BMJ Open

Physicians' knowledge and attitudes towards telesurgery and its associated factors in a resource-limited setting, Northwest Ethiopia, 2022: a cross-sectional study design

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To cite: Reda MM, Gashu KD, Beshir MA, *et al*. Physicians' knowledge and attitudes towards telesurgery and its associated factors in a resource-limited setting, Northwest Ethiopia, 2022: a cross-sectional study design. *BMJ Open* 2024;**14**:e079046. doi:10.1136/bmjopen-2023-079046

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (https://doi.org/10.1136/bmjopen-2023-079046).

Received 19 August 2023
Accepted 27 June 2024

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ABSTRACT

Background Telesurgery has become helpful in overcoming the current shortage of surgeons and reducing the barriers to timely and effective surgical intervention caused by long-distance travel, which is caused by distance, cost, complexity and frequent hazards. However, knowledge and attitude remain challenges in the implementation of such a system.

Objective This study aimed to assess physicians' knowledge and attitude towards telesurgery and associated factors at resource-limited setting, Northwest Ethiopia.

Method and analysis A simple random sampling method was carried out to choose study participants from each referral hospital, and data were collected using self-administered questionnaires. Descriptive and inferential statistics were applied to estimate knowledge and attitudes towards telesurgery among physicians and to identify factors associated with physician knowledge and attitudes towards telesurgery.

Study design Cross-sectional study design.

Setting This study was conducted at six specialised referral hospitals and two specialised and teaching referral hospitals in the Amhara region, northwest Ethiopia.

Result 408 physicians were included for analysis, with a response rate of 96.45%. Among study participants, 47.8% and 43.1% had good knowledge and attitudes towards telesurgery, respectively. Educational status, digital literacy, source of information, computer training, digital health training and internet access in the organisation were factors associated with a physician's knowledge of telesurgery. Moreover, physician's knowledge, technology use, educational status, computer training, computer access and internet access in the organisation were factors associated with physicians' attitudes towards telesurgery.

Conclusion and recommendation Almost half of physicians had good knowledge, and less than half had a good attitude towards telesurgery, so healthcare policy-makers should improve physicians' digital literacy, technology use and internet access to enhance their knowledge and attitudes for future implementation.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Provides novel insights, understanding and knowledge in surgical procedures through the introduction of telesurgery.
⇒ Includes various types of physicians (general practitioners, residents, specialists) to raise awareness and share knowledge on telesurgery technology.
⇒ Contributes to Ethiopian health policy by highlighting physicians' knowledge and attitudes towards telesurgery for future implementation.
⇒ Findings are limited to similar institutions within the Amhara region.
⇒ Institutional-based and cross-sectional design prevents establishing causal relationships between physicians' knowledge/attitude and associated factors.

INTRODUCTION

During an outbreak or pandemic like COVID-19, there is an increased need for healthcare delivery systems to improve the accessibility of virtual care technologies, such as telehealth, telemedicine, telenursing, telesurgery, telecare, etc, which support affordable, high-quality and person-centred treatment.[1]

Telesurgery is widely defined as the ability to perform surgery from long distances using modern surgical techniques by overcoming the obstacles of time and distance.[2] This technology not only addresses the current scarcity of surgeons but also eliminates geographical restrictions, financial burdens and problems associated with long-distance travels that hinder prompt and high-quality surgical intervention. Furthermore, it enhances surgical accuracy and ensures the safety of surgeons.[3 4]

Telesurgery is a system that connects patients and doctors (surgeons) using both wired and wireless networks, along with a

robotic system. Enabling surgeons to provide surgical care to patients from anywhere in the world, telesurgery is a remarkable way for patients to receive medical attention without needing to travel beyond their local hospitals.[5 6] The ultimate goal of telesurgery is to enable the specialist surgeon to be virtually present at the patient's bedside.[1–3] This is especially crucial in situations like:

- Distance: for example, in remote and rural areas.
- Special conditions: such as a battlefield or accident scene.
- Risks caused by patients to the surgical team: like infectious diseases and radioactive contamination.
- Risks posed by the surgical team that threaten the patient's health: for instance, an immune deficiency in a patient.

Due to a shortage of healthcare specialists in many developing countries, there is a high mortality rate among patients with various diseases. The scarcity of physicians results in limited access to healthcare services, contributing to an increasing death rate.[4 6] Healthcare professionals' knowledge and attitude towards telemedicine are important factors that can influence the successful future implementation of telesurgery.[5] A study conducted in Egypt found that only 39% of physicians have a decent understanding of telemedicine while 12% are unfamiliar with this strategy.[7] This technology not only benefits today's shortage of surgeons, but evidence shows that telesurgery minimises the current geographical barriers to accessing prompt, high-quality surgical care: long travel distances, a lack of experts and a large financial burden.[1 4 6]

In Ethiopia, the physician–patient ratio is one physician for every 42 000 people, which shows a shortage of physicians in the field.[8] The use of digital technologies like telesurgery could allow for the provision of healthcare in remote settings where physicians are scarce.

Physicians' knowledge and attitude could be considered an essential requirement in the deployment of any digital health technology, including the implementation of telesurgery in the health system.[7]

However, limited evidence exists on basic knowledge and attitudes towards telesurgery and determinant factors in Ethiopia. Thus, this study aims to assess physicians' current knowledge and attitudes towards telesurgery, providing valuable insights. The findings could prove useful for policy-making, informing practice and initiating further studies. Additionally, the results may guide decisions about curriculum development and revision for physicians' training in higher education institutions.

METHODS

Study design, study period and setting

An institutional-based cross-sectional study design was employed among physicians working at a specialised referral hospital in the Amhara region of northwest Ethiopia. The study was conducted from 16 May 2022 to 20 July 2022, at eight locations, including six specialised referral hospitals and two specialised and teaching referral hospitals in the Amhara region. These locations are the University of Gondar Specialized and Teaching Referral Hospital, Dessie Specialized Referral Hospital, Felege Hiwot Specialized Referral Hospital, Wolo Specialized Referral Hospital, Tibebe Gihon Specialized and Teaching Referral Hospital, Debre Birehan Specialized Referral Hospital, Debre Tabor Specialized Referral Hospital and Debre Markos Specialized Referral Hospital.

Source and study population

The source population for our study comprised all physicians who worked in specialised and referral hospitals, as well as specialised teaching referral hospitals, in the Amhara regional state of Northwest Ethiopia. While these physicians were available during the data collection period in those specialised referral hospitals, the specialised teaching and referral hospitals in the region were considered our study population.

Inclusion and exclusion criteria

All physicians, including general practitioners (GPs), residents, specialists and subspecialists, who were permanently employed at specialised referral hospitals in the Amhara Region and available during data collection, were included in this study. However, physicians who were temporarily working in specialised referral hospitals as exchange, guest or adjunct staff from outside the region and abroad were excluded.

Sample size determination and sampling procedures

There were 8 specialised referral hospitals in the Amhara region with a total of 972 physicians. All specialised referral hospitals in this region were approached. The sample size was determined by using a single population proportion formula and considering the following assumptions: Z=standard normal deviation (Z/2=1.96) with a 95% CI level, n=final sample size, p=proportion of telesurgery knowledge and attitude, and an associated factor of 50% since there has been no previous study done in the same area with d=desired degree of precision (the margin of error) of 5% and the calculated sample size was 384.

$$n = \frac{\frac{(Z\alpha)^2}{2} * pq}{d^2} \quad (1)$$

Where, n=required sample size, d=margin of error, p=proportion of telesurgery-related knowledge and q=1 p.

$$n = \frac{\frac{(Z\alpha)^2}{2} * p(1-P)}{d^2} = n = \frac{(1.96)^2 * 0.50(1-0.50)}{(0.05)^2} = 384 \quad (2)$$

By assuming a 10% non-response rate, the final total sample was 423. Finally, we applied a simple random sampling method followed by proportional allocation to select appropriate study participants.

Study variables

Dependent variables

Knowledge and attitude.

Independent variables

Sociodemographic-related factors (age, sex, educational status, working department and years of experience), technological-related factors (digital literacy and technology use), personal or behavioural-related factors (motivation and confidence to use new technology), sources of information about telesurgery (training, internet (like social media, journal sites), public media (like radio, TV, meetings, etc), and colleagues), and organisational-related factors (basic computer training, digital health-related training, trained staff available on telesurgery or any digital health-related training, computer access in your organisation, internet access, etc).

Data collection tools and procedure

A pretested and structured self-administered questionnaire was used to collect the data. The tool was adapted after reviewing different literature from previous studies.[3 5 7–13]

Data were collected using a self-administered structured questionnaire, which had 60 questions consisting of a 'yes' or 'no' question, a 5-point Likert scale question, and a list of questions with five sections, such as sociodemographic, organisational, technological, personal characteristics, knowledge and attitude-related questions (see online supplemental file questionnaire S1).

Data quality management

To ensure data quality, we used standardised and pretested questionnaires and provided 2 days of training to 12 data collectors. The pretest was conducted to confirm the degree to which the measuring tool produces consistency and reliability. The internal consistency of each dimension of the data collection instrument was checked using Cronbach's alpha. The pretest shows that the value of Cronbach's alpha was above 70%. According to Cronbach's alpha (α), the value for the measuring tool was 0.82 for knowledge and 0.83 for attitude. Continuous supervision up to the end of data collection was conducted to check its consistency and completeness. After data collection, questionnaires were reviewed and checked for completeness, and the data were cleaned to identify and correct errors and missing values. All errors were identified and corrected.

Operational definitions

Knowledge of telesurgery

Knowledge of telesurgery encompasses the fundamental understanding and insights that physicians possess about telesurgery technology, including how they perceive its meaning and benefits. This knowledge was assessed using nine questions and categorised as either poor or good knowledge of telesurgery.[5 14 15]

Poor knowledge

If a study participant achieves a score lower than the median, they are considered to have poor knowledge of telesurgery.[5 14 15]

Good knowledge

If a study participant achieves a score higher than the median, they are considered to have good knowledge of telesurgery.[5 14 15]

Attitude towards telesurgery

Refers to how physicians' opinions, personal intentions and outlook on telesurgery technology are expressed and how they will accept this technology if it is applied to a health facility. This was measured by nine 5-point Likert scale questions and was categorised as a poor and good attitude towards telesurgery.[5 15]

Poor attitude

If a study participant achieves a score lower than the median, they are considered to have a poor attitude towards telesurgery.[5 15]

Good attitude

If a study participant achieves a score higher than the median, they are considered to have a good attitude towards telesurgery.[5 15]

Data analysis and processing procedure

The collected data were entered into EpiData V.4.6. After producing the cleaned data, it was exported to SPSS V.26 software for further analysis. Descriptive statistics were presented through percentages, frequency tables and graphs, and a binary logistic regression analysis was computed to identify the associated factors in both the bivariable and multivariable analyses. During the bivariate analysis, variables with a p<0.2 were candidates for the multivariate analysis.

Whereas, in multivariable analysis, variables with a p≤to 0.05 were considered statistically significant variables. Moreover, before bivariate and multivariate analysis, outliers and multicollinearity were checked using variable inflation factors (VIFs). Based on the multicollinearity result, the VIF value is between 1.056 and 6.622, which shows that multicollinearity is not a problem because most researchers consider a VIF>10 an indicator of multicollinearity.[16] Accordingly, our results show that multicollinearity is not an issue in our data.

The fitness of the model was checked by using the Hosmer and Lemeshow test for both model fits (knowledge and attitude). The results of logistic binary regression revealed that the model adequately fits our data and that the model has a good fit with a χ^2 value of 3.081 and 4.654 for model fit for knowledge and attitude, respectively, and a p value >0.05 (p=0.929 and 0.794). The full model correctly predicted 85.3% and 84.3% of the observed respondents who had good knowledge and a good attitude, respectively. Finally, we used adjusted ORs (AOR) with a 95% CI and a p value of 0.05 to determine factors associated with the physician's knowledge and attitude towards telesurgery.

Patients and public involvement

Patients or the public were not involved in the study.

Table 1 Sociodemographic characteristics of physicians' telesurgery knowledge and attitude in specialised referral hospitals, Amhara Region, Northwest Ethiopia (2022/2023) (n=408)

Variables	Category	Frequency (n)	%
Age	24–34	325	79.7
	>34	83	20.3
Sex	Male	315	77.2
	Female	93	22.8
Educational status	GP	332	81.4
	Resident	47	11.5
	Specialist	29	7.1
Working department	IPD	77	18.9
	Gynaecology	58	14.2
	OPD	60	14.7
	Paediatrics	52	12.7
	Ophthalmology	24	5.9
	Neurology	22	5.4
	Cardiology	23	5.6
	Orthopaedic	24	5.9
	General surgery	40	9.8
	Others	28	6.9
Year of experience	<1 year	106	26.0
	1–5 year	216	52.9
	>5 year	86	21.1

Other working departments are 'dermatology and ENT'.
ENT, ear, nose and throat; GP, general practitioner.

RESULTS

Sociodemographic characteristics

423 physicians were selected from specialised referral hospitals in the Amhara Region. 408 of them consented and responded to completing all questionnaires with a 96.45% response rate. Of the total 408 respondents, among those 81.4% were GP, 11.5% were residents and 7.1% were specialists. Among the study participants, 77.2% were male. The majority of the study participant age group was 24–34 (79.9%) and the majority of study participants had 1–5 years of job experience which accounted for about 52.9% (see table 1).

Organisational characteristics

As shown in table 2, of the total study participants, only 133 (32.6%) and 102 (25%), respectively, took computer training and digital health training, and 127 (31.1%) of the physicians had computer access in their organisations (see table 2).

Technological-related factors

As figure 1 shows, only 179 (43.9%) and 174 (42.60%) study participants had good digital literacy and were able to use the technology, respectively (see figure 1).

Table 2 Organisational-related factors of physicians' telesurgery knowledge and attitude in specialised referral hospitals, Amhara Region, Northwest Ethiopia (2022/2023) (n=408)

Variables	Category	n	%
Basic computer systems training	No	275	67.4
	Yes	133	32.6
Digital health relating training	No	306	75.0
	Yes	102	25.0
Trained staff available on telesurgery	No	355	87.0
	Yes	53	13.0
Computer access in your organisation	No	281	68.9
	Yes	127	31.1
Internet access in the organisation	No	138	33.8
	Yes	270	66.2
24-hour service of uninterrupted electric power	No	364	89.2
	Yes	44	10.8
Availability of electric power backup	No	351	86.0
	Yes	57	14.0

Personal characteristics

There has been uncertainty in organisational, behavioural, technical and all other fields among the physicians, with 50.70% having good confidence and 44.40% of physicians having good motivation to use new technology (see online supplemental material figures S2).

Physicians sources of information about telesurgery

As figure 2 shows, different training and internet (like journal sites, social media, etc) were the major common sources of information about telesurgery among the study participants, accounting for 177 (43.4%) and 157 (38.5%), respectively (see figure 2).

Physicians' knowledge and attitudes towards telesurgery

Physician's knowledge of telesurgery

Among study participants, 195 (47.8%) physicians (with a 95% CI 43.1 to 52.7) had good knowledge about telesurgery (see online supplemental materials figures S2).

Physician attitude towards telesurgery

From a total of 423 study participants (physicians), 176 (43.1%) (95% CI of 39.7 to 48.7) had good attitudes towards telesurgery (see figure 3).

Binary logistic regression analysis for factors associated with knowledge and attitude of telesurgery among physicians

Factors associated with physician knowledge of telesurgery

Binary logistic regression of multivariable analysis reveals that in addition to the age of the study participant (AOR 2.25, 95% CI (1.005 to 5.03)), educational status (AOR 8.36, 95% CI 1.93 to 36.3)), work experience (AOR 3.1, 95% CI (1.32 to 7.26) and AOR 6.34, 95% CI (2.37 to 16.95)), digital literacy (AOR 3.80, 95% CI (2.08 to 6.95)),

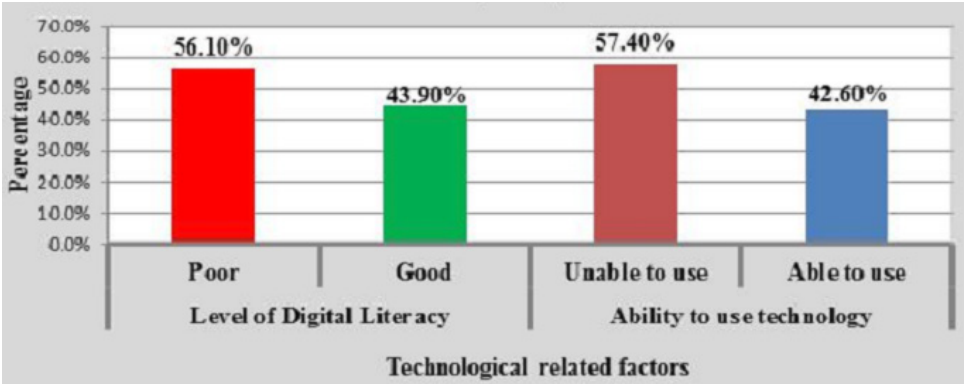

Figure 1 Technological-related factors influencing physicians' attitude and knowledge in specialised referral hospitals, Amhara Region, Northwest Ethiopia (2022/2023) (n=408).

source of information (AOR 4.25, 95% CI (2.31 to 7.807) and AOR 1.90, 95% CI (1.02 to 3.539)), basic computer training (AOR 2.23, 95% CI 1.26 to 5.57) e-health/digital health training (AOR 2.72, 95% CI (2.62 to 8.06)), trained staff available on telesurgery or any related field (AOR 2.12, 95% CI (1.01 to 5.24)) and internet access in the organisation (AOR 2.25, 95% CI (1.16 to 4.37)) were significantly associated with physician knowledge towards telesurgery (see online supplemental materials table S3).

Factors associated with physician attitude towards telesurgery

Binary logistic regression of multivariable analysis reveals that physicians' knowledge about telesurgery (AOR 4.79, 95% CI (2.34 to 9.79)), job experience (AOR 3.09, 95% CI (1.12 to 8.55)), technology use (AOR 2.25, 95% CI (1.16 to 4.38)), educational status (AOR 4.02, 95% CI (1.5 to 10.73) and AOR 7.87, 95% CI (1.56 to 39.66)), e-health/digital health training (AOR 2.50, 95% CI (1.14 to 5.5)), digital literacy (AOR 2.82; 95% CI 1.47 to 5.41), basic computer training (AOR 3.48, 95% CI 1.79 to 6.78), computer access (AOR 3.32, 95% CI 1.42 to 7.72) and internet access in the organisation (AOR 2.26, 95% CI 1.14 to 4.46) were significantly associated with physician attitude towards telesurgery (see online supplemental materials tables S3).

DISCUSSION

This study assessed physicians' knowledge and attitude towards telesurgery and its associated factors at a referral hospital. The conclusion of this study reveals that about half of the study participants (physicians) had good knowledge, and less than half of them had a good attitude towards telesurgery. This study revealed that 47.8% (95% CI 43.1% to 52.7%) of the participants had good knowledge about telesurgery.

This finding is slightly similar to the studies conducted in Ethiopia[14 17] where about 45.8% of nurses had good knowledge about telenursing and about 50% of health sciences students had good knowledge about evidence-based medicine; this similarity might be due to the similarity of study period and study area, and in Saudi Arabia, 46.1% of the respondents had good knowledge of telemedicine.[10] This similarity might be due to all study participants being the same; all participants are physicians, the sample size is closely similar and most physicians had not participated in the training.

On the other hand, the current study finding was lower than the study conducted in Australia, medical staff reported the highest rate of robotic-assisted surgery knowledge (70.7%),[18] and in Malaysia, health

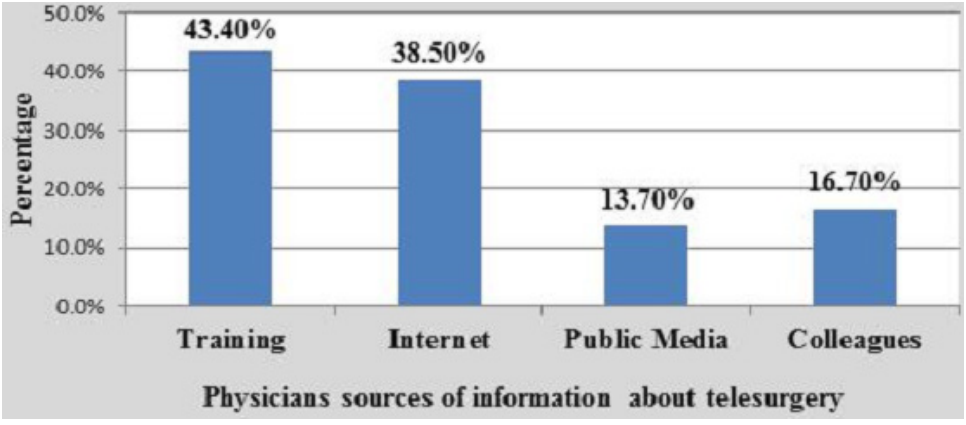

Figure 2 Sources of information about telesurgery among physicians in specialised referral hospitals, Amhara Region, Northwest Ethiopia (2022/2023) (n=408).

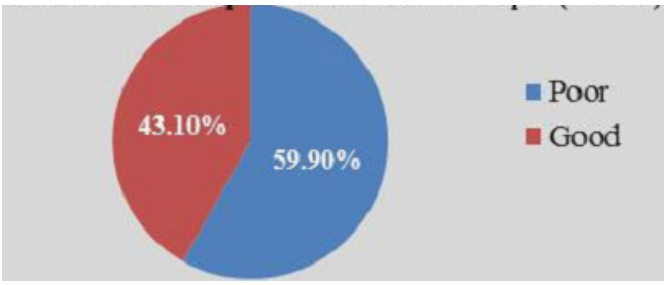

Figure 3 Level of physician attitude towards telesurgery in specialised referral hospitals, Amhara Region, Northwest Ethiopia (2022/2023) (n=408).

professionals (57%) have known about telesurgery.[19] The difference might be due to the study settings and sample variation and technology. Moreover, this finding is higher than the previous study done in Ethiopia which reported 37.6% good knowledge of telemedicine[5] and India (41%).[20] This difference could be due to differences in a study participant, study area, sample size, scope of study model and study participant's educational background. A previous study was conducted with 312 and 120 health professionals, respectively.

Regarding physicians' attitudes, 43.1% (95% CI (38.5% to 48.0%)) of the participants had a good attitude about telesurgery. This finding is lower than the study in Ethiopia,[5] Australia[18] and Iran.[13] This difference might be due to the difference in the study participants, study area, sample size, availability of technology, the scope of the study, and educational background of study participants and variations of study participants. This finding is higher than a study in India showed that the attitude level 30% of the respondents have a low or below the moderate level of attitude towards telemedicine, 31% possess a moderate level of attitude and 39% possess a high attitude level towards telemedicine.[20]

In this finding, 48.5% of physicians agree that telesurgery can save time, and 46.3% of physicians agree that ICT (Information communication technology)-enabled health services can improve the accessibility of healthcare. This finding is supported by a study conducted in Saudi Arabia, which emphasises the potential role of ICT in the healthcare system to become more efficient and effective. The majority of physicians in the study also agreed that telemedicine could save both time and money.[10]

Computer and e-health or digital health-related training positively affected the attitudes of physicians towards telesurgery. Taking computer and e-health or digital health-related training increased the level of physicians' attitudes by 77.68% and 71.43%, respectively. This finding supports a study in Saudi Arabia, which reported that a lack of suitable training and consultation between information technology experts and clinicians affects physicians' perceptions in adopting telemedicine technology.[10]

According to this study, having good knowledge about telesurgery increases the level of attitude towards telesurgery by 82.73%. This finding is supported by a study in Egypt showing that a good attitude correlates positively with user knowledge of telemedicine applications.[7] The availability of ICT equipment like internet and computer is a factor in to use telesurgery, this finding is supported by the study done at the Tehran University of Medical Science infrastructure for the implementation of remote surgery was one of the most noticeable strengths of the implementation of remote medical technology services in the hospitals.[3] The other study in Malaysia showed information systems such as computer, internet and telephone should be reliable for a better implementation of telemedicine in developing countries.[19]

The study revealed that physicians with high confidence in telesurgery are 2.2 times more likely to exhibit a positive attitude towards telesurgery. This discovery of confidence emerges as a significant factor influencing the attitude of telesurgery physicians. This finding is consistent with studies conducted in Indonesia,[21] Malaysia[22] and China,[23] emphasising that confidence has a positive influence on individual attitudes towards accepting digital health technology such as telenursing, telemedicine and e-health. This correlation may be attributed to the importance of individual confidence as a factor that positively impacts attitudes towards the advancement of digital health technology use.

Additionally, the study found a positive correlation between computer access in the organisation and physicians' attitudes. Access to computers within the organisation resulted in a 69.32% increase in physicians' attitudes. This finding is consistent with studies conducted in Iran,[24] China,[23] Canada.[25] The observed increase can be attributed to the essential role computers play in facilitating the proper utilisation of digital health. Therefore, the availability of computer access within the organisation can enhance physicians' attitudes towards telesurgery, fostering a greater sense of familiarity and comfort with digital health.

In contrast, this study found no significant relationship between backup power, 24-hour electricity supply and physicians' attitudes towards telesurgery. This contradicts studies conducted in Australia[26] and Iran[24] which reported electricity supply is fundamental to the basic function and advancement of digital health technology, including telemedicine and in-home medical devices. It has been reported that electricity supply is fundamental to the basic function and advancement of digital health technology, including telemedicine and in-home medical devices. This discrepancy highlights significant differences in electricity access among countries, with Australia and Iran boasting universal access (100%)[27] in contrast to Ethiopia's lower penetration rate of 54.2%.[28]

Strengths and limitations of this study

According to our findings, this is the first study in Ethiopia to assess knowledge and attitudes towards telesurgery among physicians so; it is good input for future study and implementations of telesurgery by providing information about knowledge and attitudes of physicians towards

telesurgery. This study has certain limitations. This has included only physicians working in public referral hospitals. It did not include physicians in public primary and general hospitals as well as private hospitals, which could affect the generalisability of the findings.

CONCLUSIONS

The finding implied that close to half of the physicians in this study setting had a good level of knowledge and below half of them had a good level of attitude about telesurgery applications. Sources of information, trained staff available in telesurgery or any related field, digital literacy, educational status, job experience, basic computer training, digital health-related training, and the ability to use technology, computers, and internet access in the organisation were associated with physicians' knowledge and attitudes towards telesurgery.

Recommendation

Healthcare policy-makers, the government and other concerned bodies like higher education institutions or universities and teaching specialised referral hospitals should stress improving computer access, education, training and enhancing physicians' levels of digital literacy, technology use and internet access in the organisation to improve physicians' telesurgery-related knowledge and attitudes for future sustainable implementation.

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Acknowledgements First, I would like to thank the almighty God. Second, my deepest gratitude goes to my advisors, KDG and MAB, for their unlimited support, and I would also like to express my greatest gratitude to the University of Gondar, College of Medicine and Health Sciences, Institute of Public Health and Department of Health Informatics, for providing me with this excellent opportunity to carry out this thesis work. I would like to thank my family for their constructive ideas and support. Finally, I would like to express my sincere gratitude to my friends who helped during the data collection and analysis, especially my friends FWB, Haregwoin Wuletaw and all data collectors.

Contributors MMR, KDG and MAB made significant contributions to the work reported, whether that was at the beginning of design, data collection, supervision, data curation, investigation, data analysis, interpretation, preparing figures, writing up the manuscript or in all these areas. FWB has made significant contributions to this work from the beginning until the submission of this manuscript in the areas of data analysis, editing and revision of the manuscript. Finally, all authors agreed to be held accountable for all aspects of the work and participated in writing, revising or critically reviewing the paper.

Funding The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and ethical clearance was obtained from the ethical review board of the University of Gondar College of Medicine and Health Science with the ethical reference number IPH/2110/2014. Informed consent was obtained from each study participant after they were informed of the objectives and benefits of the study. To maintain the confidentiality of the information provided by the study subjects, the data collection procedure was anonymous. Additionally, this study was conducted under the Declaration of Helsinki. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request.

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