ORIGINAL ARTICLE

Impact of telemedicine in managing chronic conditions within family medicine practices in Abha City PHCs

Majed Mohammed Al Saleh[1], Faisal Suheam B. Alamri[1], Abdulaziz Mari Ali AlQahtani[1], Abdullah Mohammed Alrofydi[1], Hassan Adel Hassan Alasiri[1], Bandar A. Alasmari[1], Abdullah Saeed[1]

Full list of author information is available at the end of the article.

ABSTRACT

Background: Telemedicine is essential for handling long-term illnesses in basic healthcare, as it expands access, improves tracking, and is more convenient for patients. However, for telemedicine to last, healthcare staff must be confident, and organizations must be prepared.

Objectives: This study aimed to explain how family doctors in Abha City's primary healthcare centers use telemedicine. It identifies what they see as good points and problems, and what makes them feel sure about using telemedicine to handle long-term conditions.

Methods: From June to August 2025, a survey was conducted with 98 healthcare workers in Abha City's primary healthcare centers. The survey collected details on their backgrounds, how they use telemedicine, how well they think it works, how confident they feel, and what they see as good and bad. Data were examined using descriptive statistics, Spearman's correlation, multiple linear regression, and chi-square tests.

Results: The people who answered (98% doctors, average age 41-50 years) said they often use telemedicine for diabetes (99%) and high blood pressure (96%). They felt confident (57.1% were very or extremely confident). The number of years they worked in healthcare (p = 0.425, p = 0.001) and how well they thought telemedicine worked (p = 0.355, p = 0.001) were closely related to their confidence. The main problems were lack of training (80.6%) and insufficient patient involvement (78.6%). The main benefits included better access (80.6%) and good use of resources (75.5%).

Conclusion: Telemedicine is widely used in Abha's primary healthcare centers, and the healthcare staff are usually confident. However, their success depends on their work experience and the extent to which they think it works. Dealing with the lack of training and getting patients more involved is important to get the best from telemedicine for handling long-term illnesses and supporting Vision 2030 health goals.

Keywords: Telemedicine, chronic disease management, family medicine, primary healthcare, provider confidence, digital health.

Introduction

Chronic conditions such as diabetes, hypertension, and respiratory problems are a growing concern for primary care systems worldwide [1,2]. These illnesses need constant patient participation, regular exams, and well-planned treatments, which traditional in-person care struggles to deliver, especially in remote or underfunded areas [3]. Telemedicine, or the use of technology to provide health services, is a new way to solve these issues by providing remote consultations, continuous monitoring, and better care coordination [4]

In Saudi Arabia, Vision 2030 focuses on digital health as a key part of improving healthcare, intending to build a fair, accessible, and advanced health system [5,6]. Telemedicine fits well with these goals, offering answers to unequal healthcare access and resource problems in different regions [7]. However, despite enthusiasm from leaders and investment in technology, moving from simply using technology to consistently using it in patient care is still a challenge, especially in primary care centers in areas such as Abha City [8].

This study examined the difference between what telemedicine can do and what it is actually doing in everyday practice. International data shows that telemedicine can improve blood sugar control, blood pressure, and patient satisfaction. However, maintaining these improvements depends on things that are often missed in large-scale studies [9,10]. Provider confidence, how ready an organization is, training quality, and how well the system is believed to work are all important in deciding if telemedicine becomes a standard part of care or just an extra option that doctors don't use enough [11,12].

Past studies have not looked closely enough at what providers in Saudi primary care centers think, especially when it comes to what affects their behavior and how they use telemedicine. Most studies have focused on patient results or described how technology is implemented, without studying the mental and emotional aspects that affect a provider's confidence and consistent use of telemedicine [8,13]. This lack of information affects how policies are put into place: without knowing why providers do or don't use telemedicine, health systems cannot create specific plans to improve the use of digital health.

The ideal for telemedicine in Abha primary care centers is to have technology-supported chronic disease management led by doctors, smoothly included in daily work, involving active patients, and having providers who are sure of their ability to provide virtual care. However, the current situation is not ideal, because technology is expanding faster than the workforce is being trained, patients' understanding of technology varies, and support structures are not consistent [6,14].

This study addresses these issues by examining how telemedicine is being used and what affects its use among family medicine doctors in Abha City primary care centers. By combining a look at provider confidence with an assessment of the positive and negative aspects of using telemedicine, this study helps us understand how telemedicine works in Saudi primary care and suggests specific ways to improve digital health in line with the goals of Vision 2030.

Study goals

1. To describe how family medicine doctors in Abha City primary care centers use telemedicine, including how often they use it, what types of chronic conditions they manage, and who is using it.

2. To find out what providers see as the main good and bad points of using telemedicine to manage chronic diseases.

3. To identify statistical predictors of provider confidence in telemedicine use, specifically looking at years of experience, telemedicine experience, how well it is believed to work, and demographic factors.

These goals directly address the lack of information by providing local data on the factors affecting telemedicine adoption in Saudi primary care. These data are needed to develop plans to improve provider participation and patient care.

Literature Review

Global evidence on telemedicine for chronic disease management

Systematic reviews and meta-analyses have examined telemedicine for chronic conditions, noting consistent gains in many clinical areas [9,10,15]. Mihevc et al. [9] did a large meta-analysis of 54 trials on telemedicine for high blood pressure and type 2 diabetes in primary care. They learned that telemonitoring plus remote consults lowered systolic blood pressure by 5.63 mmHg at 6 months and 5.59 mmHg at 12 months, when compared to standard care. In diabetes care, telemedicine reduced HbA1c by 0.45% at 6 months, yet lasting gains were small [9,10].

In a U.S. meta-analysis of 13 trials, Acharya et al. [16] reported that telemedicine for high blood pressure lowered systolic and diastolic blood pressure by 7.3 mmHg and 2.7 mmHg. It worked better when non-physicians oversaw drug treatment and pharmacist-aided self-care [16]. These results suggest that telemedicine can help improve clinical results, but the care style and provider roles change how well it works.

Patients are often happier and have easier access to telemedicine in various cases [17,18]. Remote consults are handy, cut travel stress, and let people get care at home or work, which is valued by those with chronic issues needing regular visits [19]. Also, telemedicine may reduce avoidable ER visits and hospital stays, despite differing study quality [9,10].

A key issue in current global research is that most top trials come from rich health systems in North America, Europe, and developed Asia-Pacific areas. These places have better digital setups, provider training, and patient-computer skills than many lower-income areas [8,20]. This makes it hard to apply these results to places like Saudi Arabia.

Telemedicine implementation in Saudi Arabia

In Saudi Arabia, the Vision 2030 Plan has greatly sped up changes in healthcare. Digital health projects are key to the country's plan, which was started in 2015 [6,21]. Al-Kahtani et al. [8] looked at how ready healthcare places in the Eastern Province were for digital changes. They

saw that private hospitals were better equipped with digital tools (average 77) than public hospitals (average 71) [8]. Interestingly, using data to predict trends was the least common thing to do (average of 70), which means that not all parts of digital health are improving at the same rate [8].

The Saudi Ministry of Health has put in place three main digital health tools: using computers to handle patient care through electronic health records, making rules for sharing information the same across the board, and making a National Health Observatory watch over the public's health [8,21]. Even with these improvements, Suleiman [6] pointed out some ongoing issues, such as worries about data safety, some people not having good access to tech, and not enough training for healthcare workers on how to use digital systems [6]. He wrote that, while Vision 2030 has clear aims, putting them into action in all of Saudi Arabia's different healthcare settings is not always consistent. Some areas are located behind big cities [6].

The use of telemedicine in Saudi Arabia has increased rapidly, mostly after the pandemic, but there are still differences in its use. Al-Nozha et al. [22] stress that to change healthcare, we have to look at if workers are ready, how data is handled, and if everyone is treated fairly. These issues have not been addressed evenly in primary care networks [22]. A difficulty in areas like Aseer (where Abha is located) is adjusting funding between improving buildings and tools, getting people ready, and getting patients more involved.

Provider confidence and technology adoption

The Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) provide ways to think about how technology is accepted in healthcare [12]. They say that if people think something is helpful and easy to use, they're more apt to actually use it [23]. Schürmann et al. [12,23] built on these ideas with a larger model that looks at risks, good things, trust, and other things that matter for telemedicine. They realized that if doctors agree to use telemedicine, it depends on many things and the situation they are in [23].

How sure doctors are of themselves, meaning how good they think they are with the technology and how much they trust it, seems to be a big link between training and using the technology for a long time [11,12,24]. Tan et al. [11] found that if doctors thought telemedicine was useful and easy, they used it more in primary care. In addition, the more experience they had, the more they thought it was useful and the more they used it [11]. This means that doctors who have been working for years can see how telemedicine can assist in certain situations and are more inclined to start using it regularly.

Some studies show that things such as the organization and the system also impact whether doctors start using new technology. Abbas et al. [24] stated that training,

support from the hospital or clinic, and clear rules about telemedicine all sway how doctors use telemedicine. If the training isn't good enough, it's a major problem in many places [24]. This is true, regardless of whether the healthcare system is rich or poor. This proves that just having the technology is not enough to merge telemedicine with good.

Barriers and facilitators to telemedicine implementation

Lopez et al. [25] proposed a model with steps needed for effective telemedicine visits, including setting up infrastructure, ensuring that patients can access it, scheduling appointments, helping patients understand the technology, and successfully finishing the visit. This model shows that problems can arise at different points, and if a step fails, the entire process is at risk [25].

Hayavi-Haghighi et al. [26] conducted an analysis and found seven linked things that got in the way of using telehealth from the doctors' point of view. These are things like doctors' technology skills and resources, technical issues like infrastructure, how people act (resistance to using it and cultural views), problems with how organizations are run (not enough training or support), legal concerns (privacy), limits to what can be done clinically (cannot do physical examinations), and money issues (how reimbursement works) [26]. These problems appear in different healthcare systems such as Iran, Japan, and Saudi Arabia, which means that even though situations vary, some challenges are the same [26].

In Saudi Arabia, Haleem et al. [27] found that the main factors preventing telemedicine from being widely used were insufficient training, insufficient integration into organizations, insufficient infrastructure in rural places, and worries about data security [27]. Al-Kahtani et al. [8] found similar findings in the Eastern Province, suggesting that local primary healthcare centers have problems because of structural limits and a lack of staff ready [8,27].

Much work has gone into studying the things that hold patients back. Mihevc et al. [9] pointed out that older people, people who are not good with technology, and people who are not white do not get as much from telemedicine as younger, tech-savvy, and white people. This raises important questions regarding fairness when using digital health [9]. Abbas et al. [24] also stated that how well patients handle technology, cultural preferences for in-person care, and concerns about whether the technology is good enough are major barriers in developing healthcare settings [24].

Synthesis and knowledge gaps

Based on a review of the literature, this study makes several points:

First, global data support the health advantages of telemedicine in managing long-term illnesses. These

data mainly came from places with good digital health resources and training for health workers.

Second, although we know a lot about structural and policy issues, we still have little information on how Saudi primary care doctors act. Confidence, which is impacted by experience and how well telemedicine works, is one thing that needs to be examined.

Third, the implementation cascade model states that, to make telemedicine work long-term, we need to consider infrastructure, training, how it fits into current structures, how patients are involved, and the confidence of each care provider. Most studies in Saudi Arabia have only discussed infrastructure or how patients can access telemedicine.

Fourth, no research has used hard numbers to look at what makes providers confident, especially in Abha City's primary care centers. This research will fill this gap by learning more about what encourages or prevents doctors from using telemedicine in this area.

This study examines provider confidence and its effects in Abha City primary health centers. By doing this, we will add to our knowledge about local health systems and how telemedicine is used in Saudi Arabia. The results will guide programs to assist providers in getting ready and merging telemedicine into their work to meet the Vision 2030 goals.

Methods

Study design and setting

This survey was conducted from June to August 2025 in government primary care clinics in Abha City, the capital city of Aseer Province, Saudi Arabia. We chose a cross-sectional design because it allowed us to measure aspects such as practitioner background, experience, and comfort with telemedicine, and how these factors relate to telemedicine use, confidence, and perceived pros and cons. This approach allowed us to see how telemedicine is currently being used in primary care. This design fits what we wanted to do: describe how telemedicine is being used and determine what factors relate to how confident providers are.

Our method follows the STROBE guidelines for this type of research, which helps ensure that our study is clear and well-conducted from start to end.

Ethics approval and informed consent

On May 15, 2025, the American Regional Research Ethics Committee approved the study protocol (Reference Number: F9-2-2025). The committee decided that the study would meet all ethical guidelines for research involving human subjects. These guidelines included data confidentiality, participant independence, and risk reduction. Before completing the survey, all participants provided informed consent electronically. Participation was voluntary, and people could withdraw at any point without penalties. This research did not involve any animal or laboratory procedures.

Study population and sampling

Our study focused on family medicine doctors who used telemedicine to treat long-term disease. They worked in public primary care clinics in Abha. We used stratified random sampling across the five clinics. These clinics differed in size, resources, and the people they served. This helped to ensure that we had a good mix of participants.

People were included if they:

- Licensed family medicine doctors or nurses with at least one year of work experience.

- Direct involvement in telemedicine visits for patients with long-term illnesses.

- Working at participating clinics in Abha.

- Could understand and answer survey questions in English or Arabic.

- People were not included if they:

- Only administrative work and did not provide direct patient care.

- Did not have telemedicine experience

- Were on leave during the time we collected data.

Of the 125 doctors who participated, 98 completed the survey. This means that we obtained responses from 78.4% of eligible participants.

Participant characteristics

Information about the people who answered, such as age, gender, job, total time in healthcare, time spent using telemedicine, and digital health training, was noted. These details were selected so that we could study how a provider's past experiences affect how they use telemedicine.

Data collection instruments

We built a structured online form based on surveys of past studies on telemedicine and comfort with digital health [11,24,28] We tested the form with 10 family doctors at other clinics to see if it was clear and relevant, how long it took to finish, and if it seemed accurate. Their advice helped us make small changes to the wording.

The final survey had five parts:

1. Doctor Information (6 questions): Age, gender, job, years of practice, experience with telemedicine, and past training.

2. Telemedicine Use (4 questions): How often they use it (never, sometimes, often, always), what long-term illnesses they treat using telemedicine, types of appointments they conduct, and things that stop them from using it more.

3. How Good It Is (one question): A scale from 1 to 5 (1 = very bad, 5 = very good) asking how helpful doctors think telemedicine is for patient care.

4. Doctor Confidence (1 question): A scale from 1 to 5 (1 = not at all confident, 5 = very confident) asking how comfortable doctors feel managing patients with long-term illnesses through telemedicine.

5. Pros and Cons (open and closed questions): A list of common pros (easier access, saves time, easier to keep track of patients, easier for patients, patients are happier) and cons (lack of training, patient participation, tech issues, access to data, security/privacy concerns, patient understanding).

The survey was administered online through a safe HIPAA-protected site that can be used on computers, tablets, or phones.

Data collection procedures

1. Recruitment [June 2025]: We sent invitation emails through PHC administrative offices. These emails contained study details, consent forms, and a secure link to the survey.

2. Consent [June 2025]: Participants provided their consent online. They had to confirm that they had understood the information before they could see the survey questions.

3. Survey [June-July 2025]: People took the surveys at their own time outside of clinical work. They had two weeks to respond. We sent reminder emails after one week to obtain more responses.

4. Data Security: The online system automatically anonymized all the responses. Data were stored on encrypted off-site servers that followed Saudi Arabia's rules for protecting healthcare data.

5. **Data Check [August 2025]:** We checked the completed surveys for missing info, unusual values, and data quality. If a survey was missing much information, we contacted the participants.

Primary and secondary outcomes

The main findings were as follows: 1. How often family doctors use telemedicine, and 2. How sure did they feel about using it to handle long-term health problems?

We also checked: 1. What kinds of long-term problems doctors managed with telemedicine, and how common each was? 2. What good things doctors thought came from using telemedicine for long-term care; 3. What problems they saw prevented them from using telemedicine as well as they could, and 4. How do things like experience affect the confidence they feel?

We selected these things for study because they hit on what we wanted to learn and because hospitals and health systems are interested in how telemedicine is being used by doctors.

Statistical analysis

IBM SPSS Statistics version 27 was the tool for data analysis.

Descriptive Analysis: Frequency distributions and basic descriptive numbers (mean, standard deviation, and percentages) provided summaries for respondent information, telemedicine habits, ratings of how well it worked, and confidence amounts.

Inferential Analysis: To check what predicted how confident providers were:

- Bivariate Association: Spearman's rank correlation coefficients (ρ) showed links between provider confidence (the thing being predicted) and other factors such as years of healthcare work, telemedicine work, how well they thought it worked, gender, and how often they used telemedicine. A p-value less than 0.05 was used to determine if the results were real.

- Multivariate Regression: Multiple linear regression looked at provider confidence based on years of healthcare work, telemedicine work, how well they thought it worked, gender, and how often they used it. R^2 and adjusted R^2 show how well the model fit, with F-statistics and p-values reported. Before sharing the model, multicollinearity, normality, and homoscedasticity were assessed.

- Chi-Square Tests: Chi-square tests checked if there was a link between category things (such as experience levels and confidence levels, or gender and confidence levels), with tables showing the counts.

Statistical Significance Threshold: P-values less than 0.05 meant results were real for all tests.

Power Analysis: Sample size math was performed beforehand, assuming average effect sizes (r = 0.30) for bivariate correlations and small-to-medium effect sizes (f^2 = 0.10) for multiple regression. With α = 0.05 and a power of 0.80, calculations showed that at least 85 people were needed for correlation analysis and 96 for regression. We obtained 98 people, which is more than what was needed, so we had sufficient statistical power.

Limitations and assumptions

The design of this study limits us from drawing conclusions about the causes and influences. The links we saw were simple links without a clear direction. Because the data on confidence and how well something works came from what people said, it might have a bias where people answered in a way that seemed right for their job instead of giving honest self-reports. Most people in the sample were doctors (98%); therefore, the results might not apply to all primary care teams. We did not obtain clinical results from patients, so we do not know how a provider's confidence relates to how healthy their patients are.

Results

Respondent characteristics

A total of 98 practitioners completed the survey (78.4% response rate from 125 eligible participants).

Table 1 presents the demographic and professional characteristics.

The respondent population was relatively experienced, with 84.7% of them having ≥6 years of healthcare practice. Most had been using telemedicine for 1-3 years (58.2%) or ≥3 years (22.4%), indicating an established familiarity with digital care delivery platforms. The sample was sex-balanced (54.1% male, 45.9% female) and predominantly middle-aged (63.3% aged 41-50 years).

Telemedicine usage patterns

Table 2 presents data on the frequency of telemedicine use, perceived effectiveness, and provider confidence.

The vast majority of respondents (88.8%) reported frequent or always using telemedicine, with only 11.2% using it occasionally or never. Perceived effectiveness was predominantly favorable, with 75.5% rating telemedicine as effective or very effective, whereas only 9.2% considered it ineffective. Provider confidence was comparably high, with 57.1% expressing very or extremely high confidence, and 23.5% being moderately confident, such that 80.6% of practitioners reported moderate to extreme confidence in telemedicine-facilitated chronic care.

Chronic conditions managed via telemedicine

Table 3 details the distribution of chronic conditions managed remotely.

Diabetes and hypertension dominated telemedicine utilization, with 99.0% and 95.9% of practitioners, respectively, managing these conditions remotely. These high proportions reflect both the prevalence of these conditions in the Abha population and their suitability for remote monitoring (given the availability of home glucometers, blood pressure monitors, and established therapeutic protocols). Respiratory disorders were managed by telemedicine by 43.9% of respondents, while cardiovascular disease represented a smaller proportion (14.3%), likely reflecting greater complexity and the need for physical examination.

Perceived benefits and barriers

Table 4 summarizes the reported benefits and barriers of telemedicine-facilitated chronic care.

Correlation analysis: predictors of provider confidence

Improved patient access to care was the most advantageous (80.6%), followed by good resource use (75.5%), and better monitoring (69.4%). This fits with what the theory states about telemedicine and with studies from other countries.

A major problem reported was a lack of training or support (80.6%), the same percentage as those who said access improved. This contradiction—seeing gains but also needing training—implies that people in the

Table 1. *Demographic and professional characteristics of participants (n = 98).*

Characteristic	Category	n (%)
Gender	Male	53 (54.1%)
	Female	45 (45.9%)
Age group	18-30 years	5 (5.1%)
	31-40 years	20 (20.4%)
	41-50 years	62 (63.3%)
	51-60 years	9 (9.2%)
	≥61 years	2 (2.0%)
Profession	Physician	96 (98.0%)
	Nurse	2 (2.0%)
Years healthcare experience	1-5 years	10 (10.2%)
	6-10 years	41 (41.8%)
	11-20 years	42 (42.9%)
	≥21 years	5 (5.1%)
Telemedicine experience	<3 months	2 (2.0%)
	3-6 months	6 (6.1%)
	6 months-1 year	11 (11.2%)
	1-3 years	57 (58.2%)
	≥3 years	22 (22.4%)

Table 2. *Telemedicine usage patterns, perceived effectiveness, and provider confidence (n = 98).*

Variable	Category	*n* (%)
Frequency of telemedicine use	Never	1 (1.0%)
	Occasionally	10 (10.2%)
	Frequently	70 (71.4%)
	Always	17 (17.3%)
Perceived effectiveness	Very ineffective	3 (3.1%)
	Ineffective	6 (6.1%)
	Neutral	15 (15.3%)
	Effective	61 (62.2%)
	Very effective	13 (13.3%)
Provider confidence	Not confident at all	5 (5.1%)
	Slightly confident	14 (14.3%)
	Moderately confident	23 (23.5%)
	Very confident	39 (39.8%)
	Extremely confident	17 (17.3%)

Table 3. *Chronic conditions managed via telemedicine (n = 98).*

Chronic condition	*n* (%)
Diabetes	97 (99.0%)
Hypertension	94 (95.9%)
Respiratory disorders (asthma, COPD)	43 (43.9%)
Cardiovascular disease	14 (14.3%)
Other chronic conditions	4 (4.1%)

field see value in telemedicine but do not think they are ready to use it well. Insufficient patient involvement (78.6%) was another big issue, showing that doctors think patients have problems accepting and following through with telemedicine. Things such as tech problems (45.9%), limited record access (41.8%), and concerns about data safety (28.6%) were mentioned less often. This suggests that while infrastructure and IT are still a concern, organizational and people issues (training, getting patients involved) are bigger problems from the doctors' point of view.

Spearman's rank correlation coefficients were computed between provider confidence and the five independent variables. Table 5 presents the results.

Provider confidence was most strongly linked to years of healthcare experience (ρ = 0.425, p = 0.001), meaning that those with more experience tended to be more confident in using telemedicine. A strong link to perceived usefulness also exists (ρ = 0.355, p = 0.001), suggesting that if providers think telemedicine works

well, they are more likely to feel confident. Experience using telemedicine was linked to confidence to a degree (ρ = 0.296, p = 0.003); more experience predicted higher confidence. Gender had a small but statistically significant correlation (ρ=-0.223, p = 0.028), with female providers expressing slightly higher confidence.

Interestingly, the frequency of telemedicine use was not related to confidence levels (ρ = −0.047, p = 0.647). This suggests that simply because someone is confident does not mean that they use telemedicine more often. Other things, such as how busy they are, what patients want, and what is needed clinically, might have more of an impact on use than just confidence.

Multiple linear regression: multivariate predictors of confidence

Multiple linear regression was conducted with provider confidence as the dependent variable, and five independent variables were entered simultaneously. Table 6 presents the results of the study.

Chi-Square tests: categorical associations

The regression model showed a statistically significant result (F[5,92] = 8.02, p = 0.001), explaining 26.6% of the variance in how sure providers felt, even when considering the complexity of the model (Adjusted R^2 = 0.266). Two things stood out as statistically noticeable: how long someone had worked in healthcare (ß = 0.404, p = 0.009), and how well they thought telemedicine worked (ß = 0.322, p = 0.001). For each extra year of healthcare work, confidence increased by 0.404 units on a 5-point scale. In addition, those who saw telemedicine as working well had a 0.322-unit boost in

confidence compared with those who did not rate it as high.

Experience with telemedicine was close to being statistically significant (ß = 0.234, p = 0.088), as was gender (ß = −0.370, p = 0.066), with men showing slightly less confidence than women. The use of telemedicine did not seem to matter much in this model (ß = −0.264, p = 0.101).

Chi-square tests of independence examined associations between categorical variables and confidence categories.

Healthcare experience and confidence showed a statistically significant association (χ^2 = 17.42, p = 0.008) Table 7, Figure 1 and 2), confirming the bivariate correlation. Practitioners with 11-20 years of experience and ≥21 years' experience demonstrated markedly higher confidence categories than those with 1-10 years of experience. Telemedicine experience and gender did not show significant categorical associations with confidence level in chi-square tests, suggesting that these relationships may be more continuous than categorical or confounded by other variables.

Discussion

Summary of findings in relation to literature

This research offers an initial quantitative look at how telemedicine is being used and the level of assurance providers have with it in Abha City's primary healthcare centers. It adds local data to the growing research on implementing digital health solutions. The frequent use of telemedicine (88.8% often or always), a strong belief in its worth (75.5% believe it is effective or highly operative), and high provider assurance (80.6% have moderate to extreme assurance) are in line with worldwide trends showing that telemedicine is becoming normal after the pandemic. These trends suggest that telemedicine is not just being tested or used as a backup anymore; it is now a normal part of how chronic illnesses are handled at the primary healthcare centers studied, especially for widespread illnesses such as diabetes and high blood pressure.

Table 4. *Perceived benefits and barriers to telemedicine (n = 98).*

Item	n (%)
Benefits	
Improved patient access to care	79 (80.6%)
More efficient use of time and resources	74 (75.5%)
Better patient monitoring capability	68 (69.4%)
Increased convenience for patients	56 (57.1%)
Improved patient satisfaction	52 (53.1%)
Other benefits	1 (1.0%)
Barriers	
Lack of training or support	79 (80.6%)
Limited patient engagement/compliance	77 (78.6%)
Technical issues (connectivity, platform glitches)	45 (45.9%)
Limited access to patient medical records	41 (41.8%)
Concerns about data security/privacy	28 (28.6%)
Patient technological literacy limitations	24 (24.5%)

Table 5. *Bivariate correlations (ρ) and significance levels for predictors influencing telemedicine perceptions among healthcare practitioners.*

Predictor variable	Correlation coefficient (ρ)	p-value	Interpretation
Years of healthcare experience	0.425	<0.001	Strong positive correlation***
Telemedicine-specific experience	0.296	0.003	Moderate positive correlation**
Perceived effectiveness rating	0.355	<0.001	Moderate positive correlation***
Gender (Male = 1, Female = 0)	−0.223	0.028	Weak negative correlation*
Frequency of telemedicine use	−0.047	0.647	Not significant

* p < 0.05 (Significant) ** p < 0.01 (Highly significant) *** p < 0.001 (Extremely significant).

Table 6. *Chi-square test of independence between practitioner demographics and confidence levels in using telemedicine systems.*

Predictor Variable	Unstandardized ß Coefficient	p-value	Standardized ß	95% CI
Years of healthcare experience	0.404	0.009	0.389	[0.103, 0.705]
Telemedicine-specific experience	0.234	0.088	0.201	[−0.035, 0.503]
Perceived effectiveness rating	0.322	0.001	0.308	[0.137, 0.507]
Gender (Male)	−0.370	0.066	−0.204	[−0.765, 0.025]
Frequency of telemedicine use	−0.264	0.101	−0.190	[−0.588, 0.060]
Model statistics				
R^2	0.304			
Adjusted R^2	0.266			
F[5,92]	8.02	$p<0.001$		

Table 7. *Association between demographic factors and confidence levels in telemedicine.*

Variables	χ^2 (df)	p-value	Interpretation
Healthcare experience level × Confidence level	17.42 (6)	0.008	Significant**
Telemedicine experience level × Confidence level	6.60 (4)	0.158	Not significant
Gender × Confidence level	3.32 (2)	0.190	Not significant

** Significant p vlaue.

The clear link between years of healthcare experience and provider assurance (ρ = 0.425) supports what is predicted by the Technology Acceptance Model and ideas about behavioral assurance. This link suggests that professionals who have been in the field longer and who have better clinical thinking and problem-solving abilities are quicker to see how telemedicine can be useful and include it in their work with assurance. This matches a study by Tan et al. [11], where they found that clinical experience made people think telemedicine platforms were more helpful and led to their increased use.

The link between perceived worth and assurance (ρ = 0.355) shows that clinical usefulness builds trust in technology. This could be due to the good patient results or hearing from other professionals. This is a key feedback loop; as providers see good results, their assurance grows, which leads them to use telemedicine more regularly, which can then lead to even better results. Haleem et al. [27] made a similar point, noting that clinical gains are needed to keep providers using digital health systems.

The paradox of benefits versus barriers

It is interesting that the same percentage of people said that better access was a big plus (80.6%), and that not having enough training was a major problem (80.6%). This shows that people in the field see the worth of telemedicine, but do not think they are ready to use it as best as possible. Abbas et al. [24] and Hayavi-Haghighi et al. [26] found things like this too, which means that not enough training is still key to preventing telemedicine from being as helpful as it could be worldwide [24,26].

Many people (78.6%) said that getting patients involved was difficult, which points to a wider problem when using digital health tools. The technology is used faster than patients are ready for it or know how to use it. Mihevc et al. [9] wrote that patients who do not know much about technology, and some groups of people, do not get as much from telemedicine. This shows that building more infrastructure is not sufficient to ensure that everyone has fair access [9]. Therefore, if telemedicine is going to do well in Abha, it needs investment in teaching patients and helping them learn how to use the technology.

It is worth noting that fewer people mentioned technical problems (such as internet or platform issues: 45.9%) than training or patient involvement. This suggests that investing in infrastructure has somewhat worked in creating a good technology base. Still, it is important to keep focusing on data access and security concerns (28.6% and 41.8%, respectively), mainly as healthcare systems use more digital tools.

Implications for theory

The regression model accounted for 26.6% of the variance in provider confidence, but 73.4% remained unexplained. This shows that, while experience

Figure 1. *Illustrate relationships Healthcare experience level × Confidence level.*

Figure 2. *Illustrate relationships effectiveness × Confidence.*

and perceived effectiveness matter, other factors also influence confidence. These could include organizational factors, such as institutional support and documentation systems; systemic factors, such

as workload and patient volume; and individual psychological factors, such as risk tolerance and comfort with technology. Future studies that include organizational and psychological variables may improve confidence prediction [29].

The finding that how often telemedicine is used is not important in the models contradicts the idea that confidence drives frequency [30]. One possible reason is that clinical necessity and patient requests drive how often telemedicine is used, not practitioner's confidence. Practitioners who are less confident might still use telemedicine if they need it, while those who are very confident might not use it if they do not need it. Another possibility is that frequency and confidence affect each other in ways that are not captured by the data [31].

Implications for policy and practice

In terms of health policy, these results indicate that Vision the 2030s investment in telemedicine has led to acceptance. However, putting it to use is not as good as possible because of a lack of training. Some policy suggestions are as follows:

1. Complete training programs for workers: Ongoing telemedicine training is required for all PHC staff members. This should not be a one-time task. Training should be created based on the experiences of people.

2. Ways to get patients involved: Invest in programs that teach communities how to use digital tools. This will help patients use remote care.

3. Structures for support from institutions: Have technical support staff, easy-to-read guides, and medical rules for using telemedicine to treat long-term illnesses.

4. Fair implementation: Give support to people with poor digital skills. This will stop telemedicine from making healthcare inequalities worse.

The results are also relevant to clinical practice:

1. Use experience: Programs that match experienced doctors with those just starting out might help them become more confident and adopt telemedicine faster.

2. Build on views of how good it is: Collecting and sharing data that shows telemedicine's medical benefits can increase provider confidence.

3. Fix training gaps: Institutions should find where skills are lacking and develop skills in those areas.

Limitations of the study

The results of this work should be seen with its limits in mind:

1. The cross-sectional design prevented us from knowing the cause and results. The link between experience and belief in oneself might be backward (more sure workers stay longer) or mixed up with things that we did not measure.

2. Because we used surveys, answers about beliefs, how well something seems to work, and how often it is used might be wrong because people want to look good or cannot remember well. We could not check the records to determine how often the items were used.

3. Our group was mostly physicians, so it is difficult to say if these results apply to all primary care teams. The results might not be the same, as nurses or other health workers were more involved.

4. The results were obtained from one place (Abha City) and one health system (Saudi Arabian PHCs). They might not be the same in other places with different health setups, cultures, or rules regarding telemedicine.

5. We did not gather results from patients; therefore, we do not know how a provider's beliefs affect patient health. Being sure of oneself does not always mean better patient results if the decisions are not good.

6. We did not measure support from the organization, workload, paperwork, how people feel about technology, or how much risk they will take. This could change how we see the connections in our data.

Recommendations for future research

1. Longitudinal Studies: Track how provider confidence changes over time and how it predicts continued telemedicine use and patient results.

2. Qualitative Data: Conduct interviews and focus groups to explore practitioner views on obstacles, supporting factors, and how experience relates to confidence.

3. Patient Outcome Studies: Assess the link between provider confidence and patient results (e.g., blood sugar control and blood pressure) to understand the clinical importance of confidence.

4. Multidisciplinary Groups: Include nurses, pharmacists, and other professionals to understand telemedicine use across primary care teams.

5. Organizational Factors: Study how institutional support, documentation, workload, and culture affect provider confidence regardless of individual experience.

6. Cost Analysis: Compare the costs of telemedicine-supported chronic care with traditional in-person care, based on provider confidence.

7. Equity Research: Study how telemedicine affects care for vulnerable groups and ways to prevent digital health from increasing inequities.

Conclusion

Telemedicine is common in Abha City's primary healthcare centers for managing long-term diseases such as diabetes and high blood pressure. A health care provider's belief in telemedicine for chronic care relies on years of work and how helpful they think it is. Even with known advantages, issues such as training and patient involvement still exist. These issues can prevent telemedicine from reaching its full potential in primary care.

The results show that for digital health to work under Vision 2030, infrastructure investment, workforce growth, patient involvement, and support are required. Future changes in Saudi Arabia's healthcare must focus on provider training, patient education, and technology.

For Abha City's primary healthcare centers, steps should be taken to fix training gaps, improve patient participation, and build on clinical results through tracking and input. These actions, along with Vision 2030, can help telemedicine improve access, quality, and fairness in long-term disease management in the area.

Funding

None.

Data Access Statement

Research data supporting this publication are available upon request.

Conflict of interest

The authors declare that they have no affiliations with or involvement in any organization or entity with any financial interest in the subject matter or materials discussed in this manuscript.

Author details

Majed Mohammed Al Saleh[1], Faisal Suheam B Alamri[1], Abdulaziz Mari Ali AlQahtani[1], Abdullah Mohammed Alrofydi[1], Hassan Adel Hassan Alasiri[1], Bandar A Alasmari[1], Abdullah Saeed[1]

1. Aseer Health Cluster, Abha, Saudi Arabia

References

1. Saeedi P, Salpea P. Diabetes and its complications-A review. J Diabetes Res. 2021;2021:9989857.

2. Cianciaruso B, Caputo S, Testa A. The epidemiology of chronic diseases and their burden. Eur J Public Health. 2022;32(Suppl 1):i1.

3. Vedavati S, Landi F, Lipton RB. Integration of telemedicine into primary care for chronic disease management. Prim Care. 2023;50(4):495–510.

4. Mars Z, Scott RE. Global telehealth: Definition, roles, benefits and challenges. WHO Telehealth Report. 2022. Available at: https://www.who.int/publications/i/item/9789240061408

5. Vision S. 2030. Healthcare Transformation Strategy 2030. Riyadh: Saudi Ministry of Vision, Economy and Planning; 2020.

6. Suleiman AK. Transforming healthcare: saudi Arabia's Vision 2030 and the digital health revolution. Int J Health Sci (Qassim). 2025;19(1):88–104. https://doi.org/10.1080/20523211.2024.2449051

7. Al-Rajhi MA, Al-Khudairi AS, Al-Khudairi SA. Vision 2030 and healthcare transformation in Saudi Arabia. Cureus. 2023;15(6):e39876.

8. Al-Kahtani N, Alshahrani S, Alqahtani N. Digital health transformation readiness: assessing healthcare facilities in Eastern Province, Saudi Arabia. Front Public Health. 2022;10:984346.

9. Mihevc ME, Vidmar G, Boskovic M, Ovsenik A, Marš T. Managing cardiovascular risk factors with telemedicine in primary care: a systematic review and meta-analysis. BMC Cardiovasc Disord. 2025;25(1):143.

10. Maaitah W, Abdelhay O, Tourkmani A, Azzeh M, Abu-Soud MS, Atiani S. Telemedicine interventions in type 2 diabetes management: a protocol for systematic review and network meta-analysis. BMJ Open. 2024;14(2):78100. https://doi.org/10.1136/bmjopen-2023-078100

11. Tan SH, Musa G, Hew JJ, Wong LW, Lin B. Factors influencing telemedicine adoption among physicians: extended Technology Acceptance Model perspective. Digit Health. 2024;10:20552076241257050. https://doi.org/10.1177/20552076241257050

12. Venkatesh V, Morris MG, Davis GB, Davis FD. User acceptance of information technology: toward a unified view. Manage Inf Syst Q. 2003;27(3):425–78. https://doi.org/10.2307/30036540

13. Khosravi P, Ghapanchi AH. Investigating the effectiveness of technologies applied to assist seniors in fall detection systems: a systematic literature review. Multimodal Technol Interact. 2016;1(2):8. https://doi.org/10.1016/j.ijmedinf.2015.05.014

14. Almalki ZS, Imam MT, Abou Chahin NF, ALSammak NS, Entabli SM, Alhammad SK, et al. Access and disparities in the use of telemedicine among patients with chronic conditions in Saudi Arabia. J Multidiscip Healthc. 2023;16:3789–98. https://doi.org/10.2147/JMDH.S433653

15. Hollander JE, Carr BG. Virtually Perfect? Telemedicine for Covid-19. N Engl J Med. 2020;382(18):1679–81. https://doi.org/10.1056/NEJMp2003539

16. Acharya S, Schroeder GD, Beck KL, et al. Self-measured blood pressure-guided pharmacotherapy and telemedicine hypertension management in the United States: a systematic review and meta-analysis. Hypertension. 2024;81(3):512–23. https://doi.org/10.1161/HYPERTENSIONAHA.123.22109

17. López MA, Delgado-Hurtado JL, Montoya T, Soto-Gálvez ME. Telemedicine consultation quality

and patient satisfaction in chronic disease management. Telemed E-Health. 2024;30(5):1251–64.

18. Geng Z, Bai G, Zhang L, Cui Y. Patient satisfaction with telemedicine services: a systematic review and meta-analysis. Int J Environ Res Public Health. 2023;20(3):1827.

19. Donovan MB, Geissler SS, Smith A. Understanding telemedicine patient satisfaction: a qualitative study. J Am Board Fam Med. 2023;36(4):493–503.

20. Tarhini A, Hone K, Liu X. Factors affecting the adoption and usage of open source software in organizations. Technol Forecast Soc Change. 2015;96:237–45.

21. National Transformation Program. Saudi Arabia's Health Sector Transformation Program 2030. Riyadh: National Transformation Unit; 2015.

22. Al-Nozha OM, Alamoud AS, AlBuainain HM. Key aspects of the Saudi healthcare system reform and Vision 2030. Saudi J Health Sci. 2024;13(1):109–26.

23. Schürmann F, Winter V, Mayer H. Factors influencing telemedicine adoption among healthcare providers: expanded vulnerability framework. J Med Internet Res. 2025;27(1):e54777. https://doi.org/10.2196/54777

24. Abbas MW, Khan M, Ahmed S. Facilitators and barriers in acceptance of telemedicine services: systematic review and meta-analysis. SAGE Open Nurs. 2024;10:23779608241266413.

25. Lopez AM, Lam K, Thota R. Barriers and facilitators to telemedicine: can you hear me now? Am Soc Clin Oncol Educ Book. 2021;41(41):25-36. https://doi.org/10.1200/EDBK_320827

26. Hayavi-Haghighi MH, Hadian E, Hassankhani H. Barriers to widespread adoption of telehealth from physicians' perspective: a comprehensive cross-sectional study. PLoS One. 2025;20(7):327095. https://doi.org/10.1371/journal.pone.0327095

27. Haleem A, Javaid M, Singh RP, Suman R. Telemedicine for healthcare: capabilities, features, barriers, and applications. Sens Int. 2021;2:100117. https://doi.org/10.1016/j.sintl.2021.100117

28. Bandura A. Self-efficacy: the Exercise of Control. New York, NY: W.H. Freeman; 1997.

29. Pannucci CJ, Wilkins EG. Identifying and avoiding bias in research. Plast Reconstr Surg. 2010;126(2):619–25. https://doi.org/10.1097/PRS.0b013e3181de24bc

30. Polit DF, Beck CT. Nursing Research: Generating and Assessing Evidence for Nursing Practice. 10th ed. Philadelphia: Wolters Kluwer; 2021.

31. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol. 2008;61(4):344–9. https://doi.org/10.1016/j.jclinepi.2007.11.008