ORIGINAL ARTICLE

Perceptions of emergency medicine residents toward online medical education during the COVID-19 pandemic: a cross-sectional survey study

Turki S. Al-Harbi[1*], Ali Al-Shehri[2,3,4,5,6], Thamer K. Zoghbi[7], Badir W. Abulhamail[2,3,4], Turki Aljuhani[3,4]

ABSTRACT

Background: The COVID-19 pandemic affected many aspects of medical education that were based on the traditional classroom experience. To maintain postgraduate education during the lockdown, many of these activities continued via virtual methods. We aim to assess residents' perceptions of online medical education.

Methods: This is a cross-sectional study targeting emergency medicine residents in the western region of Saudi Arabia. An electronic self-administered validated survey was used to assess the residents' experiences and perceptions of online medical education.

Results: A total of 125 participants were surveyed (52% response rate). There was a significant increase in hours spent in online education after COVID-19 according to Wilcoxon signed rank test ($p < 0.001$). On a Likert scale, most residents agreed that they found online medical education enjoyable and easy to engage with. However, most did not find it as interactive as the traditional teaching methods. The most enjoyed aspects were the ability to learn in their own homes, and the flexibility in scheduling. The biggest barriers were difficulties in maintaining focus, and technical problems. Most (59.2%) of the residents found that online learning did not cover procedural skills acquired from simulation and direct patient training.

Conclusion: The convenience and diversity of online education make it a good alternative tool compared to traditional methods. Despite the disadvantages of online education, we think it will continue to play a role in residency programs going forward in the future.

Keywords: Emergency, online, education, COVID-19.

Introduction

In March 11, 2020, the World Health Organization (WHO) declared COVID-19 to be a global pandemic and advised many precautions, including quarantine and social distancing [1,2]. These precautions by the government body in Saudi Arabia impacted traditional physical education which was then replaced with online, distant education [3,4]. Among medical residents, the shift to online learning has been particularly challenging, as they require hands-on experience to acquire the necessary skills to become competent physicians [5-7].

Conventional medical education activities are mostly based on traditional gatherings and face-to-face classroom-based learning. In recent years, however; various blended learning strategies have been implemented in medical education, such as flipped classrooms, simulation-based training, and virtual patient encounters [8,9]. Flipped classrooms involve students watching pre-recorded lectures before attending a live online session where they can interact with the

Correspondence to: Turki S. Al-Harbi
*Teaching Assistant, Senior Registrar, Department of Emergency Medicine, Faculty of Medicine,
King Abdulaziz University, Jeddah, Saudi Arabia.
Email: Dr.turkisaud@gmail.com
Full list of author information is available at the end of the article.
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instructor and their peers. Simulation-based training allows residents to practice and refine their clinical skills in a safe and controlled environment. Virtual patient encounters provide residents with the opportunity to diagnose and treat patients in a simulated environment, improving their clinical reasoning and decision-making skills [10].

Several studies have examined the effect of online and blended learning on resident or resident performance. A systematic review and meta-analysis by Cook et al. [11] found that blended learning, which combines online and face-to-face instruction, resulted in higher knowledge acquisition and improved clinical skills compared to traditional classroom teaching alone. Similarly, a meta-analysis by Brydges et al. [12] showed that blended learning was associated with higher knowledge retention and better patient-related outcomes.

While these blended learning strategies have shown promise, their implementation depends on many aspects [12]. One of them is the feedback from learning recipients, namely emergency medicine residents in this study. To the best of our knowledge, no studies were made to assess residents' thoughts and opinions regarding the new teaching modalities.

This study aims to explore the perceptions of emergency medicine residents toward online medical education during the COVID-19 pandemic, with a focus on the effectiveness of blended learning strategies and their association with resident performance.

Methods

This is a cross-sectional study in which an electronic structured survey was distributed via digital means. The target population for this study was residents enrolled in the emergency medicine training program in the western region of Saudi Arabia, sector 2, including the cities of Jeddah, Makkah, and Taif. Our inclusion criteria were all emergency residents from all of the sector's centers (Appendix A). Our exclusion criteria were all residents who completed the survey but were not enrolled in the emergency medicine training program and residents who did not complete the questionnaire. Ethical approval was obtained from the KAIMRC IRB.

The sample size was calculated using the Raosoft sample size calculator. We assumed a 95% confidence level, a 5% margin of error, and a 50% response distribution probability. The minimum recommended sample size was 88. An electronic survey hosted on SurveyMonkey was used to gather the data. The survey was distributed by sending an invitation (containing the survey's website link) via emails and social media applications to our population. The participants were informed that filling out the survey was considered as consent to participate in the study. The survey used is a structured, 33-questions, self-administered survey, validated by Dost et al. [9]. Permissions to use the survey were granted by the same author. The survey covered items related to demographic information, technology devices used, methods of education prior to and after COVID-19 (including video tutorials, live sessions, online question banks, digital flashcards, simulation-based education, and prerecorded sessions), and perception toward the changes in the learning experience.

Statistical Package for Social Sciences (version 28.0, IBM Corp., USA) was used for statistical analysis. Descriptive, inferential, and comparative tests were used; categorical data were produced as frequencies and percentages. Cronbach's alpha was used to assess the internal consistency of the nine items describing the perception of residents regarding distant, online education. The Wilcoxon test was used to compare hours of online education before and during the COVID-19 pandemic. The significance of the difference between the groups was determined using a chi-square test with a statistical significance cutoff set at $p < 0.05$.

Results

Sample characteristics

A total of 125 residents consented to participate and completed the survey. With a total population of 240 residents across all academic levels in the western region, the response rate to our survey is 52%. Most of the residents fell into the 26-30-year-old age group (74.4%). The sample was almost equally distributed across all four levels of training. The residents were sampled from all training centers located in the Western Region, but the largest group of participants were from King Abdulaziz Medical City National Guard Health Affairs (NGHA)- Jeddah (38.4%). Additional demographic information is reported in Table 1.

Usage and access to online medical education

Regarding their usage and access to online medical education, the results show that most of the participants had acceptable or better than acceptable internet service (only 1.6% had "bad" quality of internet service), and most of the respondents reported using their tablets to access medical education, followed by their laptop/desktop (46.8% and 40.8%, respectively). Additionally, the most used form of online academic activity was live sessions delivered via Zoom (87.2%), followed by pre-recorded sessions (16.8%). The most popular form of online medical education prior to the pandemic was video tutorials (76.8%), followed closely by online question banks (74.4%). Further information on usage and access is reported in Table 2.

Impact of the pandemic on hours spent on online medical education

There was a significant increase in the number of hours spent on online education methods during the pandemic compared to before the pandemic, with a Wilcoxon signed-rank test result of p value <0.001 and a mean of 3.8 versus 2.9, respectively (Figure 1).

Attitudes toward online academic activities and medical education

The perception and attitude of the participants toward different aspects of online academic activities are displayed in Figure 2 and Table 3. Using a Likert-scale to answer the questions, most of the residents agreed that they enjoy taking part in online medical education and find this classroom

Table 1. Sample characteristics.

Variables	Total participants *n* = 125
Age (%)	
20-25	15 (12)
26-30	93 (74.4)
31-40	17 (13.6)
Gender (%)	
Male	68 (54.4)
Female	57 (45.6)
Marital status (%)	
Married	51 (40.8)
Not married (single, divorced, widowed)	74 (59.2)
Center (%)	
King Abdulaziz Medical City NGHA- Jeddah	48 (38.4)
King Abdulaziz University Hospital- Jeddah	25 (20)
King Faisal Specialist Hospital & Research Center - Jeddah	12 (9.6)
King Fahad Armed Forces Hospital- Jeddah	8 (6.4)
King Abdullah Medical Complex- Jeddah	5 (4)
The International Medical Center- Jeddah	4 (3.2)
King Abdullah Medical City- Makkah	11 (8.8)
Security Forces Hospital- Makkah	3 (2.4)
King Abdulaziz Specialist Hospital- AlTaif	9 (7.2)
Level of training (%)	
R1	30 (24)
R2	30 (24)
R3	33 (26.4)
R4	32 (25.6)

Table 2. Usage and access to online medical education.

Variables	Total participants (*n* = 125)
Quality of internet service	
Bad	2 (1.6)
Acceptable	12 (9.6)
Good	35 (28)
Very good	50 (40)
Excellent	26 (20.8)
The device is mostly used for online medical education	
Laptop/Desktop computer	51 (40.8)
Tablet	58 (46.4)
Smartphone	16 (12.8)
Online education platforms/resources used before the COVID-19 pandemic.	
Video tutorials e.g., YouTube/Osmosis	96 (76.8)
Live tutorials via Zoom/similar platforms	31 (24.8)
Online question banks e.g., Rosh Review/ Med-Challenger	93 (74.4)
Online/Digital flashcards e.g., Brainscape/ Anki	10 (8)
Pre-recorded tutorials via SCFHS online learning platform	11 (8.8)
Using online platforms (e.g., zoom) to study with a friend/group	
Yes	91 (72.8)
No	34 (27.2)
Emergency medicine residency training program (EMRTP) adaption for teaching/learning activities for the residents during the current COVID-19 pandemic	
Delivered live sessions/tutorials via Zoom/ similar platforms	109 (87.2)
Delivered pre-recorded sessions/tutorials	21 (16.8)
Introduced a new online learning platform with new resources	14 (11.2)
Introduced new resources to an existing online learning platform	18 (14.4)

approach easy to ask questions in. However, most disagreed with finding this approach as an interactive and effective method of education (Figure 2). Regarding students' outlook on online medical education in general, the most-enjoyed aspects of online medical education were the ability to learn at their own home, its flexibility, and the fact that it requires no transportation (Table 3). The biggest barriers for students were difficulties in maintaining focus and technical/internet problems. Most of the participants (59.2%) reported that online learning does not adequately cover the procedures and skills that are normally acquired from simulation and direct patient training. Furthermore, 63% of those surveyed stated that they are unable to learn such skills via online learning. Almost half of the respondents self-reported that their academic performance has not been affected by their use of online education. The methods of education that the respondents found most effective were online question banks and video tutorials (31.2% and 24.8%, respectively). Finally, when asked about their preferences, most of the participants responded that they would prefer to have a mixture of both methodologies (traditional and online) rather than either of them alone (68.8%).

Discussion

Online medical education, advantages, and disadvantages

The push toward online medical education as an alternative to traditional teaching during the pandemic has brought to light its many advantages and drawbacks. As previously published literature agreed upon, advantages are related to the modality's convenience and flexibility [9,13]. This is similar to the findings in our study. We believe this is due to most platforms being accessible from any device and from any place. We hypothesize this is also attributed to the fact that online education is cost-effective as it requires no traveling usually, and the devices needed are already owned by most residents prior to the pandemic.

On the other hand, online education also has its drawbacks. Despite the ability of participants to ask questions, we found this approach to be less interactive. This concurs with what was found in other studies as well [14-16]. This is probably due to the lack of face-to-face interaction, as a person usually finds it difficult to maintain their focus with an inanimate object and has an overall lower level of perceived efficacy [9].

Another issue we found with online education was having internet connection issues; technical difficulties remained an issue for up to 48.8% of the participants. This aspect was not reported in many other studies as they probably did not think of it as a limitation, but the sudden surge of educators of all ages to online platforms might have contributed to experiencing technical issues.

Traditional teaching versus online medical education

The efficacy of e-learning in improving trainees' knowledge and clinical practice has been demonstrated across multiple studies even before the pandemic [17-19]. This is in agreement with what our residents feel about their own knowledge and performance. However, a major area in which traditional teaching remains unparalleled is hands-on and procedural skills, as many papers have suggested online methods are not suitable for this kind of

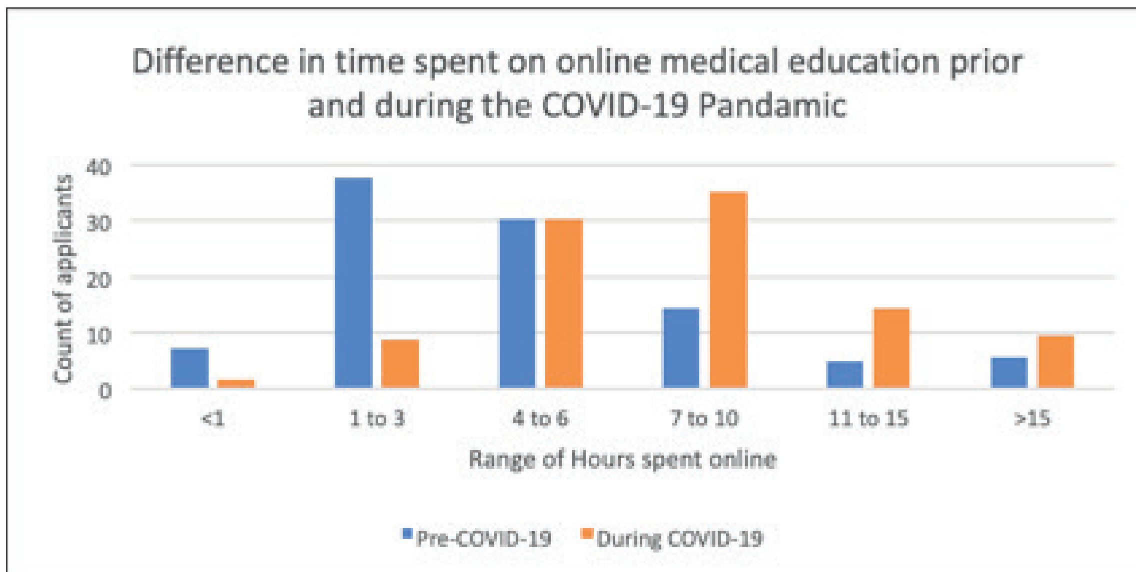

Figure 1. *Difference in time spent on online medical education before and during the COVID-19 pandemic.*

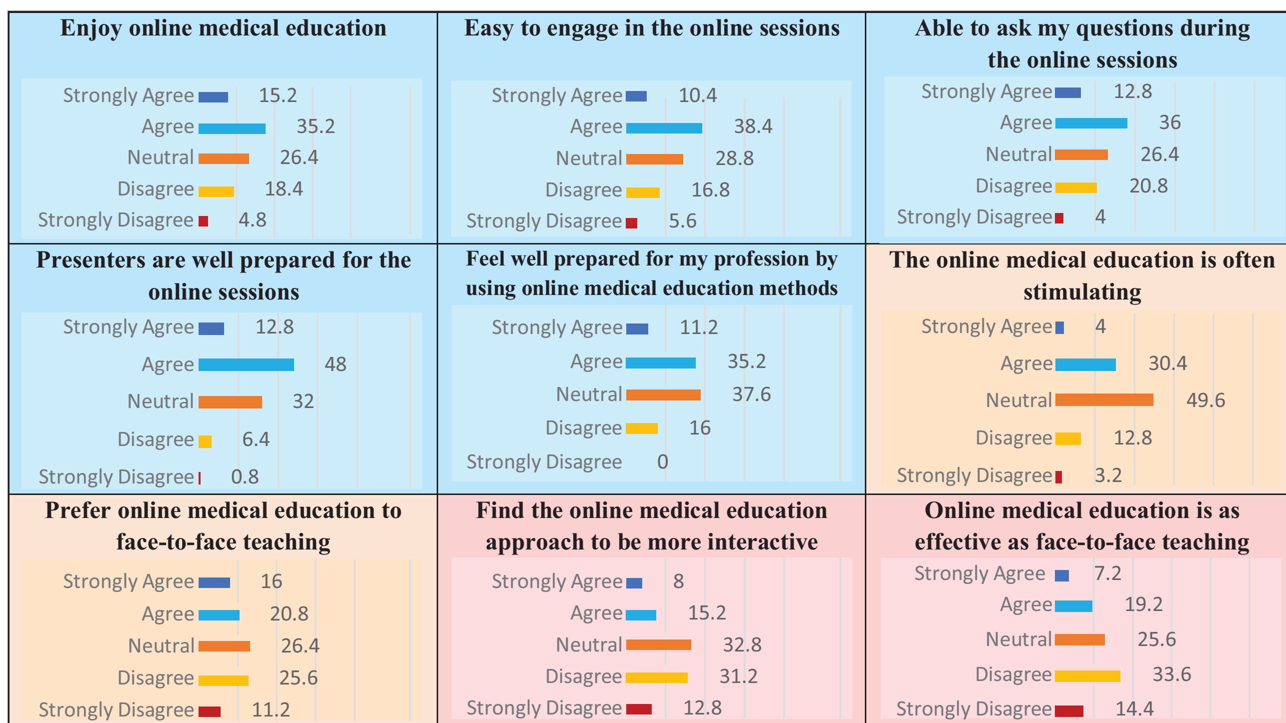

Figure 2. *Emergency medicine residents' perceptions toward using online medical education in the EMRTP weekly academic activities (presented as percentages, n = 125).*

skill [5-7,9]. Our residents had the same opinion where they felt that the quality of the practical aspect of training was lacking. This is, of course, due to the fact these skills improve with better quantity and quality of exposure, and both were not available via online methods. In the future, we believe combining both methods in a hybrid/blended curriculum format will result in getting the benefits of both as many authors agree with [14,15,20].

Future evolution in online medical education

Our study, along with others, finds that many current online medical education curriculums and tools are lacking in terms of interactivity and discussion-enabling capabilities [9,14-16]. We believe this is because online methods used at the start of COVID-19 were merely a shift of the old-style teaching to the online platform which reduced the benefits of the teaching process without adding new features.

Although less implemented, other forms of sessions were being utilized, especially ones that focus on the discussion as discussion-based learning leads to better knowledge yield and problem-solving skills [21-23]. Therefore, we hypothesize that addressing these new forms of sessions should be the focus of devices and applications development teams, and should be encouraged in academic curricula. Currently, the use of breakout rooms and polling should be encouraged whenever possible to enhance the discussion.

Table 3. Attitude toward online medical education.

Variables	Total participants (n = 125)
Enjoyed aspects of online medical education	
No travel	84 (67.2)
Cost savings	70 (56)
Interactive	32 (25.6)
Ability to ask questions	26 (20.8)
Ability to learn at own pace	69 (55.2)
Flexibility	90 (72)
Ability to learn in own private space/home	98 (78.4)
Barriers/challenges to online medical education	
Internet connection	55 (44)
Family distractions	53 (42.4)
Lack of proper space	8 (6.4)
Lack of proper device	5 (4)
Confidentiality issues; due to the risk of security breaches on online platforms	21 (16.8)
Technical problems related to online platforms	61 (48.8)
Physical discomfort (e.g., exhaustion, visual problems)	22 (17.6)
Difficulties in maintaining focus/concentration while facing a screen	65 (52)
Decreased attendees' engagement and decreased interactivity	57 (45.6)
Anxiety	8 (6.4)
Online teaching/learning has successfully covered practical aspects (e.g., procedures & skills) from direct patient contact/manikin simulation-based learning	
Yes	16 (12.8)
No	74 (59.2)
Yes, to some extent	35 (25)
Able to learn practical clinical skills (e.g., procedures) through online learning	
Yes	5 (4)
No	79 (63.2)
Yes, to some extent	41 (32.8)
Academic performance during the incorporation of online medical education in the academic activity.	
Overall performance enhanced.	41 (32.8)
Overall performance decreased.	22 (17.6)
No change in overall performance.	62 (49.6)
The most effective method of medical education	
Video tutorials e.g., YouTube/Osmosis	31 (24.8)
Live sessions via Zoom/similar platforms	7 (5.6)
Online question banks	39 (31.2)
Digital flashcards e.g., Brainscape/Anki	2 (1.6)
Traditional face-to-face classroom education	23 (18.4)
Simulation-based education	23 (18.4)
Preference for future academic activity	
Online medical education.	24 (19.2)
Traditional face-to-face classroom education.	23 (18.4)
A mixture of both.	86 (68.8)

Study limitations and future studies

Since the data were collected via an online survey, response bias is likely. Additionally, relying on the participants' recollections may introduce some recall bias. Another limitation of the current study is that all the participants were enrolled in an emergency medicine residency, which might limit the generalizability of the results to trainees in other specialties. Furthermore, the study examined the perception of the residents regarding the current application/use of online medical education; however, since this is a relatively new and emerging modality, it is likely to continue to evolve to cover the trainees' needs beyond that which is currently available. Lastly, the performance of residents was assessed in a subjective manner of simply what they think, which leaves room for ambiguity. Future studies can address these concerns and further study the impact that online education will continue to have on knowledge acquisition and clinical performance.

Conclusion

The convenience and versatility of online education platforms make them a useful tool in the face of the barriers currently related to traditional teaching. Furthermore, as platforms develop, they will likely integrate more features that facilitate interaction and direct feedback. Despite its shortcomings, it is clear that online medical education will continue to play a role in residency programs - even after the pandemic subsidies - in the form of hybrid academic curricula. Understanding the challenges and opportunities of online medical education can help medical educators develop effective teaching methods that combine the best of both online and in-person learning.

List of Abbreviations

NGHA National Guard Health Affairs
EMRTP Emergency Medicine Residency Training Program

Conflict of interests

The authors declare that there is no conflict of interest regarding the publication of this article.

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None.

Consent to participate

Written consent was obtained from all the participants.

Ethical approval

Ethical approval was granted by Institutional Review Board, King Abdullah International Research Medical Center (KAIMRC), Letter no.: IRBC/2703/21, Date of approval: 29 Dec 2021.

Author details

Turki S. Al-Harbi[1], Ali Al-Shehri[2,3,4,5,6], Thamer K. Zoghbi[7], Badir W. Abulhamail[2,3,4], Turki Aljuhani[3,4]

1. Department of Emergency Medicine, Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia
2. Emergency Medicine Department, Ministry of the National Guard - Health Affairs, Jeddah, Saudi Arabia
3. King Abdullah International Medical Research Center, Jeddah, Saudi Arabia
4. King Saud bin Abdulaziz University for Health Sciences, Jeddah, Saudi Arabia
5. Emergency Medicine Physician, King Abdulaziz Medical City, Jeddah, Saudi Arabia
6. Emergency Medicine Consultant, King Abdulaziz Medical City, Jeddah, Saudi Arabia
7. Emergency Medicine Senior Registrar, Security Forces Hospital, Makkah, Saudi Arabia

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Appendix

Appendix A (inclusion and exclusion criteria)

Inclusion criteria:
All emergency medicine residents of the Emergency Medicine Residency Training Program in the Western Region of Saudi Arabia, Sector 2, including the following centers:

1) King Abdulaziz Medical City NGHA - Jeddah
2) King Abdulaziz University Hospital - Jeddah
3) King Faisal Specialist Hospital & Research Center - Jeddah
4) King Fahad Armed Forces Hospital - Jeddah
5) King Abdullah Medical Complex - Jeddah
6) The International Medical Center - Jeddah
7) King Abdullah Medical City - Makkah
8) Security Forces Hospital - Makkah
9) King Abdulaziz Specialist Hospital - AlTaif
10) All nationalities. Both males and females.

Exclusion criteria:

1) All those who were not enrolled in the Emergency Medicine Residency Training Program.
2) All those who are outside the Western Region of Saudi Arabia (sector 2).
3) All who did not meet the inclusion criteria.
4) Those who do not complete the questionnaire.