

Knowledge, Attitude and Practices of Anesthetists Towards Telehealth in Rwanda.

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Abstract

Background: Limited anesthetic capacity, including shortages of trained providers and equipment, contributes significantly to preventable deaths from surgical conditions in low-income countries. Telehealth has the potential to improve access to specialist support and enhance surgical care. This study assessed the knowledge, attitudes, and practices (KAP) of anesthesia practitioners toward telehealth in Rwanda.

Methods: A quantitative Analytical cross-sectional study was conducted among anesthetists in Rwanda. Participants were recruited through the Rwanda Allied Health Professionals Council using a census sampling approach between 6 March and 7 May 2024. Data were analyzed using descriptive and analytical statistics, chi-square tests, and logistic regression, with statistical significance set at $p < 0.05$ at a 95% confidence level.

Findings: Among respondents, 67.05% demonstrated high knowledge of telehealth, 57.8% had a positive attitude, while only 23.12% exhibited good telehealth practice. Poor practice was significantly associated with lack of telehealth training, lower awareness of telehealth benefits, female gender, and older age groups. Resistance from colleagues and lack of trust in telehealth equipment were not significantly associated with practice levels.

Conclusion: Although anesthesia practitioners in Rwanda generally demonstrate adequate knowledge and favorable attitudes toward telehealth, actual utilization remains low. Addressing training gaps and increasing awareness of telehealth benefits may improve adoption and strengthen surgical care delivery.

Keywords: Knowledge, Attitude and Practices, Anesthetists, Telehealth

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INTRODUCTION

Telehealth, defined as the use of digital communication technologies to provide healthcare services remotely, including consultations, patient monitoring, and education, has gained significant global traction. In anesthesia practice, telehealth enables remote preoperative assessments, intraoperative consultations, and postoperative follow-ups [1]. The COVID-19 pandemic accelerated telehealth adoption, with global consultations increasing by over 50% in 2020 compared to pre-pandemic levels [2]. The global telehealth market, valued at USD 87.8 billion in 2022, is projected to reach USD 559.52 billion by 2027 [3].

High-income countries, such as the United States, United Kingdom, and Australia, have widely integrated telehealth into anesthesia. In the U.S., for instance, anesthesiologists, healthcare professionals specialized in perioperative care, pain management, and patient sedation, have adopted telehealth for remote evaluations [4]. In the UK, the NHS expanded virtual consultations by 80% during the pandemic [5], and in Australia, remote anesthesia services improved access in rural areas [6].

In contrast, low- and middle-income countries (LMICs) face infrastructure and policy barriers. A systematic review found that only 40% of LMICs had formal telehealth policies, and up to 60% of rural populations lacked stable internet access [7]. Yet, countries like India, Brazil, and the Philippines have initiated tele-anesthesia services to support remote surgical care [8,9].

In Africa, telehealth is still emerging. A review by Olanrewaju et al. [10] found that only 35% of African nations had structured frameworks, and 43% of the population lacked internet access. Nonetheless, countries like South Africa and Nigeria have piloted anesthesia-related telehealth programs that improved care quality and efficiency [11,12].

In East Africa, Kenya and Uganda have launched telehealth-supported anesthesia models. Kenya improved rural access to preoperative evaluation, though challenges like internet reliability persist [13]. Uganda saw a 30% reduction in unnecessary referrals due to perioperative assessments supported by telehealth [14].

In Rwanda, telehealth gained momentum during COVID-19, with national initiatives like the Rwanda Telemedicine Network supporting remote consultations [15]. However, anesthesia-specific telehealth remains nascent. With only 1 anesthetist per 100,000 people [2], tele-anesthesia could address gaps in perioperative planning. Recent pilot programs in district hospitals reportedly reduced patient travel costs by 40% [16].

A 2022 WHO survey underscored the urgent need for anesthesia support in Rwanda, citing shortages of trained personnel in 6 out of 44 district hospitals and inadequate airway equipment, especially in paediatric care [17]. The broader anesthesia crisis affects surgical access and outcomes, leading to preventable mortality and disability [18].

This study therefore aims to assess the knowledge, attitudes, and practices (KAP) of anesthetists in Rwanda regarding telehealth.

The add value of this study to the science

This study:

- Provides the first comprehensive empirical evidence on the gap between knowledge, attitudes, and actual practice of telehealth among anesthetists in Rwanda, contributing novel insights from a low-resource anesthesia workforce context.
- Advances current science by identifying modifiable individual and organizational determinants of telehealth adoption, informing evidence-based strategies to strengthen digital anesthesia services in similar low- and middle-income health systems.

Here, knowledge refers to the anesthetists' awareness and understanding of telehealth technologies and their relevance in anesthesia; attitude denotes their perceptions and willingness to adopt telehealth; and practice involves the actual use of telehealth in activities such as remote consultations and perioperative decision-making [19,20].

METHODS

Study Design and Sampling

In this study, the researcher used a cross-sectional research design and adopted quantitative research approach and was conducted during the period of March to May 2024.

Study population

The study population number was found to be 250 anesthetists in Rwanda Allied Health Professionals Council.

Inclusion criteria

Anesthetists enrolled in Rwanda Allied Health Professionals Council with practice license who were willing to participate in the study.

Exclusion criteria

Participants who were unwilling to participate in the study.

Research instruments.

The study utilized a structured questionnaire adapted from previous research and a validated international telehealth journal [23]. The tool consisted of five sections, with specific parts dedicated to assessing knowledge, attitude, and practice (KAP) toward telehealth among anesthetists. Knowledge was measured through multiple-choice and true/false questions, with correct answers assigned one point and incorrect answers given zero. The Modified Bloom's Cutoff was used to categorize knowledge levels, considering scores of $\geq 60\%$

as high and $< 60\%$ as low, following the method outlined by Tuma and Nassar [24].

Attitude was assessed using a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), with statements evaluating perceptions of telehealth's feasibility, effectiveness, and impact on anesthesia services. A positive attitude was defined using a threshold of 3.4, based on the scale's midpoint (3.0) and empirical research, ensuring that only participants leaning toward agreement were classified as having a positive attitude. This approach aligns with previous healthcare studies categorizing attitudes using similar cutoff values between 3.2 and 3.5 [24].

The dependent and independent variables of this study

The dependent variable was defined as the Practice of tele-health that include all the activities, visual or voice-based communications and technological interactions between patients and anesthetists to ensure effective evaluation before surgical operation or medical procedure that requires anesthesia. The independent variables were Knowledge and attitude among anesthetists in Rwanda.

Validity

The pre-test of the study instrument was ensured by doing a pilot study in a different health facility to ensure that the instrument is valid. Additionally, the Content validity index was measured for utilizing a valid instrument. The content validity index measured by dividing relevant items with total items has yielded the result of 0.71 which showed that our study instrument was valid [25].

Reliability

Instrument reliability refers to the extent to which a data collection tool consistently measures what it is intended to measure, producing stable and repeatable results over time and across different settings. To ensure the reliability of the instrument in this study, a test-

retest method was employed. This approach was used to assess the consistency of responses and to confirm that the questionnaire content was clear, readable, and appropriate for the target participants [25].

Data analysis procedure

Following data collection, the researcher performed data cleaning and inputted the data into the Statistical Package for Social Scientists (SPSS) version 22.0 for analysis. Variables were quantified using frequencies and percentages, while a Likert scale was used to categorize attitude-related data as either positive or negative. Anesthetists with a mean attitude score above 3.4 were considered to have a positive attitude, while those below were categorized as having a negative attitude [24].

Descriptive analysis was conducted using univariate analysis, and bivariate analysis was performed using the Chi-square test. For overall knowledge and practice levels, the modified Bloom's cut-off was applied, with a high level considered at 60% and above, and a low level for rates below 60% [24]. Significant variables were adjusted using logistic regression, with a significance level set at a p-value of <0.05 at a 95% confidence interval.

RESULTS

Table 1 showed that majority of participants were male (74.6%) and aged between 31–40 years (49.7%). Most respondents held a bachelor's degree (52.0%), had more than five years of working experience (42.2%), and were working in urban areas (64.2%).

Table 1. Socio-demographic characteristics among anesthetists in Rwanda

Variables	Frequency	Percentage
Gender		
Male	129	74.6
Female	44	25.4
Age		
20-30 years	48	27.7
31-40 years	86	49.7
> 40 years	39	22.5
Level of education		
Diploma	27	15.6
Bachelor	90	52.0
Master and above	56	32.4
Working experience		
Less than 3 years	46	26.6
3-5 years	54	31.2
More than 5 years	73	42.2
Working area		
Rural	62	35.8
Urban	111	64.2

Researcher, 2024

Table 2 focuses on the knowledge of anesthetists towards telehealth in Rwanda. The responses are categorized into Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), and Strongly Agree (SA) with corresponding frequencies and percentages, as well as the mean score for each item. About half

of the providers (52.1%) have either not heard or are neutral about telehealth in anesthesia. Over half (53.2%) agree or strongly agree that telehealth can be used to provide healthcare services remotely.

Table 2. Knowledge of anesthetists towards the use of telehealth among anesthetists in Rwanda.

Variable	SD	D	N	A	SA	Total	Mean
Have you ever heard about telehealth?	61(35.3)	29(16.8)	28(16.2)	28(16.2)	27(15.6)	173(100.0)	2.60
Can virtual consultation be used by anesthetists to provide healthcare services to patients remotely?	27(15.6)	27(15.6)	27(15.6)	37(21.4)	55(31.8)	173(100.0)	3.38
Can telehealth be used as a tool for education and training of anesthetists?	17(9.8)	16(9.2)	29(16.8)	38(22.0)	73(42.2)	173(100.0)	3.77
Could telehealth decrease the isolation of anesthetists by providing peer contact specialist	20(11.5)	19(10.9)	28(11.6)	40(23.1)	66(38.2)	173(100.0)	3.65
Could virtual anesthesia consultation be used to obtain anesthesia decision for patient?	20(11.6)	17(9.8)	38(22.0)	43(24.9)	55(31.8)	173(100.0)	3.55
Could telehealth be used in pre-anesthetic assessment?	21(12.1)	26(15.0)	34(19.7)	32(18.5)	60(34.7)	173(100.0)	3.49
Could virtual assistance be used during surgery (Intraoperative anesthesia Management of patients)?	23(13.3)	20(11.6)	37(21.4)	49(28.3)	44(25.4)	173(100.0)	3.41
Could virtual consultation be used to facilitate post-operative follow-up of patients?	18(10.4)	27(15.6)	38(22.0)	33(19.1)	57(32.9)	173(100.0)	3.49
Could telehealth be used for resuscitation of patient during surgery?	33(19.1)	32(18.5)	40(23.1)	34(19.7)	34(19.7)	173(100.0)	3.02
Could virtual consultation be used for peer-to-peer clinical communication among anesthetists?	12(6.9)	24(13.9)	35(20.2)	40(23.1)	62(35.8)	173(100.0)	3.67
Can telehealth prevent anesthetists' mistakes and improve cost effectiveness of anesthesia services?	19(11.0)	33(19.1)	28(16.2)	35(20.2)	58(33.5)	173(100.0)	3.46
Could telehealth/virtual presence be used in Burn unit, critical care unit or trauma management unit?	21(12.1)	29(16.8)	35(20.2)	42(24.3)	46(26.6)	173(100.0)	3.36

SD= Strongly disagree, D=Disagree, N: Neutral A=Agree SA=Strongly Agree

Researcher, 2024

A significant majority (64.2%) agree or strongly agree that telehealth can be used for education and training. Over 60% believe telehealth can reduce the isolation of providers by facilitating peer contact. More than half

(56.7%) support the idea of using virtual consultations for anesthesia decision-making. About 53.2% agree or strongly agree on the use of telehealth for pre-anesthetic assessment. There is a mixed response with 53.7% agreeing

or strongly agreeing on virtual assistance during surgery. About 52.6% support using telehealth for post-operative follow-up. The responses are mixed with no clear majority in favor of using telehealth for resuscitation. A majority (58.9%) agrees or strongly agrees on using telehealth for peer-to-peer clinical communication. Over half (53.7%) believe telehealth can help prevent mistakes and improve cost-effectiveness. A moderate number (50.9%) supports using telehealth in critical care units.

Figure 1 presents the overall knowledge of anesthetists in Rwanda towards telehealth. For the overall knowledge and practice level we used the modified bloom's cutoff where high level considered at 60% and above and low level for the rate below 60%. In sum, 67.05% of respondents have a high level of knowledge towards telehealth while 32.95% of respondents have a low level of knowledge towards telehealth.

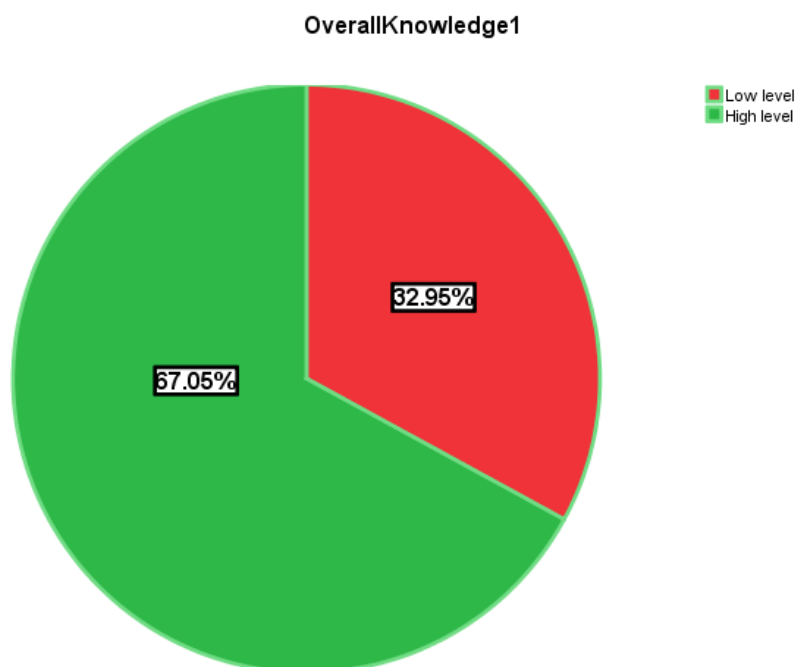


Figure 1. Overall, Knowledge level of anesthetists towards telehealth in Rwanda.

Table 3 provides a detailed overview of the attitudes of anesthetists in Rwanda towards telehealth, categorized by various statements and their levels of agreement. The responses are divided into five categories: Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), and Strongly Agree (SA). The findings are summarized as follows: Majority agree (28.9%) or strongly agree (38.2%) that telehealth can save time. The Mean score: 3.89, indicating a

generally positive attitude towards telehealth as a time-saving tool. Majority agree (26.0%) or strongly agree (36.4%) that they would consider virtual consultations for these purposes. The Mean score: 3.71, indicating a positive attitude towards using telehealth for assessments and follow-ups. The majority agree (28.3%) or strongly agree (31.8%) on the potential advantages. The Mean score: 3.65, showing a favorable view of telehealth in

managing patient visits. The majority agree (26.6%) or strongly agree (36.4%) that telehealth will reduce pending patient lists. The Mean score: 3.72, indicating a positive expectation for telehealth to manage patient backlogs. The majority agree (27.2%) or strongly agree (33.5%) that telehealth can provide a good understanding of patients' health issues.

The Mean score: 3.69, reflecting a positive belief in the effectiveness of telehealth for understanding patient conditions. Majority agree (30.6%) or strongly agree (29.5%) that telehealth will provide a standard way of delivering anesthesia. The Mean score: 3.66, indicating a generally favorable attitude

towards the standardization potential of telehealth. Responses are mixed, with a notable percentage disagreeing (22.0%) or strongly disagreeing (16.2%) about the accuracy. The Mean score: 3.1, reflecting skepticism about the accuracy of virtual consultations compared to in-person ones. Mixed responses with a notable percentage agreeing (28.9%) or strongly agreeing (24.9%). The Mean score: 3.47, showing a moderate positive attitude towards cost reduction. Majority agree (27.2%) or strongly agree (41.0%) that telehealth can be effective for education and training. The Mean score: 3.86, indicating a strong positive attitude towards the use of telehealth for professional development.

Table 3. Attitude of anesthetists towards the use of telehealth among anesthetists in Rwanda.

Variable	SD	D	N	A	SA	Total	Mean
I think telehealth can save me time.	9(5.2)	10(5.8)	38(22.0)	50(28.9)	66(38.2)	173(100.0)	3.89
I would consider virtual consultations to provide pre-anesthesia assessment and post anesthesia follow up.	12(6.9)	24(13.9)	29(16.8)	45(26.0)	63(36.4)	173(100.0)	3.71
I believe that telehealth has potential advantages in anesthesia patient visit management.	13(7.5)	20(11.6)	36(20.8)	49(28.3)	55(31.8)	173(100.0)	3.65
I believe that telehealth will reduce pending patient list scheduled to receive pre-anesthesia assessment.	11(6.4)	25(14.5)	28(16.2)	46(26.6)	63(36.4)	173(100.0)	3.72
Telehealth can provide me a good understanding of the patient's health problem over the internet.	13(7.5)	18(10.4)	37(21.4)	47(27.2)	58(33.5)	173(100.0)	3.69
I think Telehealth will provide standard way of anesthesia delivery	13(7.5)	15(8.7)	41(23.7)	53(30.6)	51(29.5)	173(100.0)	3.66
I think examination done through virtual anesthesia consultation is as accurate as face-to-face consultation	28(16.2)	38(22.0)	37(21.4)	29(16.8)	41(23.7)	173(100.0)	3.1
I think telehealth can reduce the costs of anesthesia services	14(8.1)	26(15.0)	40(23.1)	50(28.9)	43(24.9)	173(100.0)	3.47
I think through videoconference students can be educated and staff be trained effectively	11(6.4)	19(11.0)	25(14.5)	47(27.2)	71(41.0)	173(100.0)	3.86

SD= Strongly disagree, D=Disagree, N: Neutral A=Agree SA=Strongly Agree

Researcher, 2024

Figure 2 presents the overall attitude of anesthetists in Rwanda towards Telehealth. Anesthetists with attitude level, above 3 mean

level were considered having positive attitude and negative for below score. In sum, 57.8% of respondents have positive attitude while 42.2%

of respondents have negative attitude towards telehealth.

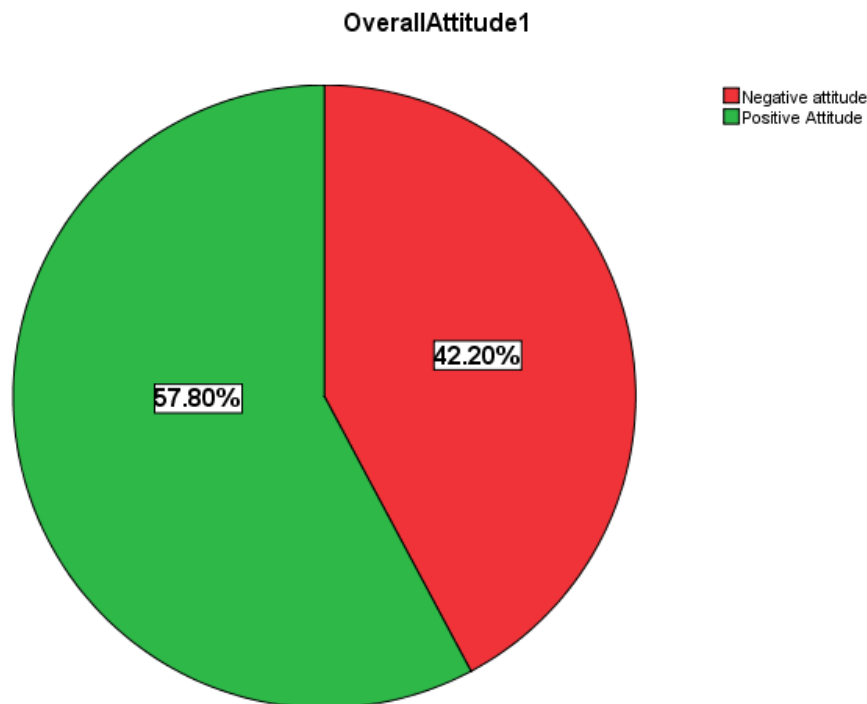


Figure 2. Overall Attitude level of anesthetists towards telehealth in Rwanda.

Majority of anesthetists do not use telehealth for patient consultations (56.6%). Slightly more than half of the providers (56.1%) use Telehealth to consult with students. A significant portion of providers (61.3%) consult with educators via Telehealth. A high percentage of providers (69.9%) consult with specialists using Telehealth. Majority of providers (59.5%) consult with their peers through Telehealth. Over half (58.4%) use videoconferencing for inter-communication. Email is a commonly used intercommunication tool (60.1%). A large majority (74.0%) use phone calls and SMS for communication.

Social Media and Video Conferencing Platforms (Facebook, LinkedIn, WhatsApp, Zoom, Teams, Google Meet) are widely used for communication purposes (75.1%). Discussing patient cases is a common reason for using Telehealth (76.9%). Information sharing is a significant practice among providers (68.8%). Seeking expert opinions is a prevalent practice (73.4%). Follow-up with patients is a common Telehealth practice (65.3%). Many providers (59.0%) use Telehealth for course material clarification. (Figure 2)

Table 4. Practice of anesthetists towards the use of telehealth in Rwanda.

Variables	Practice among anesthetists towards telehealth		
	Yes	No	Total
Consultation with patients	75(43.4)	98(56.6)	173(100.0)
Consultation with students	97(56.1)	76(43.9)	173(100.0)
Consultation with educators	106(61.3)	67(38.7)	173(100.0)

Consultation with specialists in the same field	121(69.9())	52(30.1)	173(100.0)
Consultation with own peers	103(59.5)	70(40.5)	173(100.0)
Usage of videoconference as a means of intercommunication	101(58.4)	72(41.6)	173(100.0)
Usage of email as a means of intercommunication	104(60.1)	69(39.9)	173(100.0)
Phone call and SMS	128(74.0)	45(26.0)	173(100.0)
Facebook, LinkedIn, WhatsApp, zoom, teams, google meet	130(75.1)	43(24.9)	173(100.0)
Discussing a patient's case as a reason of communication	133(76.9)	40(23.1)	173(100.0)
Patient information sharing as a reason of communication	119(68.8)	54(31.2)	173(100.0)
Getting opinion from an expert for a patient case as reason of communication	127(73.4)	46(26.6)	173(100.0)
Patients follow up as a reason of communication	113(65.3)	60(34.7)	173(100.0)
Course material clarification as a reason of communication	102(59.0)	71(41.0)	173(100.0)

Researcher, 2024

Figure 3 presents the primary practice of anesthetists in Rwanda towards telehealth. In sum, 23.12% of respondents have good practice

while 76.88% of respondents have poor practice towards telehealth.

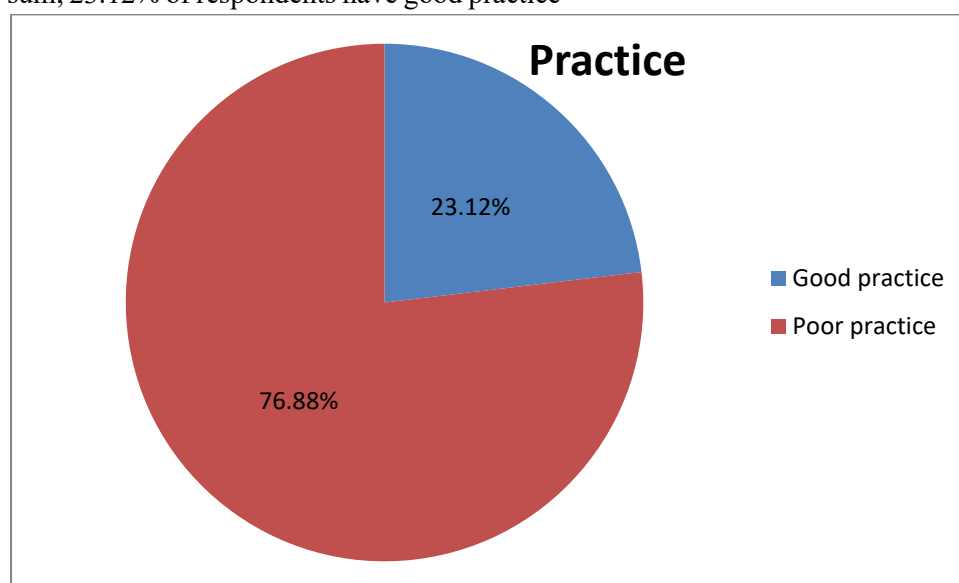


Figure 3. Practice of anesthetists towards the use of telehealth.

A significant majority of anesthetists (84.4%) perceive lack of training as a major challenge to the use of telehealth. Over 60% of providers are worried about making mistakes during data entry. This suggests that providers might benefit from training and user-friendly systems

to reduce errors. Slightly more than half of the providers do not trust telehealth equipment to function properly, indicating a need for reliable and well-maintained telehealth infrastructure. About half of the respondents find telehealth equipment difficult to use, highlighting a need

for user-friendly designs and comprehensive training. There is considerable resistance from colleagues or staff, with over 60% perceiving it as a barrier. A high percentage (80.3%) believe

that a lack of awareness about the benefits of telehealth among anesthetists is a significant barrier.

Table 5. Frequency of perceived challenges of anesthetists towards the use of telehealth among anesthetists in Rwanda.

Variables	Challenges among anesthetist's professionals towards telehealth.		
	Yes (%)	No (%)	Total (%)
Telehealth is still an issue because of lack of training	146(84.4)	27(15.6)	173(100.0)
I am worried about data entry mistakes.	110(63.6)	110(36.4)	173(100.0)
I can't trust telehealth equipment to work.	90(52.0)	83(48.0)	173(100.0)
Telehealth equipment will be difficult for me to use them	87(50.3)	86(49.7)	173(100.0)
There is resistance from colleagues or staff in anesthesia services provision	105(60.7)	68(39.3)	173(100.0)
The lack of awareness about telehealth benefits by anesthetists will be a barrier to its use.	139(80.3)	34(19.7)	173(100.0)

Researcher, 2024

Female anesthetists are more likely to exhibit poor practice towards telehealth anesthesia, with a significantly higher adjusted odds ratio (AoR) of 7.634 (95% CI 1.699-34.298) compared to male providers ($p = 0.008$). Anesthetists aged 31-40 years old are more likely to show poor practice, with a higher AoR of 9.020 (95% CI 3.848-19.298), compared to those aged 20-30 years old ($p = 0.03$). Anesthetists over 40 years old are also more likely to exhibit poor practice, with a significantly higher AoR of 12.439 (95% CI 0.942-18.759) ($p = 0.004$). Anesthetists who have not received training in telehealth are more likely to demonstrate poor practice, with a substantially higher AoR of 8.610 (95% CI 4.016-20.102) ($p < 0.001$). Anesthetists with a low level of knowledge about telehealth are

more likely to exhibit poor practice, with a higher AoR of 13.663 (95% CI 1.972-24.665) ($p = 0.008$). Concerns about telehealth impacting patient safety, confidentiality, and privacy (though not statistically significant at $p = 0.06$) suggest they are more likely to influence poor practice. Lack of trust in telehealth equipment functionality ($p = 0.8$) does not significantly impact poor practice. Providers facing resistance from colleagues or staff are more likely to demonstrate poor practice, with a higher AoR of 2.986 (95% CI 0.964-9.249) ($p = 0.058$). Lack of awareness about the benefits of tele-health among providers significantly correlates with a higher AoR of 6.354 (95% CI 1.767-22.854) ($p = 0.005$) for poor practice. (Table 6)

Table 6. Multivariate analysis of factors associated with poor practice of anesthetists towards the use of telehealth among anesthetists in Rwanda.

Variables	Factors associated with poor practice towards telehealth anesthesia among anesthetists		P-value
	AoR	95%CI	
Gender			
Female	7.634	1.699-34.298	0.008
Male	Ref		
Age			
20-30 Years	Ref		
31-40 Years	9.020	3.848-19.298	0.03
>40 years	12.439	0.942-18.759	0.004
Training			
Yes	Ref		
No	8.610	4.016-20.102	<0.001
Knowledge			
High level	Ref		
Low level	13.663	1.972-24.665	0.008
Telehealth is still an issue because of Lack of training			
No	Ref		
Yes	9.333	2.108-20.638	<0.001
Telehealth is still an issue because it raises concerns and threatens patient safety, confidentiality, and privacy.			
No	Ref		
Yes	3.241	0.951-11.052	0.06
I can't trust telehealth equipment to work.			
No	Ref		
Yes	0.887	0.243-3.249	0.8
There is resistance from colleagues or staff in anesthesia services provision			
Yes	Ref		
No	2.986	0.964-9.249	0.058
The lack of awareness about telehealth benefits by anesthetists will be a barrier to its use.			
Yes	Ref		
No	6.354	1.767-22.854	0.005

Researcher, 2024

Discussion

The findings on anesthetists' knowledge levels towards telehealth in Rwanda reveal that 67.05% of respondents demonstrate a high level of understanding, while 32.95% exhibit a low level. This distribution aligns with studies from similar healthcare contexts. For instance, a

study conducted among health professionals in Northwest Ethiopia found that 39% had a high level of understanding of telemedicine, while 12% were unfamiliar with the concept [26]. These findings suggest that knowledge gaps are prevalent across different healthcare settings, influenced by factors such as training availability and educational emphasis.

The results of this study indicate that 57.8% of anesthetists have a positive attitude towards telehealth, while 42.2% hold a negative attitude. This distribution is comparable to findings in other low- and middle-income countries. For example, a study among doctors in Karachi reported that while telemedicine is recognized as an affordable use of information and communication technology, its concept remains relatively new in the developing world, leading to varying levels of acceptance among healthcare professionals [27]. This suggests that while positive attitudes towards telehealth are emerging globally, significant variations remain influenced by local healthcare contexts and implementation strategies.

The disparities in knowledge and attitudes observed in Rwanda may stem from infrastructural challenges, limited access to educational opportunities, and differing stages of healthcare system development. In resource-limited environments, telemedicine is viewed as an effective channel for utilizing scarce medical resources and infrastructures. However, slow progress in telehealth services in low- and middle-income countries, with little to no evidence of the cost and effectiveness of such programs, may contribute to these disparities [28].

The results of this study indicate that 23.12% of anesthetists exhibit good practices towards telehealth, while a significant majority (76.88%) demonstrate poor practices. This distribution highlights challenges similar to those observed in other developing countries where healthcare providers face barriers such as limited infrastructure, inadequate training, and organizational resistance to Telehealth adoption. For instance, studies in rural areas of Nigeria show that only about 15% of healthcare providers demonstrate good practices towards Telehealth, reflecting systemic challenges in technology integration and healthcare delivery [29]. This suggests that while telehealth holds promise for improving healthcare access, its effective implementation requires targeted

interventions to overcome operational and cultural barriers.

In contrast, healthcare systems in developed countries often report higher rates of good practices among providers due to robust infrastructure, extensive training programs, and supportive policy frameworks. Similarly, research in sub-Saharan Africa indicates that mobile applications are effective in providing information for referrals of potential COVID-19 patients, demonstrating the potential of telehealth in resource-limited settings [30]. The disparities in practice levels observed in Rwanda may thus reflect the need for enhanced investment in healthcare infrastructure and tailored educational strategies to improve telehealth adoption and implementation.

The findings from the study among anesthetists in Rwanda highlight several significant factors associated with poor practice towards telehealth anesthesia, with notable implications for healthcare delivery and technology adoption. Female anesthetists are notably more likely to exhibit poor practice, as indicated by a significantly higher adjusted odds ratio (AoR) of 7.634 compared to their male counterparts. This finding resonates with broader research indicating that gender influences healthcare professionals' attitudes and behaviors towards adoption of technology, potentially influenced by cultural norms and professional expectations [31].

Age also emerges as a critical factor, with anesthetists aged 31–40 years and those over 40 years demonstrating higher odds of poor practice compared to their younger peers. This trend suggests that older providers may face greater challenges in adapting to new technologies, potentially due to entrenched practices and perceived barriers associated with technological integration [32]. Addressing age-related disparities through targeted training and support mechanisms could mitigate resistance and enhance telehealth adoption among anesthetists in Rwanda.

Furthermore, the impact of training and knowledge on telehealth practices is substantial. Providers who have not received formal training in telehealth or possess a low level of knowledge about its applications demonstrate significantly higher odds of poor practice. This underscores the critical role of education in fostering positive attitudes and practices towards Telehealth, aligning with global initiatives that emphasize the importance of continuous professional development in healthcare technology adoption [33].

The study also highlights organizational factors influencing telehealth practice among anesthetists. Resistance from colleagues or staff and lack of awareness about telehealth benefits emerge as significant barriers associated with poor practice. While these factors did not always reach statistical significance, their impact underscores the importance of organizational culture and awareness campaigns in promoting cohesive and informed telehealth practices within healthcare settings [34]. Addressing these organizational challenges through targeted interventions and leadership support could enhance Telehealth integration and improve healthcare outcomes in Rwanda.

Study limitations

However, the study's findings also highlight several limitations that warrant consideration. Firstly, the cross-sectional nature of the study limits the ability to establish causal relationships between identified factors and poor telehealth practices. Longitudinal studies would provide more robust insights into how attitudes and practices evolve over time with changing educational and organizational interventions. Secondly, the study's reliance on self-reported data may introduce response bias, where participants might overestimate or underestimate their knowledge and practices towards Telehealth. Future research could benefit from mixed methods approaches that include qualitative insights to complement quantitative findings, providing a deeper

understanding of the contextual factors influencing telehealth adoption. Lastly, the study's focus on anesthetists in Rwanda may not fully capture the diverse perspectives and challenges faced by healthcare professionals in other specialties or regions within the country, warranting broader representation in future research endeavors to ensure comprehensive insights into Telehealth integration across the healthcare system.

Study Implications

Based on the findings, several implications for policy and practice can be discerned. Firstly, addressing the identified disparities based on gender, age, training, and knowledge levels is crucial for enhancing Telehealth adoption and efficacy. Tailored training programs that cater to different demographic groups, coupled with organizational strategies to promote awareness and mitigate resistance, could significantly improve telehealth practices among anesthetists. Moreover, integrating Telehealth competencies into formal education and continuous professional development frameworks can ensure a sustainable approach to enhancing healthcare delivery and patient outcomes in Rwanda. These efforts are essential not only for improving individual provider practices but also for fostering a supportive environment conducive to technological innovation in healthcare.

CONCLUSION

This study demonstrates that most anesthetists in Rwanda possess a high level of knowledge and generally positive attitudes toward telehealth; however, the level of practical telehealth use remains low, with only about one quarter exhibiting good practice. Poor telehealth practice was significantly associated with female gender, older age, lack of training, low telehealth knowledge, organizational resistance, and insufficient awareness of telehealth benefits. Strengthening structured telehealth training and supportive institutional

policies is recommended to enhance effective telehealth anesthesia practice.

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Author contributions:

“ER&GN played a role in the conception of the study. ER analysed and interpreted data and ER was the major contributor to writing the manuscript. CN supervised and reviewed this study. ER, CN, PN edited, revised, and approved the final manuscript”.

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Data availability

All data were shared within this study.

Declarations

Ethics Approval and consent to participate

Ethical Clearance for this study was obtained from Institutional Review Board of University of Rwanda College of Medicine and Health Sciences (UR-CMHS IRB: Reference number: CMHS/IRB/201/2024). In addition, permission to contact participants was requested and granted by the council. Participants were informed about the aim of the study, its benefits, and their role in the study prior to starting data collection. Participants signed the consent form as well before starting data collection. Anonymous questions were used to ensure participants confidentiality.

Competing interests

This study declared no competing interests.

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