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Respiratory Health Care Professionals' Acceptance and Challenges Concerning Telemedicine Application in Saudi Arabia

**Aisha A Hagag^{1,2*}, Atheer M Alsubhi², Aisha S Aloufi², Manar R Almatrafi²,
Rawan H Bedaiwi², Taif A Alouf²**

¹Cardiorespiratory department, Faculty of physical therapy, Cairo University, Egypt.

² Respiratory therapy department, college of medical rehabilitation science, Taibah University, Saudi Arabia

Corresponding author: Aisha A Hagag

E-mail: aishahagag73@gmail.com

Phone cell: 00966 550568660

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Abstract

Background: Telemedicine was introduced to Saudi Arabia years ago when the Ministry of Health worked on applications that helped healthcare professionals to provide medical services over long distances. **Objectives:** This study aimed to evaluate the acceptability and challenges of using telemedicine among respiratory healthcare professionals. **Methods:** The study is a cross-sectional conducted in Saudi Arabia. An online survey was distributed through social media from 15 February to 24 April 2023 targeting respiratory healthcare professionals. Statistical Package for Social Sciences (SPSS) version (29.0.1.0) was used to perform a descriptive analysis of the data. The chi-square test was used to determine the relationship between variables. **Results:** A total of 224 participants were included in the study, of whom 70 (31.3 %) were female; and 154 (68.8%) were male. Around 133 (59.4%) of participants were familiar with telemedicine, and 35 (15.6%) use it on an intermittent basis. Overall, 121 (54%) thought that telemedicine was somewhat socially acceptable in Saudi Arabia. The most frequently reported challenge of using telemedicine was technical issues (71.24%), and the challenge of future implementation of telemedicine was diagnostic reliability (56.7%). **Conclusion:** Telemedicine provision in Saudi Arabia is steadily improving; a high level of acceptance among respiratory healthcare professionals to telemedicine was observed, as a high level of awareness and the reported benefits that telemedicine can provide. Along with highlighting the most common challenges to telemedicine application, this study could lead to further future improvements in the delivery of telemedicine services.

Keywords: telemedicine, respiratory health care professionals, acceptance, challenges.

Introduction

Telemedicine is the provision of medical services and the exchange of medical data over long distances. The contact between the patient and the expert, and the sort of information being conveyed are two factors that may be used to categorize telemedicine episodes (e.g., text, audio, and video). Most of the telemedicine now used is carried out in wealthy nations like the USA; however, poorer countries are becoming more interested in using telemedicine. In general, there are two circumstances in which telemedicine should be considered: when no other option is available (e.g., in emergencies in remote environments), and where it is superior to the current standard of care (e.g., teleradiology for rural hospitals). For instance, it is reasonable to anticipate that telemedicine would increase the quality, efficiency, and equity of access to healthcare. In the late 1990s, telemedicine research grew steadily (1).

The delivery of healthcare services has transformed since the widespread Internet access and technological breakthroughs. This improvement in healthcare services helped to prevent and treat the world's major causes of mortality and disability. For example, mobile health technology facilitates clinical interventions and the delivery of non-clinical care services such as health education, data reporting, and monitoring (2,3).

Telemedicine was introduced to Saudi Arabia when the Ministry of Health (MOH) launched the first telemedicine project called the Saudi telemedicine network (4). Years later, as a part of improvement according to the 2030 vision, the Ministry of Health expanded the use of telemedicine to provide healthcare services by launching the 'seha' application in 2018 (5). During the covid-19 pandemic, the governments in Saudi Arabia took decisive measures like lockdowns and social distancing to prevent the spread of infection that made providing face-to-face healthcare services harder (6). Therefore, telemedicine was required to help healthcare professionals continue to provide patients with health services (7). Ministry of Health has launched new mobile applications and added features to some already been used to provide some health care services (Sehhaty and seha) (8,9). During the pandemic, Sehhaty was the main app used that helped to provide 1.5 real-time consultants (8,10). This indicates the importance of the future application of telemedicine.

The main element affecting the success and stability of telemedicine is the acceptance of technology by medical professionals (11). Understanding health care professionals' acceptance of telemedicine may help the development of effective, higher-quality, and safer telemedicine. The implementation of telemedicine has been limited by the lack of staff acceptance (12). Clinician acceptance mean a health care professional's readiness to accept telemedicine as a service delivery option, whether by adopting a telemedicine invention or incorporating it into an already-existing medical service (11).

The factors that influence people's acceptance of and use of technologies, particularly health factors, are determined using a variety of models (13). These models include the extended technology acceptance model (TAM2), Theory of Planned Behaviour (TPB), Technology Acceptance Model (TAM), and Diffusion of Innovations Theory (DIT) (14). Because it is important to study the factors influencing telemedicine acceptability as one of the most widely used information technologies in health, several studies have used the above models to identify the variables influencing its acceptance (13).

There are several challenges of telemedicine application despite its high demand in clinical practice (15). In 2022, Ftouni et al. conducted a qualitative systematic review to detect challenges of telemedicine during the COVID-19 pandemic, including 27 studies in 12 different countries including Saudi Arabia. Challenges and barriers to telemedicine application became more obvious during the COVID-19 pandemic and they assembled under seven categories: technical aspects, data confidentiality and reimbursement, privacy, training of healthcare providers and patients, special populations, physical examination and diagnostics, doctor-patient relationship, and acceptability (16). In 2012, EL-Mahalli et al. conducted a study to assess Successes and Challenges in the Application and Implementation of Telemedicine in the Eastern Province of Saudi Arabia. Challenges as perceived by healthcare professionals were lack of sufficient knowledge about telemedicine, followed by difficulty in the application of telemedicine and then lack of time to implement telemedicine (17).

Since the COVID-19 pandemic, the role of respiratory healthcare professionals (HCPs) has increased in various telemedicine services, which include routine assessments, monitoring, and management of COVID and non-COVID patients, as well as patients who are seeking rehabilitation (18).

The success of telemedicine applications depends on the acceptance of healthcare professionals (19). However, there is limited information related to respiratory HCPs' acceptance. In addition, we lack awareness of the challenges facing this group. Because of the insufficient studies, this study aims to identify respiratory HCPs' acceptance and challenges regarding the application of telemedicine in Saudi Arabia.

Materials and Methods

Study population

The main targets of the study were Respiratory health care professionals in Saudi Arabia. Inclusion criteria involved participants who graduated as respiratory HCPs. An online survey circulated through social media (Twitter, WhatsApp, and Telegram) from 15 February to 24 April 2023. This study was approved by research and ethics board of the College of Medical Rehabilitation Sciences, Taibah University, CMR-RT-2023-09.

Sample size:

Convenience sampling techniques were used to recruit the study participants. The sample size was calculated with the calculator. net software (24), and the minimum sample size is 308 with confidence level 95%, margin of error 5%, population proportion 50%, and population size is 1539 according to Saudi Ministry of Health (25).

Data collection methods & Data management

An English-language online survey was designed using Google Forms (Appendix1) and circulated to participants via social media. The first page of the survey explained the purpose of the study and ensure that the data collected were confidential for research purposes only. Participants were ensured that they could withdraw at any time and agreed to participate voluntarily by answering "yes" to the

question "Do you agree to participate in the survey?". The expected completion time was approximately three minutes. The survey included 24 questions that covered seven sections. The first section was demographical information that contained seven questions to collect information such as age, gender, nationality, years of clinical experience, educational degree, name of working hospital, and geographical location. The second section was about knowledge of telemedicine among respiratory HCPs which included a question about familiarity with telemedicine technology where participants had two options (yes/no) and other questions to assess the degree of knowledge about telemedicine and frequency of telemedicine use before and after the Covid-19 pandemic. The third section was about the acceptance of telemedicine in Saudi Arabia, consisted of two questions. The fourth section consisted of 5 statements to agree or disagree with, using a 5-point Likert scale ranging from 1 (=strongly disagree) to 5 (=strongly agree). In the fifth section, we included two multiple-choice questions about the challenges of telemedicine use among respiratory HCPs. The sixth section was about services offered using telemedicine. The last part of the survey consisted of two questions related to training in the use of telemedicine. We developed two of these questions and used fifteen questions chosen from four research (20–23). We contacted the authors via email and obtained approval to use some of their questions and modify some to suit our research topic. Questions were validated and their reliability was confirmed using Cronbach's alpha test.

Statistical analysis

Data from 224 participants were coded and entered to Statistical Package for Social Sciences (SPSS) version 29.0.1.0. Descriptive analysis was conducted to report data in percentages and frequencies and results were organized into tables. The chi-square test was used to determine the relationship between variables, with significance set to $P \leq 0.05$. Microsoft excel was used to generate figures.

Results

Total Respiratory health care professionals (HCPs) completed the online survey between 15 February, and 24 April 2023 were 238 participants. Fourteen participants were excluded as they were students and did not fulfil the inclusion criteria. Responses from 224 participant were used in this study, 154 male (68.8 %) and 70

female (31.1 %). Out of 224 participants, 21 mentioned that they are not employed yet (9.38 %). the demographic data shown in table 1,

Table 1. Demographic data and general characteristics of the participants (n= 224).

Variable	Frequency (%)
Age group	
20 – 25	167 (74.6 %)
26 – 30	36 (16.1 %)
31 – 35	15 (6.7 %)
36 – 40	4 (1.8 %)
Older than 40	2 (0.9 %)
Gender	
Male	154 (68.8 %)
Female	70 (31.3 %)
Nationality	
Saudi	221 (98.7 %)
Non-Saudi	3 (1.3 %)
Region	
Southern province	33 (14.7 %)
Northern province	5 (2.2 %)
Central province	39 (17.4 %)
Eastern province	98 (43.8 %)
Western province	49 (21.9 %)
Degree	
Diploma	5 (2.2 %)
Bachelor	211 (94.2 %)
Master	6 (2.7 %)
PhD	2 (0.9 %)
Years of clinical experience	

2 years or less	185 (82.6 %)
3 – 5 years	25 (11.2 %)
6 – 10 years	8 (3.6 %)
More than 10 years	6 (2.7 %)

Data were presented as frequencies and percentages

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Telemedicine saves my time.	88 (39.3%)	98 (43.8%)	29 (12.9%)	7 (3.1%)	2 (0.9%)
Telemedicine allows me to care for more patients.	63 (28.1%)	108 (48.2%)	44 (19.6%)	6 (2.7%)	3 (1.3%)
Telemedicine is a viable approach for providing medical care services to patients.	70 (31.3%)	103 (46.0%)	40 (17.9%)	9 (4.0%)	2 (0.9%)

Table 2. Statements to agree or disagree with, using a 5-point Likert scale.

Do you believe that telemedicine can substitute face to face encounters in the post Covid-19 era?	57 (25.4%)	76 (33.9%)	51 (22.8%)	21 (9.4%)	19 (8.5%)
Do you believe that telemedicine can be used in emergency situations?	44 (19.6%)	70 (31.3%)	58 (25.9%)	29 (12.9%)	23 (10.3%)

Data were presented as frequencies and percentages.

For the components of the questionnaire covering the Likert scale-based responses in table 2, there was a high level of agreement with the following statements: "Telemedicine saves my time." (39.3%) strongly agreed and (43.8%) agreed.

"Telemedicine allows me to care for more patients." (28.1%) strongly agreed and (48.2%) agreed. "Telemedicine is a viable approach for providing medical care services to patients." (31.3%) strongly agreed and (46.0%) agreed. Results showed a lower level of agreement for the following statements: "Do you believe that telemedicine can substitute face-to-face encounters in the post-Covid-19 era?" (25.4%) strongly agreed and (33.9%) agreed, while on the other hand, (9.4%) disagreed and (8.5%) strongly disagreed. In addition, "Do you believe that telemedicine can be used in emergency situations?" (19.6%) strongly agreed and (31.3%) agreed, while (12.9%) disagreed and (10.3%) strongly disagreed.

Table3. Acceptance of telemedicine related to the gender.

In your opinion, how far is telemedicine socially acceptable in Saudi Arabia?						
		Extremely Acceptable	Very Acceptable	Somewhat Acceptable	Not Acceptable	Total
Gender	Female	6 (8.6%)	22 (31.4%)	39 (55.7%)	3 (4.3%)	70 (31.3%)
	Male	21 (13.6%)	39 (25.3%)	82 (53.2%)	12 (7.8%)	154 (68.8%)
Total		27 (12.1%)	61 (27.2%)	121 (54.0%)	15 (6.7%)	224 (100%)

Data were presented as frequencies and percentages.

There is no statistically significant difference between male and female acceptance since the p-value was 0.454 (table 3).

There is a statistically significant relationship between age and familiarity with telemedicine, as shown in Table 4; the older the participants, the more familiar they were with telemedicine

Table 4. Familiarity with telemedicine related to the age.

Age	Are you familiar with telemedicine?			p-value
	Yes	No	Total	
20 – 25	93 (55.7%)	74 (44.3%)	167 (74.6%)	0.027
26 – 30	21 (58.3%)	15 (41.7%)	36 (16.1%)	
31 – 35	14 (93.3%)	1 (6.7%)	15(6.7%)	
36 – 40	4 (100%)	0	4 (1.8%)	
Older than 40	1 (50%)	1 (50%)	2 (0.9%)	
Total	133 (59.4%)	91 (40.6%)	224 (100%)	

Data were presented as frequencies and percentages.

A variety of challenges of using telemedicine in clinical settings were reported as follows: technical issues (71.42%) were the most frequently reported challenge, followed by staff skill issues (58.92%), provider willingness (45.53%), high cost (32.58%) and location of healthcare institute (20.98%). Challenges of telemedicine application among Respiratory HCPs are reported in Figure 1. Future challenges are presented in fig 2

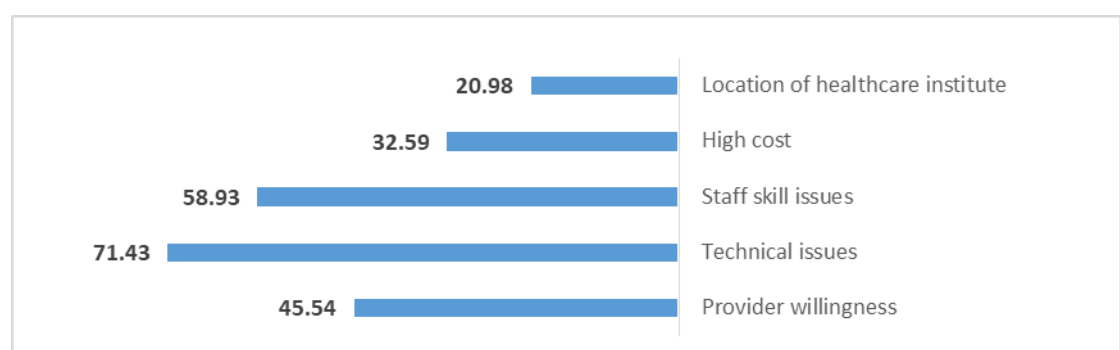


Figure 1: Challenges of using telemedicine (n=224)

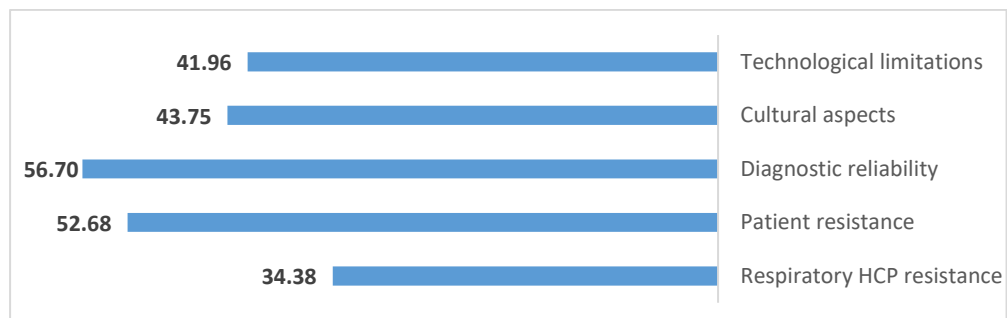


Figure 2. Challenges to the future application of telemedicine (n=224)

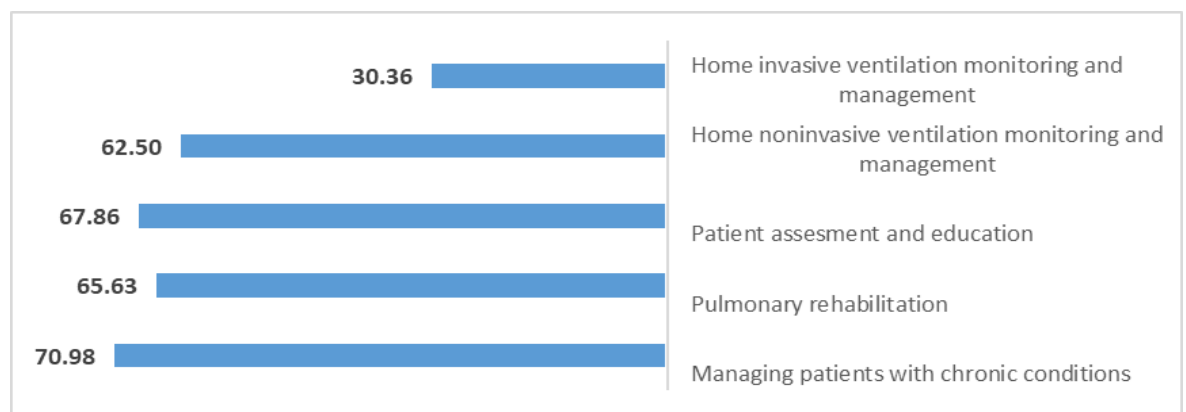


Figure 3. Respiratory therapy services that can be offered using telemedicine (n=224)

The last question was about the conditions that would benefit from emergency respiratory care services via telemedicine. The results showed that the most beneficial emergency condition is COPD exacerbation (73.66%), followed by hypercapnic respiratory failure (30.36%), ARDS (27.23%), inhalation injury (26.79%), drowning (26.34%), acute pneumonia (25.45%), and massive haemoptysis (20.09%) (Figure 4).

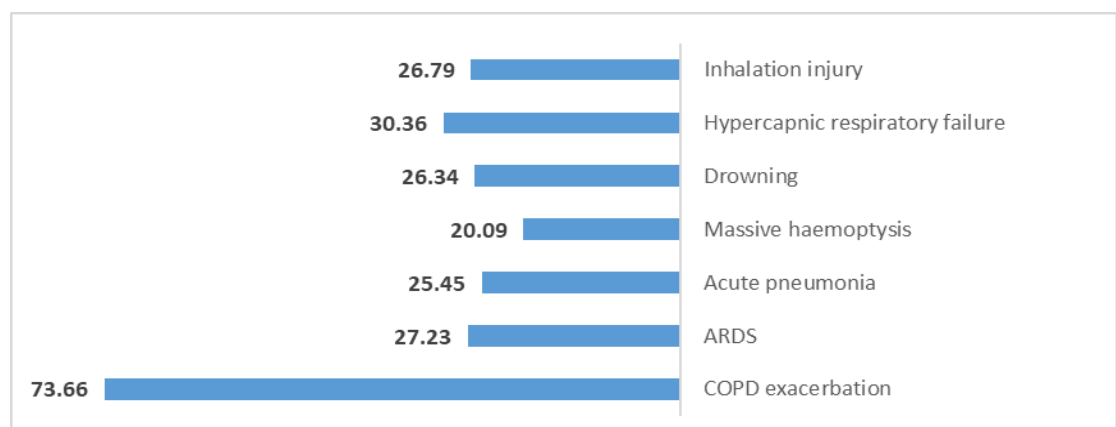


Figure 4. Medical conditions could benefit from emergency respiratory care services via telemedicine applications (n=224).

Discussion

To the best of our knowledge, this is the first national cross-sectional study exploring acceptance and challenges of telemedicine application among Respiratory HCPs in clinical setting in Saudi Arabia. The study revealed that most of our surveyed Respiratory HCPs were familiar with telemedicine (59.4%) regardless of their characteristics. Interestingly, more than half of professionals (54%) were aware of the technology but had not used it. The results showed a high acceptance level, and these results were as expected given that medical institutions have accelerated the use of telemedicine as an alternate means of delivering treatment or monitoring patients, especially after the outbreak of the COVID-19 epidemic. More importantly, the accessibility and usage of telemedicine services throughout the Kingdom of Saudi Arabia are one of the goals of the Saudi Vision 2030 plan, which emphasizes the importance of developing and establishing a national telemedicine network involving all healthcare professions (26). Our survey additionally showed that a great majority of professionals still prefer the traditional approach to get medical treatment and believe it is not as good as traditional care. When it comes to the benefits of telemedicine, most Respiratory HCPs agreed that it saves time and helps them to care for more patients. We also found that technical issues are a major challenge from the perspective of healthcare professionals, this is not surprising given that technical issues are a prevalent barrier associated with low-level usage and satisfaction. As expected, our results showed that Respiratory HCPs believe that telemedicine is socially acceptable irrespective of their gender. Also, the older the Respiratory HCPs, the more familiar they were with telemedicine, that could be related to more expertise years they have. The results of this study show that the greatest challenge to the future implementation of telemedicine may be that its applications may result in misdiagnosis, and telemedicine reduces the patient-physician contact (i.e., physical examinations) required for effective diagnosis. The current study also showed that telemedicine was preferred in certain healthcare settings such as managing patients with chronic conditions, patient assessment and education, pulmonary rehabilitation, and home non-invasive ventilation monitoring and management. On the other hand, healthcare professionals were less preferred to use telemedicine in emergency respiratory care services like massive haemoptysis, acute pneumonia, inhalation injury, and ARDS.

In this study, there was a high level of acceptance of telemedicine among respiratory HCPs. According to a previous study conducted in Saudi Arabia, telemedicine awareness, knowledge, and attitudes are becoming more widespread in Saudi Arabia, this is not a surprising outcome since the COVID-19 pandemic, medical institutions have been speeding up the implementation of telemedicine as an alternative technique for providing care and monitoring patients (27). Regarding the advantages of telemedicine, our

study found that most Respiratory HCPs believe that telemedicine can save time and be a viable approach for providing medical care services to patients. Similarly, A cross-sectional study found a high perception of telemedicine among physicians as a viable approach for providing medical services to their patients, and they agreed that telemedicine could save time and money. This can be explained by the fact that using telemedicine, physicians can bring medical care to their patients while they remain in hospitals; therefore, this can save time and the lives of patients and save money for the healthcare system (28).

Our results show that technical issues are the major challenge facing respiratory HCPs while using telemedicine applications with their patients. In a previous study conducted in Saudi Arabia, it was mentioned that this is not unexpected given that technical issues like poor internet connections frequently come up as barriers due to low levels of use and satisfaction (27).

In addition, our study found that diagnosis reliability is a major challenge to the future application of telemedicine among Respiratory HCPs. According to findings from a previous study, the main limitation of telemedicine applications during the COVID-19 pandemic that it was difficult to make the correct diagnosis due to the inability to perform the physical examination, and physicians were unable to use their hands-on expertise. Furthermore, since most of their patients are elderly and have low technological knowledge, physicians are still not convinced that their patients will begin using telemedicine technology. Some patients might not be aware that it is an option or be unaware of how to use it (29).

In this study, we found that half of the participants agreed that telemedicine can substitute face-to-face encounters. In contrast, according to a previous study (30), most participants preferred office visits over online meetings. This difference could be attributed to the difference in the study sample as their population was mainly physicians working in King Abdulaziz medical city in Riyadh, as well as the difference in services provided by physicians and Respiratory HCPs that could affect their opinion about telemedicine. According to the findings of a study assessing physician satisfaction with telemedicine (31), nearly two-thirds of the participants somewhat or strongly agreed that telemedicine care was comparable to the face-to-face visits. This study was conducted during the COVID-19 pandemic and involved physicians working in Mayo clinics in Florida, in addition to the earlier introduction of telemedicine to the healthcare system are possible reasons for the difference in the results.

Although the findings of the study were quite valuable, they come with certain limitations. We could not achieve the sample size because of time limitation so we accepted 21 responses from not employed professionals to reach the largest possible responses; hence, this may affect the result of the study. Data regarding actual number of Respiratory HCPs who received the survey could not be collected because it was

distributed through social media platforms, so it was unable to precisely determine response rate. Another major limitation of this study is that it focused on respiratory HCPs despite there are many other occupations involved in the healthcare system, thus the results of the study cannot be generalized to wider healthcare professionals. Additionally, most of the participants were younger in age and have clinical experience for 2 years or less so this could lead to bias in the results of the study.

Conclusions

Telemedicine is a helpful tool and using it has increased since the COVID-19 era. The majority of the respiratory HCPs in the study seem to be familiar with telemedicine. In addition, most of the participants showed positive acceptance and awareness of it. From the perspective of respiratory HCPs, one of the main fears concerning future telemedicine use is that its application may results in misdiagnosis. Therefore, Respiratory HCPs believe telemedicine is beneficial for saving time and caring for more patients. However, current widespread challenges must be addressed to increase awareness

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References

1. Craig J, Patterson V. Introduction to the practice of telemedicine. Vol. 11, Journal of Telemedicine and Telecare. 2005.
2. Bunnell BE, Barrera JF, Paige SR, Turner D, Welch BM. Acceptability of telemedicine features to promote its uptake in practice: a survey of community telemental health providers. *Int J Environ Res Public Health*. 2020;17(22).
3. Khairat S, Liu S, Zaman T, Edson B, Gianforcaro R. Factors Determining Patients' Choice Between Mobile Health and Telemedicine: Predictive Analytics Assessment. [cited 2023 Feb 8]; Available from: <http://mhealth.jmir.org/2019/6/e13772/>
4. National E- Health Strategy - The Roadmap of Projects [Internet]. [cited 2023 Feb 17]. Available from: <https://www.moh.gov.sa/en/Ministry/nehS/Pages/The-Roadmap-of-Projects.aspx>
5. MOH News - MoH: All the Kingdom Will be Covered by Telemedicine in Two Months [Internet]. [cited 2023 Feb 17]. Available from: <https://www.moh.gov.sa/en/Ministry/MediaCenter/News/Pages/news-2018-03-06-006.aspx>
6. Al-Tawfiq JA, Memish ZA. COVID-19 in the Eastern Mediterranean Region and Saudi Arabia: prevention and therapeutic strategies. *Int J Antimicrob Agents* [Internet]. 2020 May 1 [cited 2023 Feb 17];55(5):105968. Available from: /pmc/articles/PMC7271262/
7. Khan A, Alahmari A, Almuzaini Y, Alturki N, Aburas A, Alamri FA, et al. The role of digital technology in responding to COVID-19 pandemic: Saudi Arabia's experience. *Risk Manag Healthc Policy* [Internet]. 2021 [cited 2023 Feb 18];14:3923–34. Available from: <https://www.tandfonline.com/action/journalInformation?journalCode=drmh20>
8. Alassaf N, Bah S, Almulhim F, Aldossary N, Alqahtani M. Evaluation of Official Healthcare Informatics Applications in Saudi Arabia and their Role in

- Addressing COVID-19 Pandemic. Healthc Inform Res [Internet]. 2021 Jul 31 [cited 2023 Feb 18];27(3):255–63. Available from: <https://synapse.koreamed.org/articles/1147759>
9. Alanzi T. A review of mobile applications available in the app and google play stores used during the COVID-19 outbreak. J Multidiscip Healthc [Internet]. 2021 [cited 2023 Feb 18];14:45–57. Available from: <https://www.tandfonline.com/action/journalInformation?journalCode=djmd20>
 10. Alkhalifah JM, Seddiq W, Alshehri BF, Alhaluli AH, Alessa MM, Alsulais NM. The role of the COVID-19 pandemic in expediting digital health-care transformation: Saudi Arabia's experience. Inform Med Unlocked. 2022 Jan 1;33.
 11. Wade VA, Elliott JA, Hiller JE. Clinician acceptance is the key factor for sustainable telehealth services. Qual Health Res [Internet]. 2014 [cited 2023 Feb 10];24(5):682–94. Available from: <https://pubmed.ncbi.nlm.nih.gov/24685708/>
 12. Almojaibel AA, Munk N, Goodfellow LT, Fisher TF, Miller KK, Comer AR, et al. Health Care Practitioners' Determinants of Telerehabilitation Acceptance. Int J Telerehabil [Internet]. 2020 Mar 1 [cited 2023 Feb 10];12(1):43. Available from: [/pmc/articles/PMC7502808/](https://pubmed.ncbi.nlm.nih.gov/32080808/)
 13. Garavand A, Aslani N, Nadri H, Abedini S, Dehghan S. Acceptance of telemedicine technology among physicians: A systematic review. Inform Med Unlocked. 2022 Jan 1;30:100943.
 14. Nadri H, Rahimi B, Afshar HL, Samadbeik M, Garavand A. Factors Affecting Acceptance of Hospital Information Systems Based on Extended Technology Acceptance Model: A Case Study in Three Paraclinical Departments. Appl Clin Inform [Internet]. 2018 Apr 1 [cited 2023 Feb 10];9(2):238. Available from: [/pmc/articles/PMC5884692/](https://pubmed.ncbi.nlm.nih.gov/30884692/)
 15. Alghamdi SM, Aldhahir AM, Alqahtani JS, Siraj RA, Alsulayyim AS, Almojaibel AA, et al. Healthcare Providers' Perception and Barriers Concerning

- the Use of Telehealth Applications in Saudi Arabia: A Cross-Sectional Study. Healthcare (Switzerland). 2022 Aug 1;10(8).
16. Ftouni R, AlJardali B, Hamdanieh M, Ftouni L, Salem N. Challenges of Telemedicine during the COVID-19 pandemic: a systematic review. BMC Med Inform Decis Mak [Internet]. 2022 Dec 1 [cited 2023 Feb 9];22(1):1–21. Available from: <https://bmcmeginformdecismak.biomedcentral.com/articles/10.1186/s12911-022-01952-0>
17. El-Mahalli AA, El-Khafif SH, Al-Qahtani MF. Successes and Challenges in the Implementation and Application of Telemedicine in the Eastern Province of Saudi Arabia. Perspectives in Health Information Management / AHIMA, American Health Information Management Association [Internet]. 2012 [cited 2023 Feb 9];9(Fall):1–27. Available from: /pmc/articles/PMC3510649/
18. Sawadkar MM, Nayak VR. Telehealth: The role of respiratory therapists during the COVID-19 emergency. Can J Respir Ther [Internet]. 2021 [cited 2023 Feb 11];57:119. Available from: /pmc/articles/PMC8372871/
19. Segrelles-Calvo G, López-Padilla D, Chiner E, Fernández-Fabrellas E, de Granda-Orive JJ. Acceptance of telemedicine among respiratory healthcare professionals. European Research in Telemedicine / La Recherche Européenne en Télémédecine. 2017 Nov 1;6(3–4):147–55.
20. Albarrak AI, Mohammed R, Almarshoud N, Almujaalli L, Aljaeed R, Altuwaijiri S, et al. Assessment of physician's knowledge, perception and willingness of telemedicine in Riyadh region, Saudi Arabia. J Infect Public Health. 2021 Jan 1;14(1):97–102.
21. Kaliyadan F, A. Al Ameer M, Al Ameer A, Al Alwan Q. Telemedicine Practice in Saudi Arabia During the COVID-19 Pandemic. Cureus. 2020 Dec 10;

22. Vidal-Alaball J, Mateo GF, Domingo JLG, Gomez XM, Valmaña GS, Ruiz-Comellas A, et al. Validation of a short questionnaire to assess healthcare professionals' perceptions of asynchronous telemedicine services: The catalan version of the health optimum telemedicine acceptance questionnaire. *Int J Environ Res Public Health*. 2020 Apr 1;17(7).
23. Ullah S, Maghazil AM, Qureshi AZ, Tantawy S, Moukais IS, Aldajani AA. Knowledge and Attitudes of Rehabilitation Professional Toward Telerehabilitation in Saudi Arabia: A Cross-Sectional Survey. *Telemed J E Health*. 2021 May 27;587–91.
24. Sample Size Calculator [Internet]. [cited 2023 Mar 13]. Available from: <https://www.calculator.net/sample-size-calculator.html>
25. Statistical Yearbook - Statistical Yearbook [Internet]. [cited 2023 Mar 13]. Available from: <https://www.moh.gov.sa/en/Ministry/Statistics/book/Pages/default.aspx>
26. Alghamdi SM, Alsulayyim AS, Alqahtani JS, Aldhahir AM. Digital health platforms in saudi arabia: Determinants from the COVID-19 pandemic experience. *Healthcare (Switzerland)* [Internet]. 2021 Nov 1 [cited 2023 May 30];9(11). Available from: [/pmc/articles/PMC8618772/](https://pubmed.ncbi.nlm.nih.gov/3518772/)
27. Alghamdi SM, Aldhahir AM, Alqahtani JS, Siraj RA, Alsulayyim AS, Almojaibel AA, et al. Healthcare Providers' Perception and Barriers Concerning the Use of Telehealth Applications in Saudi Arabia: A Cross-Sectional Study. *Healthcare (Switzerland)* [Internet]. 2022 Aug 1 [cited 2023 May 20];10(8). Available from: [/pmc/articles/PMC9408269/](https://pubmed.ncbi.nlm.nih.gov/3518772/)
28. Albarrak AI, Mohammed R, Almarshoud N, Almujailli L, Aljaeed R, Altuwaijiri S, et al. Assessment of physician's knowledge, perception and willingness of telemedicine in Riyadh region, Saudi Arabia. *J Infect Public Health*. 2021 Jan 1;14(1):97–102.

29. Mubaraki AA, Alrabie AD, Sibyani AK, Aljuaid RS, Bajaber AS, Mubaraki MA. Advantages and disadvantages of telemedicine during the COVID-19

pandemic era among physicians in Taif, Saudi Arabia. *Saudi Med J* [Internet]. 2021 Jan 1 [cited 2023 May 20];42(1):110. Available from: [/pmc/articles/PMC7989314/](#)

30. Altulaihi BA, Alharbi KG, Alhassan AM, Altamimi AM, Al Akeel MA. Physician's Perception Toward Using Telemedicine During COVID-19 Pandemic in King Abdulaziz Medical City, Riyadh, Saudi Arabia. *Cureus*. 2021 Jul 2;

31. Malouff TD, TerKonda SP, Knight D, Abu Dabrh AM, Perlman AI, Munipalli B, et al. Physician Satisfaction With Telemedicine During the COVID-19 Pandemic: The Mayo Clinic Florida Experience. *Mayo Clin Proc Innov Qual Outcomes*. 2021 Aug;5(4):771–82.