Telemedicine awareness, knowledge, attitude and skills of healthcare workers in a low resource country during the COVID-19 pandemic

Muhammed Elhadi, Ahmed Elhadi, Ahmad Bouhuwaish, Fatimah Bin Alshiteewi, Amna Elmabrouk, Ali Alsuyihili, Ayiman Alhashimi, Samer Khel, Alsafa Elgherwi, Ahmed Alsoufi, Ahmed Albakoush, Abdulmuez Abdulmalik

Submitted to: Journal of Medical Internet Research
on: May 29, 2020

Table of Contents

Telemedicine awareness, knowledge, attitude and skills of healthcare workers in a low resource country during the COVID-19 pandemic

Muhammed Elhadi[1] MBBCh; Ahmed Elhadi[1] MBBCh; Ahmad Bouhuwaish[2] MBBCh; Fatimah Bin Alshiteewi[1] MBBCh; Amna Elmabrouk[1] MBBCh; Ali Alsuyihili[1] MBBCh; Ayiman Alhashimi[3] MBBCh; Samer Khel[1] MBBCh; Alsafa Elgherwi[1] MBBCh; Ahmed Alsoufi[2]; Ahmed Albakoush[1] MBBCh; Abdulmuez Abdulmalik[4] MBBCh

[1]Faculty of Medicine, University of Tripoli Tripoli LY
[2]Faculty of Medicine, Tobruk University Tobruk LY
[3]Faculty of Medicine, Al-Jabal Al Gharbi University Gherian LY
[4]Faculty of Medicine, Libyan International Medical University Benghazi LY

Corresponding Author:
Muhammed Elhadi MBBCh
Faculty of Medicine, University of Tripoli
University Road, Furnaj
Tripoli
LY

Abstract

Background: Since the beginning of the COVID-19 pandemic, several healthcare service programs that aim to provide healthcare telemedicine services have been introduced in Libya. Although they were newly introduced, many physicians have participated in these services to provide care and advice to their patients remotely, that is without the need to be present in person in the clinic. Therefore, there is a need to assess the physicians' awareness, knowledge, attitude, and skills of the usage of telehealth services.

Objective: We aimed to provide an overview of the physicians' awareness, knowledge, attitude, and skills of telemedicine.

Methods: A cross-sectional study was conducted using a web-based survey to obtain responses from healthcare workers in Libya during May 2020. The questionnaire consisted of questions on the physicians' basic characteristics, ability to use a computer, and awareness, knowledge, attitude, and skills of telemedicine.

Results: Totally, 673 healthcare workers participated in this study. The awareness and skill levels of the respondents were found to be 56% and 36.8%, respectively, while the knowledge and attitude levels were found to be 86.5% and 82.6%, respectively, which were high. There were no significant differences in the awareness, knowledge, attitude, and skill scores among physicians who worked in public hospitals, private hospitals, or both types of hospitals (employment status). We observed statistically significant differences in the mean awareness, attitude, and computer skill (P <0.05) scores, where the distribution of the scores, based on the ability to use computers, of the groups was not similar. There were no significant differences in the knowledge scores among the three groups. We found that those with professional computer skills showed significantly higher scores than those with high awareness levels [?2(3) = 14.468, P ?0.001]. We found that those with higher computer skills showed significantly higher attitude levels [?2(3) = 13.46, P = 0.001]. Additionally, there were significant differences in the mean computer skill scores of the groups [?2(3) = 199.62, P ?0.001].

Conclusions: The consequences of the COVID-19 pandemic are expected to remain ongoing for a significant time; hence, policy programs, such as telemedicine services, which aim to address the obstacles to medical treatment created due to physical distancing steps, will be continued for a long time. Therefore, there is a need to train and support healthcare workers and initiate governmental programs that provide adequate and supportive healthcare services to patients in developing countries.

(JMIR Preprints 29/05/2020:20812)
DOI: https://doi.org/10.2196/preprints.20812

Preprint Settings

1) Would you like to publish your submitted manuscript as preprint?

Please make my preprint PDF available to anyone at any time (recommended).
Please make my preprint PDF available only to logged-in users; I understand that my title and abstract will remain visible to all users.
Only make the preprint title and abstract visible.
✓ **No, I do not wish to publish my submitted manuscript as a preprint.**

2) If accepted for publication in a JMIR journal, would you like the PDF to be visible to the public?

✓ **Yes, please make my accepted manuscript PDF available to anyone at any time (Recommended).**
Yes, but please make my accepted manuscript PDF available only to logged-in users; I understand that the title and abstract will remain v
Yes, but only make the title and abstract visible (see Important note, above). I understand that if I later pay to participate in <a href="http

Original Manuscript

Original Paper

Telemedicine awareness, knowledge, attitude and skills of healthcare workers in a low resource country during the COVID-19 pandemic

Muhammed Elhadi[1*], Ahmed Elhadi[1], Ahmad Bouhuwaish[2], Fatimah Bin Alshiteewi[1], Amna Elmabrouk[1], Ali Alsuyihili[1], Ayiman Alhashimi[3], Samer Khel[1], Alsafa Elgherwi[1], Ahmed Alsoufia[1], Ahmed Albakoush[1], Abdulmuez Abdulmalik[4]

Affiliations

[1]*Faculty of Medicine, University of Tripoli, Tripoli, Libya*

[2]*Faculty of Medicine, Tobruk University, Tobruk, Libya*

[3]*Faculty of Medicine, Al-Jabal Al Gharbi University, Gherian, Libya*

[4]*Faculty of Medicine, Libyan International Medical University, Benghazi, Libya*

***Correspondence:** Muhammed Elhadi, Faculty of Medicine, University of Tripoli, University Road, Furnaj, 13275, Tripoli, Libya*

(Email: Muhammed.elhadi.uot@gmail.com) (Telephone: +218945196407)

Abstract

Background and Objectives: Since the beginning of the COVID-19 pandemic, several healthcare service programs intended to provide healthcare telemedicine services have been introduced in Libya. Many physicians have used these services to provide care and advice to their patients remotely, without the need to be present in the clinic. Assessments of physicians' awareness, knowledge, attitude and skills in using telehealth services are needed. We aimed to provide an

overview of these assessments.
Methods: A cross-sectional study conducted using a web-based survey sought responses from healthcare workers in Libya in May 2020. The questionnaire collected information on physicians' basic characteristics, ability to use a computer, and telemedicine awareness, knowledge, attitude, and skills.
Results: The awareness and skill levels of the 673 healthcare respondents were 56% and 36.8%, respectively. Knowledge and attitude levels were high (86.5% and 82.6%, respectively). There were no significant differences in awareness, knowledge, attitude and skill scores among physicians employed in public hospitals, private hospitals or both types of hospitals. Statistically significant differences were evident in the mean awareness, attitude and computer skill ($P < .05$) scores, where the distribution of the scores in the groups based on the ability to use computers was not similar. There were no significant differences in knowledge scores among the three groups. Respondents with professional computer skills showed significantly higher scores than those with high awareness levels ($\chi2(3) = 14.468$, $P \leq .001$). Respondents with higher computer skills showed significantly higher attitude levels ($\chi2(3) = 13.46$, $P = .001$). Significant differences were evident in the mean computer skill scores of the groups [$\chi2(3) = 199.62$, $P \leq .001$].
Conclusions: The consequences of the COVID-19 pandemic are expected to persist for a prolonged time. Hence, policy programs, such as telemedicine services, which aim to address the obstacles to medical treatment created due to physical distancing steps, will likely continue for a long time. Therefore, there is a need to train and support healthcare workers and initiate governmental programs that provide adequate and supportive healthcare services to patients in developing countries.

Keywords:
Coronavirus; COVID-19; Telemedicine; Awareness; Knowledge; Attitude; Skills; Pandemic

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was identified as the cause of severe viral pneumonia in the city of Wuhan, in Hubei Province of China, in December 2019. The World Health Organisation declared the disease caused by the virus (COVID-19) a worldwide pandemic in March 2020 [1-4]. As of 22 July 2020, more than 15,000,000 COVID-19 cases and more than 617,000 COVID-19-related deaths have been recorded in 213 countries and territories globally [5].
Preventive measures have been implemented to reduce the potential exposure to the virus and to decrease the burden of COVID-19 transmission. These measures include hand washing, avoiding touching the face and eyes, cleaning and disinfecting surfaces and objects, wearing protective equipment including masks, and most importantly, social distancing by staying at home, avoiding close contact with others and maintaining an adequate distance between persons [6-8].
The COVID-19 pandemic has affected the typical face-to-face healthcare service. New strategies and approaches, including telemedicine and telehealth services, must be implemented to permit video consultations and telephone applications, with the goals of delivering medical advice, diagnosis and

treatment to reduce the risk of infection [9, 10]. Telemedicine and telehealth services are especially important for non-COVID-19 patients, especially those with chronic or acute illnesses, who still require medical care during the pandemic. Several countries have begun to increase the use of telemedicine services, even prior to the COVID-19 pandemic [11-16]. Telemedicine was effective during previous outbreaks, including those of Ebola, Zika virus and SARS-CoV [17, 18].

Telemedicine is defined as the use of online knowledge and electronic information along with advanced digital network technology to promote long-distance professional health services, disseminate medical safety reports, deliver health-related education to the public and for public health monitoring [19, 20].

Since the beginning of the COVID-19 pandemic, several healthcare service programs that aim to provide healthcare telemedicine services have been introduced in Libya. Even with their recent introduction, many physicians have used these services to provide care and advice to patients remotely, without the need to be present in the clinic. There is a need to assess the awareness, knowledge, attitude and skills of physicians who use telemedicine services. The skilled use of telemedicine by physician benefits patients, who can receive a wide range of healthcare services without the need to attend the clinic. This distance care reduces the risk of infection among populations by allowing social distancing and decreasing the burden on the hospitals that care for COVID-19 patients [21-23].

We aimed to provide an overview of physicians' awareness, knowledge, attitude and skills of telemedicine, a technology that has been introduced in developing countries. This overview included an examination of the effects of COVID-19 on this technology to help clarify whether this technology can be usefully applied during the ongoing COVID-19 pandemic.

Methods

A cross-sectional study was conducted using a web-based survey to obtain responses from healthcare workers in Libya during May 2020. The survey was sent by email and mobile messages. Responses were anonymous without any identifying data. The study focussed on healthcare workers who were officially registered with Libyan hospitals during the COVID-19 pandemic and involved in patient care. The first section of the survey sought baseline information and characteristics, including age, gender, years of experience, employment status, department of work, and computer skills of the healthcare workers. There were also several general questions related to telemedicine experience. The second section contained a previously developed survey instrument that was developed by Zayapragassarazan et al. [24] that contains the four sections detailed subsequently.

Awareness Section

This section consisted of 12 statements on telemedicine used to demonstrate awareness. Each statement was answered with a grade, varying from '0' to 2', on a scale of three points. The grades included '0' for 'don't know', '1' for 'heard of it' and '2' for 'know about it'. The overall score could be from a minimum of '0' to a maximum of '24'.

Knowledge Section

This section consisted of 11 statements that assessed the physician's level of telemedicine knowledge. Each statement was answered with a response of either 'yes' or 'no'. " For every 'yes', a score of '0' was issued. For every 'no', a score of '1' was issued. The overall score could be from a minimum of '0' to a maximum of '11'.

Attitude Section

This section consisted of 11 statements used to determine the attitude of the respondents toward telemedicine. Each statement was answered with a grade, varying from '0' to 4', on a five-point

Likert scale. The grades included ‘0’ for ‘strongly disagree’, ‘1’ for ‘disagree’, ‘2’ for ‘undecided’, ‘3’ for ‘agree’ and ‘4’ for ‘strongly agree’. The overall score could be from a minimum of ‘0’ to a maximum of ‘44’.

Computer Skills Section

This section consisted of 13 statements used to determine the physician’s level of information technology and computer skills. Each statement was answered with a grade, varying from ‘0’ to 3’, on a scale of four points. The grades included ‘0’ for ‘unskilled’, ‘1’ for ‘learner’, ‘2’ for ‘mediocre’ and ‘3’ for ‘expert’. The overall score could be from a minimum of ‘0’ to a maximum of ‘39’.

COVID-19 Effects on Telemedicine

The third section included several questions on the effects of the spread of COVID-19 on telemedicine, the role of telemedicine in reducing visits, the amount of time spent on practising telemedicine, the usability of telemedicine based on local internet settings and the role of telemedicine in helping doctors avoid or decrease the risk of infection related to internal conflicts in Libya.

Raw scores of each section of the awareness-knowledge-attitude-skill questionnaires were converted to percentages and compared with the variables. We considered ≤49% to be low, 50% to 70% to be average, and ≥71% to be high. The survey was conducted in accordance with Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) [25].

Statistical Analyses

Descriptive statistics related to the basic characteristics of the physicians were calculated. Frequency and percentage were used to describe the variables. The mean and standard deviation (SD) were used to describe continuous data. None of the major continuous outcomes, which were scores of the survey, followed a normal distribution. Therefore, they were analysed using the Mann-Whitney test to determine whether there were statistically significant differences between the two groups and the score of each section. The Kruskal-Wallis H test was used to compare groups with three or more independent variables. The chi-square test was used to determine whether there was any association between the categorical groups. Statistical analysis was performed using IBM SPSS Statistics for Windows (Version 25.0).

Ethical Consideration

The authors confirm that all procedures contributing to this work comply with the ethical standards of the relevant national and institutional committee on human experimentation, with the Helsinki Declaration of 1975, as revised in 2008. Ethical approval for this study was obtained from the Bioethics Committee at the Biotechnology Research Centre in Libya. The survey was conducted anonymously, and all participants provided informed written consent before participating in the study.

Results

Of the 800 participants who received the survey, 673 responded, representing an estimate response rate of 84.12%. Among the participants, 299 (44.4%) were male and 374 (55.6%) were female. There were 288 (42.8%) specialists or senior physicians, and 385 (57.2%) physicians in training. Table 1 shows the basic characteristics of the participants.

Most (n = 631, 93.8%) participants had an average or professional level of computer and internet skills. The majority (n = 525, 78%) of the participants had taken part in training programs on telemedicine during the COVID-19 pandemic. Most of the participants (n = 639, 94.9%) expressed

willingness to take such training courses.

The questionnaires measure the physicians' awareness, knowledge, attitude and skills of telemedicine usage. The scales had a high level of internal consistency, as evident by a Cronbach's alpha of 0.823 for awareness, 0.735 for knowledge, 0.91 attitude and 0.95 for skills. The values indicated an acceptable level of internal consistency.

Interestingly, 399 (59.3%) participants perceived telemedicine as a helpful tool for elderly patients, and 486 (72.2%) thought that telemedicine could be used by physicians to obtain patients' electrocardiogram and X-ray reports for medical consultation. A minority (n = 178, 26.4%) of participants thought that direct consultation could be provided using telemedicine technology. Only 28 (4.2%) participants thought that laboratory results could be sent to patients using telemedicine, and only 81 (12%) participants thought that follow-up and response to treatment could be performed using telemedicine technology.

Many (n = 580, 86.2%) of the participants did not agree that patients should have access to information on their medical condition. However, 573 (85.1%) participants believed that telemedicine could help fill the gap between primary and secondary care by developing communication among doctors, consultants and nurses. Interestingly, 254 (37.7%) participants had little or no experience using emails and sending files.

Table 1. Basic characteristics of the 673 study participants

Variables	Total (%) n = 673	Female (%) n = 374	Male (%) n = 299	*P*-value
Age range, years				.007 [a]
<30	109 (16.2)	48 (12.8)	61 (20.4)	
30–40	442 (65.7)	247 (66.0)	195 (65.2)	
>40	122 (18.1)	79 (21.1)	43 (14.4)	
Year of experience, (mean ± SD)	8.78 ± 8.09	9.6 ± 8.54	7.76 ± 7.38	.001 [a]
Employment status				<.001 [b]
Public sector	335 (49.8)	150 (40.1)	185 (61.9)	
Private sector	82 (12.2)	49 (13.1)	33 (11.0)	
Both	256 (38)	175 (46.8)	81 (27.1)	
Ability to use computer				.004 [a]
Beginner	42 (6.2)	15 (4.0)	27 (9.0)	
Average	452 (67.2)	246 (65.8)	206 (68.9)	
Professional	179 (26.6)	113 (30.2)	66 (22.1)	
Received training for telemedicine system?				.373
Yes	525 (78.0)	287 (76.7)	238 (79.6)	
No	148 (22.0)	87 (23.3)	61 (20.4)	
Availability of telemedicine unit in your department				.606
Yes	525 (78)	289 (77.3)	236 (78.9)	
No	148 (22.0)	85 (22.7)	63 (21.1)	
Department				<.001 [b]
Internal Medicine (including all sub-specialties)	179 (26.6)	101 (27)	78 (26.1)	
Paediatric	74 (11)	33 (8.8)	41 (13.7)	
Surgery (including all sub-specialties)	160 (23.8)	131 (35)	29 (9.7)	
Gynaecology and Obstetric	72 (10.7)	3 (0.8)	69 (23.1)	
Dermatology	36 (5.3)	11 (2.9)	25 (8.4)	
Family Medicine	64 (9.5)	38 (10.2)	26 (8.7)	
Psychiatry	25 (3.7)	14 (3.7)	11 (3.7)	
Other	63 (9.4)	43 (11.5)	20 (6.7)	

SD = standard deviation

[a], Significant at $P < .05$

[b], Significant at $P < .001$

Data of physicians' awareness, knowledge, attitude and skills of telemedicine are summarised in Table 2. Three hundred seventy-seven (56%) participants showed high and adequate awareness, 582 (86.5%) showed high knowledge, 556 (82.6%) showed high attitude scores and 248 (36.8%) participants showed high computer skills of telemedicine technology for all specialities.

The results showed that 19.6% of participants were not familiar with telemedicine technology, and that 4.2% had low telemedicine knowledge. Approximately 2.4% of participants had low attitude scores.

Table 2. Different levels of awareness, knowledge, attitude and skills of the 673 participants

Degree	**Awareness**			**Knowledge**		
	Low ≤49%	Average 50%-70%	High ≤71%	Low ≤49%	Average 50%-70%	High ≤71%
Number	132	164	377	28	63	582
Percentage	19.6	24.4	56	4.2	9.4	86.5
	Attitude			**Skills**		
	Low ≤49%	Average 50%-70%	High ≤71%	Low ≤49%	Average 50%-70%	High ≤71%
Number	16	101	556	226	199	248
Percentage	2.4	15	82.6	33.6	29.6	36.8

Tables 3 and 4 provided comparisons of the scores of each section of the survey and the differences among the study participants. The Mann-Whitney U test was performed to determine whether there were significant differences in the awareness, knowledge, attitude and skill scores of males and females. The mean awareness and computer skill scores of males and females were statistically significantly different. Females showed statistically significant and higher awareness and computer skill scores than males. However, there were no significant differences in the mean knowledge and attitude scores of males and females.

The Kruskal-Wallis test was conducted to determine whether there were any differences in the awareness, knowledge, attitude and skill scores of other categorical groups, including those based on employment status, ability to use computers and departments of work. Significant differences in the awareness, knowledge, attitude and skill scores of those employed in public hospitals, private hospitals or both types of hospitals were not observed. Statistically significant differences were evident in the mean awareness, attitude and computer skill ($P < .05$) scores, where the distribution of the scores, based on the ability to use computers, of the groups were not similar. There were no significant differences in the knowledge scores of the three groups based on employment status. Participants with professional computer skills displayed significantly higher scores than those with high awareness scores ($\chi2(3) = 14.468$, $P \leq .001$). We also found that those with higher computer skills showed significantly higher attitude scores ($\chi2(3) = 13.46$, $P = .001$). Additionally, significant differences in the mean computer skill scores of different groups were observed [$\chi2(3) = 199.62$, $P \leq .001$]. Those who were more capable at using computers displayed significantly higher computer skill scores.

Based on the department in which the physician worked, statistically significant differences in attitude scores ($\chi2(8) = 16.67$, $P = .02$) and computer skills ($\chi2(8) = 22.87$, $P = .002$) of different departments were observed. We observed that those in gynaecology and obstetrics, family medicine and psychiatry showed higher attitude scores, while those in psychiatry and surgical specialities showed higher computer skill scores. However, awareness and knowledge scores of the different departments were not significantly different.

Table 3. Differences in the awareness and knowledge scores of the 673 participants, based on basic characteristics, using the Mann-Whitney test

Variables	Total (%) n = 673	Awareness Range 0 – 100			Knowledge Range 0 – 100		
		Mean ± SD	U/H	*P*-value	Mean ± SD	U/H	*P*-value
Gender Male	109 (16.2)	69.96 ± 24.82	49926.5 [a]	.017 [c]	83.0 ± 16.36	54460.5 [a]	.553

Female	442 (65.7)	66.51 ± 23.47			83.51 ± 17.05		
Employment status			2.79[b]	.248		2.16[b]	.339
Public sector	335 (49.8)	68.03 ± 24.88			83.14 ± 16.55		
Private sector	82 (12.2)	73.06 ± 21.15			86.03 ± 13.93		
Both	256 (38)	67.46 ± 24.33			82.59 ± 17.74		
Ability to use computer			41.97[b]	<.001**		1.98[b]	.371
Beginner	42 (6.2)	49.60 ± 28.07			77.27 ± 24.85		
Average	452 (67.2)	67.06 ± 23.81			83.34 ± 16.20		
Professional	179 (26.6)	76.30 ± 21.35			84.56 ± 15.50		
Department			8.99[b]	.253		10.68[b]	.153
Internal Medicine	179 (26.6)	67.43 ± 25.92			82.37 ± 17.34		
Paediatrics	74 (11)	65.59 ± 24.62			83.66 ± 15.26		
Surgical Specialties	160 (23.8)	66.95 ± 26.19			80.79 ± 19.55		
Gynaecology & Obstetrics	72 (10.7)	73.43 ± 18.16			85.61 ± 15.83		
Dermatology	36 (5.3)	70.37 ± 20.43			85.60 ± 12.36		
Family Medicine	64 (9.5)	73.50 ± 20.75			86.36 ± 15.19		
Psychiatry	25 (3.7)	73.66 ± 24.49			89.45 ± 8.16		
Other	63 (9.4)	64.28 ± 24.46			82.25 ± 15.17		

[a], Mann-Whitney: two groups with independent variables
[b], Kruskal-Wallis: three or more groups with independent variables
[c], Significant at $P < .05$
[d], Significant at $P < .001$

Table 4. Differences in the attitude and computer skill scores of the 673 participants, based on basic characteristics, using the Mann-Whitney test

Variables	Total (%) n = 673	Attitude Range 0 – 100			Computer Skills Range 0 - 100		
		Mean ± SD	U/H	*P*-value	Mean ± SD	U/H	*P*-value
Gender			55878.5[a]	.989		43475.5[a]	<.001
Male	109 (16.2)	79.81 ± 12.67			56.37 ± 25.27		
Female	442 (65.7)	79.81 ± 14.28			66.12 ± 22.27		
Employment status			1.93[b]	.379		4.169[b]	.124
Public sector	335 (49.8)	80.31 ± 13.51			60.07 ± 24.77		
Private sector	82 (12.2)	80.65 ± 13.38			66.07 ± 20.24		
Both	256 (38)	78.89 ± 13.74			62.67 ± 24.28		
Ability to use computer			13.46[b]	.001[c]		199.62[b]	<.001[d]
Beginner	42 (6.2)	72.61 ± 15.76			37.85 ± 21.63		
Average	452 (67.2)	79.64 ± 13.27			55.84 ± 20.50		
Professional	179 (26.6)	81.94 ± 13.26			82.42 ± 19.29		
Department			16.67[b]	.02[c]		22.87[b]	.002[c]
Internal Medicine	179 (26.6)	78.30 ± 13.85			59.77 ± 25.82		
Paediatrics	74 (11)	79.57 ± 13.56			56.54 ± 25.61		
Surgical Specialties	160 (23.8)	78.86 ± 15.70			67.11 ± 21.95		
Gynaecology & Obstetrics	72 (10.7)	83.14 ± 10.45			56.48 ± 23.84		

Dermatology	36 (5.3)	80.42 ± 14.02			55.27 ± 25.37		
Family Medicine	64 (9.5)	82.81 ± 13.19			63.58 ± 22.71		
Psychiatry	25 (3.7)	83.09 ± 8.94			71.89 ± 24.66		
Other	63 (9.4)	78.35 ± 10.86			64.14 ± 23.11		

[a], Mann-Whitney: two groups with independent variables
[b], Kruskal-Wallis: three or more groups with independent variables
[c], Significant at $P < .05$
[d], Significant at $P < .001$

COVID-19 Effects on Telemedicine

Among the study participants, 638 (94.8%) thought that telemedicine technology could be used to limit the spread of COVID-19. Additionally, 630 (93.6%) participants thought that telemedicine could contribute to the reduction in hospital visits to avoid COVID-19 transmission. However, only 283 (42.1%) participants thought that telemedicine could replace the usual medical visits during the COVID-19 pandemic. In addition, 616 (91.5%) participants thought that the telemedicine system could aid in patient communication and co-operation with doctors during the COVID-19 pandemic. In addition, 622 (92.4%) participants thought that the use of telemedicine and remote healthcare systems saved a lot of time that was otherwise lost in hospitals and clinics, and that these remote services could more quickly provide medical advice. However, only 437 (64.9%) participants thought that internet services in Libya met the demand for interruption-free telemedicine services. Moreover, 121 (18%) participants thought that telemedicine could help physicians avoid the issues of conflict and civil war in Libya and decrease the risks. Interestingly, 575 (85.4%) participants thought that telemedicine could protect doctors, who worked in unsafe environments, from a sense of insecurity during the civil war. Additionally, 606 (90%) participants thought that telemedicine could help physicians avoid the risk of contracting and transmitting COVID-19. However, only 385 (57.2%) participants thought that the telemedicine service technology could contribute to the improvement in the financial status of physicians.

Discussion

Telemedicine was introduced recently in developing countries, including Libya, to provide remote healthcare services, especially to patients with chronic diseases. In this study, the percentages of the responding physicians with high awareness, knowledge and attitude levels of telemedicine were 56%, 86.5% and 82.6%, respectively. However, only 36.8% of participants reported adequate or high telemedicine computer skills.

The COVID-19 pandemic was placed greater emphasis on telemedicine technology as a means of providing adequate care to patients without increasing the risk of transmission of SARS-CoV-2 to patients during clinic visits at hospitals. Additionally, telemedicine benefits healthcare workers because it decreases their risk of infection, reduces stress in the hospital, provides an adequate tool for treatment and follow-up of their patients and provides an appropriate approach for providing mental health services.

The present study was conducted to provide an overview of physicians' awareness, knowledge, attitude and skill levels of telemedicine in a developing country that suffers from a civil war, financial crisis, and a devastating healthcare system during the COVID-19 pandemic [26-28].

Only 26.6% of participants showed a professional level of computer skills, while 67.2% and 6.2% of participants showed average and beginner levels, respectively. Thus, overall, computer and information technology skills of the physician were inadequate. Such skills are crucial for the productive use of telemedicine services. Therefore, we recommend software and computer skills training programs for those who are newly introduced to telemedicine technology in developing

countries. Even with these skills, the approach may be difficult. Of the respondents, 35.1% opined that the internet services in Libya were not sufficient to meet the needs of patients using the telemedicine technology. This is due to the electricity and internet interruptions in Libya in the aftermath of the civil war [29]. This is yet another challenge for telemedicine service providers, which requires immediate attention from internet providers and telephone companies [30]. Many patients have complained about the availability of services and the service being unavailable due to high demand during the COVID-19 pandemic.

Most (82.6%) of the participants showed higher attitude levels. This is important because attitude represents how telemedicine was perceived by healthcare workers [31]. Attitude of healthcare workers is an important factor in understanding and accepting the telemedicine technology. To obtain this acceptance, the program developer is obligated to train healthcare workers and make the telemedicine programs useable for them [32].

Knowledge and attitude are important for the acceptance of telemedicine by healthcare workers. Presently, 86.5% of participants showed high knowledge. This value is higher than that in previous studies conducted in Germany [33]. The latter reported that approximately 63% of participants had some knowledge of telemedicine. Another study conducted in Lago showed that only 60.9% of participants had telemedicine knowledge [34]. Another study conducted in Pakistan reported an average telemedicine knowledge of healthcare workers [35]. Further initiatives and commitments are required to expand the use of telemedicine and increase its efficiency, especially by healthcare professionals in a post-conflict setting. There is a need for greater understanding among healthcare practitioners, particularly those who are new telemedicine users. Hence, it is important to address the obstacles to financial and physical access to telemedicine [36].

Several constraints in the implementation of telemedicine remain in developing countries, especially in emergency settings, even with the implementation of strategies to reduce the risk of exposure to the virus in the current COVID-19 situation. There are technical issues and a need to train healthcare providers to provide adequate telemedicine services. The COVID-19 pandemic has put a strain on hospital healthcare workers and challenged politicians, managers and practitioners concerning the limits of the broader healthcare infrastructure and assumptions that have restricted its potential for swift and creative reforms [30, 37, 38].

Our study was conducted in a single country using a cross-sectional study design, which may not be associated with these factors. In addition, our study did not provide detailed telemedicine types and how they can be implemented along with patients' attitude toward telemedicine. Further telemedicine studies are required to provide outcomes measured in terms of quality of healthcare provided to patients, to demonstrate access to healthcare services in other developing countries and to determine whether these telemedicine adaptations benefit patients, especially those suffering from chronic illnesses and psychiatric morbidities [39-41]. Additionally, there is a need to determine the cost benefit of these services and whether modifications of these services are required.

The consequences of the COVID-19 pandemic are expected to remain for a long time. Hence, policy programs, such as telemedicine services, which aim to address obstacles to medical treatment created due to physical distancing steps, will also continue for a long time [42]. Therefore, there is a need to train and support healthcare workers and initiate governmental programs that provide adequate and supportive healthcare services to patients in developing countries and respond to issues regarding access to these services, including internet access and advertisement, and social programs that help patients understand how to use these services.

Acknowledgements

None

Conflicts of Interest

All authors report no conflicts of interest relevant to this article.

Source of Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Authors Contribution

Each author took part in the design of the study, contributed to data collection, participated in writing the manuscript, and all agreed to accept equal responsibility for the accuracy of this paper. All the authors approved the final article.

References

1. Chan JF, Yuan S, Kok KH, To KK, Chu H, Yang J, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: a study of a family cluster. Lancet (London, England). 2020 Feb 15;395(10223):514-23. PMID: 31986261. doi: 10.1016/s0140-6736(20)30154-9.
2. Zhou F, Yu T, Du R, Fan G, Liu Y, Liu Z, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet (London, England). 2020 Mar 28;395(10229):1054-62. PMID: 32171076. doi: 10.1016/s0140-6736(20)30566-3.
3. Zhou P, Yang XL, Wang XG, Hu B, Zhang L, Zhang W, et al. A pneumonia outbreak associated with a new coronavirus of probable bat origin. Nature. 2020 Mar;579(7798):270-3. PMID: 32015507. doi: 10.1038/s41586-020-2012-7.
4. Cucinotta D, Vanelli M. WHO Declares COVID-19 a Pandemic. Acta bio-medica : Atenei Parmensis. 2020 Mar 19;91(1):157-60. PMID: 32191675. doi: 10.23750/abm.v91i1.9397.
5. Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. The Lancet Infectious diseases. 2020 May;20(5):533-4. PMID: 32087114. doi: 10.1016/s1473-3099(20)30120-1.
6. Prevention WGI. Control Network. WHO: Novel Coronavirus (2019-nCoV) advice for the public [Internet]. Novel Coronavirus (2019-nCoV) advice for the public. 2020.
7. Yan Y, Shin WI, Pang YX, Meng Y, Lai J, You C, et al. The First 75 Days of Novel Coronavirus (SARS-CoV-2) Outbreak: Recent Advances, Prevention, and Treatment. International journal of environmental research and public health. 2020;17(7):2323. PMID: 32235575. doi: 10.3390/ijerph17072323.
8. Orozco-Beltran D, Sánchez-Molla M, Sanchez JJ, Mira JJ. Telemedicine in Primary Care for Patients With Chronic Conditions: The ValCrònic Quasi-Experimental Study. Journal of medical Internet research. 2017 Dec 15;19(12):e400. PMID: 29246881. doi: 10.2196/jmir.7677.
9. Ohannessian R, Duong TA, Odone A. Global Telemedicine Implementation and

Integration Within Health Systems to Fight the COVID-19 Pandemic: A Call to Action. JMIR public health and surveillance. 2020 Apr 2;6(2):e18810. PMID: 32238336. doi: 10.2196/18810.
10. Lin C-H, Tseng W-P, Wu J-L, Tay J, Cheng M-T, Ong H-N, et al. A Double Triage and Telemedicine Protocol to Optimize Infection Control in an Emergency Department in Taiwan During the COVID-19 Pandemic: Retrospective Feasibility Study. Journal of medical Internet research. 2020;22(6):e20586-e. PMID: 32544072. doi: 10.2196/20586.
11. Liu S, Yang L, Zhang C, Xiang YT, Liu Z, Hu S, et al. Online mental health services in China during the COVID-19 outbreak. The lancet Psychiatry. 2020 Apr;7(4):e17-e8. PMID: 32085841. doi: 10.1016/s2215-0366(20)30077-8.
12. Li W, Yang Y, Liu ZH, Zhao YJ, Zhang Q, Zhang L, et al. Progression of Mental Health Services during the COVID-19 Outbreak in China. International journal of biological sciences. 2020;16(10):1732-8. PMID: 32226291. doi: 10.7150/ijbs.45120.
13. Zhou X, Snoswell CL, Harding LE, Bambling M, Edirippulige S, Bai X, et al. The Role of Telehealth in Reducing the Mental Health Burden from COVID-19. Telemedicine journal and e-health : the official journal of the American Telemedicine Association. 2020 Apr;26(4):377-9. PMID: 32202977. doi: 10.1089/tmj.2020.0068.
14. Greenhalgh T, Wherton J, Shaw S, Morrison C. Video consultations for covid-19. BMJ (Clinical research ed). 2020 Mar 12;368:m998. PMID: 32165352. doi: 10.1136/bmj.m998.
15. Hollander JE, Carr BG. Virtually Perfect? Telemedicine for Covid-19. The New England journal of medicine. 2020 Apr 30;382(18):1679-81. PMID: 32160451. doi: 10.1056/NEJMp2003539.
16. Hong Z, Li N, Li D, Li J, Li B, Xiong W, et al. Telemedicine During the COVID-19 Pandemic: Experiences From Western China. Journal of medical Internet research. 2020 May 8;22(5):e19577. PMID: 32349962. doi: 10.2196/19577.
17. Tom-Aba D, Olaleye A, Olayinka AT, Nguku P, Waziri N, Adewuyi P, et al. Innovative Technological Approach to Ebola Virus Disease Outbreak Response in Nigeria Using the Open Data Kit and Form Hub Technology. PloS one. 2015;10(6):e0131000. PMID: 26115402. doi: 10.1371/journal.pone.0131000.
18. Chang T, Lee J, Wu S. The telemedicine and teleconsultation system application in clinical medicine. Conference proceedings : Annual International Conference of the IEEE Engineering in Medicine and Biology Society IEEE Engineering in Medicine and Biology Society Annual Conference. 2004;2004:3392-5. PMID: 17271012. doi: 10.1109/iembs.2004.1403953.
19. Wootton R. Recent advances: Telemedicine. BMJ (Clinical research ed). 2001 Sep 8;323(7312):557-60. PMID: 11546704. doi: 10.1136/bmj.323.7312.557.
20. Ryu S. Telemedicine: Opportunities and Developments in Member States: Report on the Second Global Survey on eHealth 2009 (Global Observatory for eHealth Series, Volume 2). Healthc Inform Res. 2012;18(2):153-5. PMID: PMC3402558. doi: 10.4258/hir.2012.18.2.153.
21. Mann DM, Chen J, Chunara R, Testa PA, Nov O. COVID-19 transforms health care through telemedicine: evidence from the field. Journal of the American Medical Informatics Association. 2020. doi: 10.1093/jamia/ocaa072.

22. Reeves JJ, Hollandsworth HM, Torriani FJ, Taplitz R, Abeles S, Tai-Seale M, et al. Rapid Response to COVID-19: Health Informatics Support for Outbreak Management in an Academic Health System. Journal of the American Medical Informatics Association : JAMIA. 2020 Mar 24. PMID: 32208481. doi: 10.1093/jamia/ocaa037.
23. Hanlon P, Daines L, Campbell C, McKinstry B, Weller D, Pinnock H. Telehealth Interventions to Support Self-Management of Long-Term Conditions: A Systematic Metareview of Diabetes, Heart Failure, Asthma, Chronic Obstructive Pulmonary Disease, and Cancer. Journal of medical Internet research. 2017 May 17;19(5):e172. PMID: 28526671. doi: 10.2196/jmir.6688.
24. Zayapragassarazan Z, Kumar S. Awareness, Knowledge, Attitude and Skills of Telemedicine among Health Professional Faculty Working in Teaching Hospitals. J Clin Diagn Res. 2016;10(3):JC01-JC4. PMID: 27134899. doi: 10.7860/JCDR/2016/19080.7431.
25. Eysenbach G. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). J Med Internet Res. 2004;6(3):e34-e. PMID: 15471760. doi: 10.2196/jmir.6.3.e34.
26. Elhadi M, Msherghi A, Alkeelani M, Alsuyihili A, Khaled A, Buzreg A, et al. Concerns for low-resource countries, with under-prepared intensive care units, facing the COVID-19 pandemic. Infection, disease & health. 2020 Jun 5. PMID: 32631682. doi: 10.1016/j.idh.2020.05.008.
27. Elhadi M, Msherghi A, Alkeelani M, Zorgani A, Zaid A, Alsuyihili A, et al. Assessment of Healthcare Workers' Levels of Preparedness and Awareness Regarding COVID-19 Infection in Low-Resource Settings. The American journal of tropical medicine and hygiene. 2020 Jun 18. PMID: 32563273. doi: 10.4269/ajtmh.20-0330.
28. Elhadi M, Msherghi A, Elgzairi M, Alsuyihili A, Elkhafeefi F, Bouhuwaish A, et al. Assessment of the preparedness of obstetrics and gynecology healthcare systems during the COVID-19 pandemic in Libya. International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics. 2020 Jun 15. PMID: 32538491. doi: 10.1002/ijgo.13273.
29. Elhadi M, Msherghi A. COVID-19 and civil war in Libya: the current situation. Pathogens and global health. 2020 May 20:1-2. PMID: 32432976. doi: 10.1080/15575330.2020.1769292.
30. Angood PB. Telemedicine, the Internet, and world wide web: overview, current status, and relevance to surgeons. World journal of surgery. 2001 Nov;25(11):1449-57. PMID: 11760749. doi: 10.1007/s00268-001-0130-4.
31. Ayatollahi H, Sarabi FZP, Langarizadeh M. Clinicians' Knowledge and Perception of Telemedicine Technology. Perspect Health Inf Manag. 2015;12(Fall):1c-c. PMID: 26604872.
32. Ward R, Stevens C, Brentnall P, Briddon J. The attitudes of health care staff to information technology: a comprehensive review of the research literature. Health information and libraries journal. 2008 Jun;25(2):81-97. PMID: 18494643. doi: 10.1111/j.1471-1842.2008.00777.x.
33. Dockweiler C, Hornberg C. Knowledge and Attitudes as Influencing Factors For Adopting Health Care Technology Among Medical Students in Germany. J Int Soc Telemed eHealth. 2014 12/03;2:64-70.

34. Joseph L, Shittu L, Adesanya O, Mathew C, Izegbu, Oluwole A, et al. Knowledge and perception of health workers towards tele-medicine application in a new teaching hospital in Lagos. Scientific research and essays. 2007 01/01;2:016-9.
35. Ashfaq A, Memon SF, Zehra A, Barry S, Jawed H, Akhtar M, et al. Knowledge and Attitude Regarding Telemedicine Among Doctors in Karachi. Cureus. 2020;12(2):e6927-e. PMID: 32190480. doi: 10.7759/cureus.6927.
36. Woodward A, Fyfe M, Handuleh J, Patel P, Godman B, Leather A, et al. Diffusion of e-health innovations in 'post-conflict' settings: a qualitative study on the personal experiences of health workers. Human resources for health. 2014 Apr 23;12:22. PMID: 24754997. doi: 10.1186/1478-4491-12-22.
37. Lonergan PE, Washington Iii SL, Branagan L, Gleason N, Pruthi RS, Carroll PR, et al. Rapid Utilization of Telehealth in a Comprehensive Cancer Center as a Response to COVID-19: Cross-Sectional Analysis. Journal of medical Internet research. 2020;22(7):e19322-e. PMID: 32568721. doi: 10.2196/19322.
38. Xu H, Huang S, Qiu C, Liu S, Deng J, Jiao B, et al. Monitoring and Management of Home-Quarantined Patients With COVID-19 Using a WeChat-Based Telemedicine System: Retrospective Cohort Study. Journal of medical Internet research. 2020;22(7):e19514-e. PMID: 32568727. doi: 10.2196/19514.
39. Ming WK, Mackillop LH, Farmer AJ, Loerup L, Bartlett K, Levy JC, et al. Telemedicine Technologies for Diabetes in Pregnancy: A Systematic Review and Meta-Analysis. Journal of medical Internet research. 2016 Nov 9;18(11):e290. PMID: 27829574. doi: 10.2196/jmir.6556.
40. Berrouiguet S, Baca-García E, Brandt S, Walter M, Courtet P. Fundamentals for Future Mobile-Health (mHealth): A Systematic Review of Mobile Phone and Web-Based Text Messaging in Mental Health. Journal of medical Internet research. 2016 Jun 10;18(6):e135. PMID: 27287668. doi: 10.2196/jmir.5066.
41. Jiang X, Ming WK, You JH. The Cost-Effectiveness of Digital Health Interventions on the Management of Cardiovascular Diseases: Systematic Review. Journal of medical Internet research. 2019 Jun 17;21(6):e13166. PMID: 31210136. doi: 10.2196/13166.
42. O'Brien M, McNicholas F. The Use of Telepsychiatry During COVID-19 and Beyond. Irish Journal of Psychological Medicine. 2020:1-17. doi: 10.1017/ipm.2020.54.