 (70)	10 (30)
Place thumb under the bottle and place index and middle fingers around the nozzle	21 (64)	21 (64)	1.00	<.001	21 (64)	12 (36)
Point the nozzle away	21 (64)	21 (64)	1.00	<.001	21 (64)	12 (36)
Squirt a few sprays in the air	22 (67)	22 (67)	1.00	<.001	22 (67)	11 (33)
Steps for daily use						
Blow the nose	17 (52)	17 (52)	1.00	<.001	17 (52)	16 (48)
Shake the spray	22 (67)	22 (67)	1.00	<.001	22 (67)	11 (33)
Remove the dust cap	32 (97)	32 (97)	1.00	<.001	32 (97)	1 (3)
Place thumb under the bottle and place index and middle fingers around the nozzle	28 (85)	29 (88)	0.872	<.001	29 (88)	4 (12)
Keep the head straight	5 (15)	5 (15)	1.00	<.001	5 (15)	28 (85)
Close the other nostril	17 (52)	17 (52)	1.00	<.001	17 (52)	16 (48)
Point the end of the nozzle slightly outwards, away from the septum	21 (64)	22 (67)	0.933	<.001	21 (64)	12 (36)
Use contralateral hand position	13 (39)	13 (39)	1.00	<.001	13 (39)	20 (61)
Squirt a spray of mist while breathing in gently	19 (58)	21 (64)	0.874	<.001	20 (61)	13 (39)
Breathe out through the mouth	5 (15)	5 (15)	1.00	<.001	5 (15)	28 (85)
Repeat for the other nostril	27 (82)	27 (82)	1.00	<.001	27 (82)	6 (18)
Wipe the nozzle with a tissue	9 (27)	9 (27)	1.00	<.001	9 (27)	24 (73)
Replace the dust cap	17 (52)	17 (52)	1.00	<.001	17 (52)	16 (48)
Clean the nozzle once a week with warm water and let dry	3 (9)	3 (9)	1.00	<.001	3 (9)	30 (91)

Discussion

Principal Results

We found that none of the surveyed videos provide patients with correct instructions for the administration of nasal sprays as described in the standardized Dutch protocol. The instructors in the video either did not use a technique that is in line with the steps in the protocol or they showed only a few steps of the administration technique correctly. Instructions regarding keeping the head straight, breathing out through the mouth after spraying, and periodically cleaning the nozzle with water were incorrectly displayed in most of the videos. In the majority of the videos, the instructors recommended to bend the head forward during administration, instead of keeping the head straight. Exhalation through the mouth seemed to be not a conscious step specified by the instructors and was therefore not observed in the majority of the videos. Cleaning the nozzle is often not mentioned by the instructors and this indicates that the importance of this step is unknown.

The best administration technique of nasal sprays in relation to optimal treatment outcomes is marginally substantiated with research data. This may result in variations in the instructions used for the administration of nasal sprays, which is also what we observed in the web-based instructional videos. In the literature, there are differences in the instructions regarding the optimal head position, angle of the spray in the nose, and the way patients need to breathe in while spraying. However, there are studies that have clarified this. Benninger et al [14] have shown that when using intranasal corticosteroid sprays, there is no difference in the distribution of the spray for different positions of the head. Therefore, their advice is to keep the head in a neutral position. They also advise aiming the point of the nozzle outwards and away from the septum to avoid side effects such as epistaxis. Ganesh et al [11] have found that using a contralateral hand technique (using the left hand for the right nostril and vice versa) not only ensures a better effect of the spray and causes fewer side effects compared to ipsilateral administration but is also accompanied by improved compliance. The correct way to breathe in was explained by Tay et al [15]. They found that a gentle inspiration technique improves the intranasal distribution of the medication. The standardized protocol in the Netherlands for the administration of intranasal corticosteroid sprays is based on these findings and was developed to overcome the variation in the instructions [13]. We have assumed that the delivery techniques of all other sprays, in addition to intranasal corticosteroid sprays, are identical; for this reason, the Dutch protocol was used as the standard.

Previous research has shown that the majority of Dutch health care workers do not know how to administer intranasal corticosteroid sprays correctly; this may prevent them from being able to give adequate instructions to their patients [16]. Moreover, information in Dutch and British patient information leaflets is incomplete and nonuniform [12]. An increasing number of Europeans are looking for information on the internet. In the past 10 years, the percentage of people seeking health-related information on the internet has increased from 32% in 2009 to 53% in 2019 [17]. Benetoli et al [18] investigated the web-based behavior of people searching for health-related information on the internet and found that YouTube was broadly assessed for learning about medical procedures. It is therefore plausible that patients with allergic rhinitis might use YouTube for information about the correct administration of their nasal sprays. However, less is known about how these YouTube videos, easily reaching a broad audience, may affect patients [19]. This study shows that the video instructions for the administration of nasal sprays available on YouTube are of low quality, which can have important implications. It is therefore essential that correct information becomes easily available for patients with allergic rhinitis—incorrect information leads to incorrect use, and it may be confusing for patients when there are differences among the instructions they receive. As a result, patients will not recognize the need for correct use and will pay less attention when correct instructions are given. For asthma, multiple studies have shown that proper instructions ensure a better effect of the medication and that instructions must be repeated at least twice for good effect [20,21]. This indicates that there is a shortage of good research on this topic regarding nasal sprays.

We realize that everyone can make an instructional video and post it on YouTube, which means that incorrect information can be widely available. Yet, for most of the analyzed videos, the information was provided by a health care provider, which increases the trustworthiness of the video. This implies that there is a lack of substantiated knowledge about the correct administration technique of nasal sprays and that health care providers are providing instructions based on their own insights. Health care providers should be aware of the importance of the correct administration technique for nasal sprays and provide proper instructions both on the internet and in the consulting room. More attention needs to be drawn to the Dutch protocol, which can facilitate more uniform instructions given by health care professionals. In addition, health care providers should warn their patients about the low quality of web-based instructional videos, ask where patients receive their information, and explain to the patients why correct administration is so important.

Comparison With Prior Work

As far as we know, this is the first study that evaluates the instructions available in YouTube videos for the administration of nasal sprays. However, there are a few studies that are similar to ours. It is known that the administration techniques and instructions for the treatment of lung diseases such as asthma and chronic obstructive pulmonary disease are of great importance for symptom control [20,21]. Eudaley et al [22] investigated the quality of the instructions in videos on YouTube for administration of the RESPIMAT SOFT MIST inhaler. They found that none of the videos available on YouTube included all of the necessary instruction steps for correct administration, and in only 4 out of 35 videos (11%), all the steps for daily use were included correctly. This finding corresponds to our findings. For rheumatological diseases also, instructional videos for the administration of treatment are available on YouTube. Two studies about the quality of the instructions in these videos concluded that most of the information is misleading and potentially dangerous for patients [23,24]. This underscores our findings and emphasizes the need and importance of good instructional videos on YouTube.

Strengths and Limitations of Our Study

One strength of this study is that videos were found in a way that patients might also look for them; therefore, it reflects daily practice. Another strength of this study is that the videos were analyzed by 2 researchers, with a high degree of agreement in the scores (Cohen κ was used). However, this study also has some limitations. First, all videos were collected on the same day, but what is offered on YouTube changes continuously. It is possible that not all currently available videos are included in the study, although we used broad search terms to find all relevant videos. Second, this study evaluated differences between a standard protocol for nasal spray administration and protocols shown in web-based instructional videos. However, it is unclear whether patients actually look for this information as a guide to learning the correct administration technique, thereby affecting efficacy. Besides, the administration instructions in the videos are compared here with the instructions in the Dutch intranasal corticosteroid spray administration protocol but it has not yet been established whether these instructions are identical for all nasal sprays. For this reason, future research on the relation between administration technique and the efficacy of all available nasal sprays would add value. Translating the Dutch protocol into other languages and into a video for patients is also important. In addition, it is important to continuously evaluate the quality of information available on YouTube and to find ways to guarantee good quality of the available content.

Conclusions

This study shows that the majority of the instructional videos that can easily be found on YouTube do not provide patients the correct instructions for the administration of nasal sprays. This can lead to confusion in patients and to incorrect use of the nasal spray. In the future, the Dutch protocol should be translated into other languages, and evidence-based instructional videos should be made, which show patients the correct administration technique.

Authors' Contributions

The study was performed by MMPG and CR and supervised by EIM, ENvR, and TWdV. The original study protocol was set up by MMPG, CR and TWdV. The practical part of the study was carried out by MMPG and CR; EIM, ENvR, and TWdV fulfilled an advisory and supervisory role. The design of the manuscript was set up by all 5 authors, and MMPG elaborated the design in this manuscript in close cooperation with CR. All authors contributed to data analysis and to drafting and revising the article; they gave the final approval of the version to be published and agree to be accountable for all aspects of the work.

Conflicts of Interest

None declared.

Multimedia Appendix 1
Data collection flowchart.
[DOCX File , 212 KB - mededu_v6i2e23668_app1.docx]

Multimedia Appendix 2
Overview of the YouTube videos.
[DOCX File , 20 KB - mededu_v6i2e23668_app2.docx]

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Corrigenda and Addenda

Correction: Comparing Classroom Instruction to Individual Instruction as an Approach to Teach Avatar-Based Patient Monitoring With Visual Patient: Simulation Study

Julian Rössler[1], MD; Alexander Kaserer[1], MD; Benjamin Albiez[1], RN, BNSc; Julia Braun[2], PhD; Jan Breckwoldt[1], MD; Donat Rudolf Spahn[1], MD; Christoph Nöthiger[1], MD; David Werner Tscholl[1], MD

[1]University Hospital Zurich, Zurich, Switzerland

[2]Biostatistics and Prevention Institute, Departments of Epidemiology and Biostatistics, University of Zurich, Zurich, Switzerland

Corresponding Author:
David Werner Tscholl, MD
University Hospital Zurich
Raemistrasse 100
Zurich, 8091
Switzerland
Phone: 41 786636787
Email: david.tscholl@usz.ch

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In "Comparing Classroom Instruction to Individual Instruction as an Approach to Teach Avatar-Based Patient Monitoring With Visual Patient: Simulation Study" (JMIR Med Educ 2020;6(1):e17922) the authors noted one error.

Degree information for author Benjamin Albiez was incorrectly listed as "MD". This has been corrected to "RN, BNSc".

The correction will appear in the online version of the paper on the JMIR Publications website on October 1, 2020, together with the publication of this correction notice. Because this was made after submission to PubMed, PubMed Central, and other full-text repositories, the corrected article has also been resubmitted to those repositories.

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Correction: Identification of Informed Consent in Patient Videos on Social Media: Prospective Study

Jane O'Sullivan[1], MBBS; Cathleen McCarrick[2], MBBS, MPhil; Paul Tierney[3], MBBS, PhD; Donal B O'Connor[4], MBBS, MD; Jack Collins[1], MBBS; Robert Franklin[1], MBBS

[1]Department of Anaesthesia, Letterkenny University Hospital, Donegal, Ireland
[2]Department of Surgery, Tallaght University Hospital, Dublin, Ireland
[3]Department of Anatomy, Trinity College Dublin, Dublin, Ireland
[4]Professorial Surgical Unit, Tallaght University Hospital & Trinity College Dublin, Dublin, Ireland

Corresponding Author:
Cathleen McCarrick, MBBS, MPhil
Department of Surgery
Tallaght University Hospital
Tallaght
Dublin, D24 NR04
Ireland
Phone: 353 1 414 2000
Email: cathleen.mccarrick@gmail.com

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In “Identification of Informed Consent in Patient Videos on Social Media: Prospective Study” (JMIR Med Educ 2020;6(2):e14081) the authors noted one error.

The corresponding author affiliation was inadvertently published with the incorrect phone number. The correct phone number has now been added as follows: 353 1 414 2000.

The correction will appear in the online version of the paper on the JMIR Publications website on October 30, 2020, together with the publication of this correction notice. Because this was made after submission to PubMed, PubMed Central, and other full-text repositories, the corrected article has also been resubmitted to those repositories.

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