Prospects and Challenges of Telemedicine at the Primary Health Care Level: A Basis for Certification of Providers in Ghana

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Authors' contributions

This work was carried out in collaboration between both authors. Author JA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author DOM managed the analyses and the literature searches of the study. All authors read and approved the final manuscript.

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ABSTRACT

Background: Telemedicine has proven to be one of the modern medical discoveries in recent times, serving as a technological tool to deliver healthcare at a distance and providing medical solutions to remote communities with limited access to quality healthcare. However, the challenges associated with the use of telemedicine in Ghana make it difficult to scale up its application at the Primary Healthcare (PHC) level.
Aim: The aim of the study was to assess the current trends and applications of telemedicine in health care delivery at the primary health care level in Ghana. The study also sought to identify the

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prospects and challenges of telemedicine implementation in Ghana.

Study Design: The study employed both qualitative and quantitative design involving 200 respondents made up of 80 healthcare professionals and 120 patients from four primary healthcare facilities in the Ahafo-Ano North District of the Ashanti region of Ghana

Methods: Survey questionnaire, semi-structured interview guide, and field observations were used to find out the knowledge of providers, capacity, availability of network infrastructure, and challenges of implementing telemedicine at the PHC level from the viewpoint of healthcare 'professionals' and to verify factors that can persuade patients to participate in the implementation of telemedicine. Logistic regression analysis was conducted to estimate the factors influencing 'patients' decision to participate in telemedicine, while the qualitative data were analyzed using thematic content analysis.

Results: The results show that knowledge and education about telemedicine, easy access to specialist care at home, widespread use of mobile telephony, and reduction in travel cost due to telemedicine significantly influence both providers' and patients' participation in telemedicine at the primary healthcare level. The minimum educational level for patients to participate in telemedicine implementation is a primary education (OR = 0.233, p<0.025). On the other hand, inadequate infrastructure, legal issues such as non-certification of providers, reimbursement and confidentiality challenges are some of the factors that impede telemedicine implementation.

Conclusion: The authors suggest that developing countries need to take advantage of the massive use of mobile telephony and embrace telemedicine application to increase access to healthcare in rural areas. Again, certification of care providers is critical for effective application and integration of telemedicine and this should be adaptive to local needs, high internet connectivity and the demands of both healthcare professionals and patients especially in rural communities.

1. INTRODUCTION

Health services delivery from a distance using technology is one of the widely acclaimed innovations in modern times and perhaps the most vibrant emerging technology in current medical practice. Indeed, many scholars have used the terminologies; '"telehealth' or '"telemedicine' or' mobile 'health' to describe the concept. In this study, we use the three terminologies interchangeably in order to avoid confusion that may result from the many meanings ascribed to the same concept. The definition of telemedicine may appear straightforward operationally, yet it is not always clear to define it the same way in any situation. Strehle and Shabde [1] provide a precise meaning to the concept of telemedicine by asserting; it is ""healing at a distance"". This meaning denotes the use of telemedicine to improve patient health outcomes from a distance. Even though many definitions have been provided for telemedicine, and they signify the evolving nature of the phenomenon, this study adopts the definition by the World Health Organization (WHO) because of the research focus;

"The delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities" [2].

The use of telemedicine in healthcare is not a new concept - tracing back to the 19th century [3] and advancing into the 21st century following systematic improvements. The first published account on telemedicine happened in the early years of the 20th century, exemplifying the transmission of electrocardiograph data with the use of telephone lines [4]. The introduction of telemedicine can be credited to its prospects to addressing the uncompromising problems that face the health care industry. Among them are inadequate access, insufficiency of health workforce, cost inflation, healthcare inequalities and poor quality of care in some cases. In contemporary times, telemedicine has received a major boost in its application by the military, the health sector and other sectors of the economy [3]. For instance, telemedicine is used to promote remote access to healthcare especially for those who have difficulties in accessing healthcare providers due to severe workforce shortages or limited health facilities, promote research and continuing education and to

facilitate expert consultations in complex medical conditions [4].

The benefits of telemedicine are much more appreciated in developing countries where access to health care is problematic because of weak health systems [4]. Other benefits of telemedicine include reduction in cost, time saving for traveling or commuting to health facilities and also provision of a platform for continuous education for service providers. Again, patients who are not comfortable with face to face encounter with doctors feel better as it prevents the 'white coat syndrome'. That is why telemedicine, which has proven to increase access to healthcare for people living in underserved or rural areas, has globally been accepted as a way to help meet health needs and overall health outcomes of populations [5,6]. It is on this premise that the World Health Organization (WHO) established the Global Observatory for e-health (GOe) to review the benefits of telemedicine and other aspects of electronic health to healthcare in member countries at the national, regional, and global levels [4]. The GOe is to have a special lens on how e-health is being implemented especially in rural and underserved communities with considerable emphasis on the referral systems.

In many countries, the services rendered to the patient through the referral system remain the sole responsibility of the referring physician but underpinned by a strong regulatory system to ensure standards and quality of care. However, the consulted doctor can offer some form of advice to the referring doctor who is not obliged to accept or reject the advice [7]. The referring physician has the primary liability and jurisdiction of the patient, thus in the case of telemedicine, a physician takes full responsibility during telemedicine consultation and becomes answerable of any harm caused to the patient - these processes warrant important regulatory and legal issues that should be considered in the implementation of telemedicine. Malaysia for example, has enacted a law on telemedicine that requires all consultants to register under the law and be bound by the accompanying penalty of fine or imprisonment [7]. The USA is on the verge of designing a model to facilitate telemedicine across state borders with strong regulatory framework, and this may serve as a future model for other countries to emulate. Europe is also considering telemedicine implementation with strict regulation of practitioners across its borders [8].

The importance of telemedicine has been practically demonstrated during the unfortunate upsurge of COVID-19 pandemic where changes in the way health services are carried out have become very critical [9].These changes involve how health workers provide services without personal contacts or how they reduce personal contacts with patients to the barest minimum. In the USA, for instance, many states have provided guidance for the maximum use of telemedicine during the COVID-19 to complement the social distancing policy [10]. Indeed, it is anticipated that the use of telemedicine during the COVID-19 pandemic may help reduce exposures to potential infections; minimize the transmission risk of the virus; reduce the use of Personal Protection Equipment (PPE's); reduce the demand on health facilities by patients; and maintain continuity of care. In Ghana, the use of medical drones to facilitate medical supplies has received prominence during the COVID-19 pandemic, thus, demonstrating the importance of e-health in emergency situations.

1.1 The Ghana Case

Both the benefits and challenges associated with the use of telemedicine in the delivery of healthcare, especially in developing countries, have received significant attention from health managers, policy makers and healthcare professionals in the last decade [11]. Ghana has encountered similar experiences with the use of telemedicine; first, the huge benefits of telemedicine to increasing access to healthcare in rural communities; and second, barriers to scaling up telemedicine in rural communities [12]. Certainly, Ghana's case emerged from a weak health system dating back to over three decades of inadequate supply of essential health workers, brain drain of clinical health workers, and inequitable distribution patterns - skewed against rural areas [13,14]. Ghana also experienced weak health infrastructure coupled with poorly accessible roads - all compounding to limit access to healthcare for people living in rural areas [13,15]. With increasing population growth, the health sector started experiencing high demands to expand health service delivery to many areas especially rural and deprived or remote communities due to the huge unmet health needs of the populace. These demands undoubtedly resulted in an increasing need for more health workers with its associated escalating wage bill and high infrastructure cost coupled with budgetary constraints of the health sector [15]. In the area of telemedicine, it is

worthy to note that Ghana's infrastructure for telemedicine is not adequately developed and require huge investments at both the national and community levels of healthcare delivery if Ghana is to achieve its vision of achieving quality, affordable, appropriate, equitable and timely delivery of health services within the framework of the Universal Health Coverage (UHC) [12]. Again, the regulatory framework for telemedicine is not well coordinated and providers applying telemedicine have also not been certified to use the technology. Some scholars argue that since telemedicine is not a profession and it is only a means of delivery of healthcare, there is no need to certify providers who apply the technology [16].

The benefits of using telemedicine to help fill the gaps in the delivery of unmet health needs due to health worker shortages started unfolding, and the Ministry of Health in 2010, launched the first e-health strategy to encourage more innovative and effective ways in the delivery of health services across all sectors of healthcare delivery [12]. The Ghana's e-health strategy is aimed at; expanding the use of mobile telephony for healthcare delivery, increasing specialist services to enhance the health referral system, using telemedicine to support clinical decisions and e-messages to promote public health. The e-health strategy adopts a stepwise approach involving two stages to improve telemedicine application in the country. The first stage of the strategy is to develop a high-speed network or infrastructure to link specialized hospitals and clinics to health centers in rural and peri-urban areas within three years of the e-health strategy implementation. The second stage is the learning stage and it involves building the capacity of health workers in telemedicine and client education to readily accept the concept. The e-health strategy again sets out the basic ICT infrastructure for health facilities to facilitate the implementation of e-health solutions in those facilities. The infrastructure includes; computing equipment, networking devices, multimedia systems, mobile telephony and communication, imaging devices and internet systems [12]. The e-health strategy also sets out appropriate technology for telemedicine which is consistent with the literature. In a systematic review of the telemedicine literature, Bello and Otobo [16] identified digital imaging devices, electronic health records (EHRs), and clinical decision support systems (CDSSs) as some of the technologies entrenched in the sphere of telemedicine.

It could be argued that among the list of infrastructure outlined, in the e-health strategy, mobile technology is one of the highly patronized in Ghana. Indeed, Ghana can boast of the massive use of mobile technology consistent with similar application in many developing countries [17]. Currently, in Ghana, there is an estimated 70% mobile phone penetration, with only about 7% internet access in all households, of which 20% actually use internet [18]. Afarikumah [19] demonstrates that a total of twenty-two donor funded e-health projects using mobile technology have been piloted at the PHC level in Ghana over the years. The telemedicine projects were aimed at equipping health care providers with smart phones to interact with patients via toll free mobile devices and to improve access to specialist care. Yet, with such widespread use of mobile telecommunication, access to the internet remains low – a trend which is likely to affect telemedicine application. Noticeably, Ghana and the whole of Africa use a fixed broadband of about 0.5% penetration, assumed to be the lowest possible of any developing world region [18]. This restricted access in the internet infrastructure makes it difficult to support any web-based applications designed for patients. Computer illiteracy in Ghana is also high among the people in rural communities and local languages are yet to be incorporated onto the web. Clearly, these challenges matter most to the patient living in a rural community who receives healthcare from the PHC facility with anticipation that an effective e-health infrastructure would boost access to specialist care when needed. The PHC in Ghana is designed to provide general health services of preventive, curative, promotive and rehabilitative care to the population. It is the entry point of the health care system with most facilities located within recommended distance of 5 to 10 km apart [20].

The telemedicine pilot projects in Ghana have aided in the deployment of WiMAX, and this has provided better network connectivity with higher data rates operating from longer distances [21]. Yet, telemedicine implementation in Ghana has not sufficiently been examined, and the links have not been adequately explored to inform telemedicine application for overall improvement in patient's healthcare especially in rural and remote communities [21]. Thus raising questions such as: What knowledge do healthcare professionals at the PHC level have in telemedicine? Are health professionals applying telemedicine certified or regulated to ensure standardization and quality? What is network

infrastructure available to support audio-visuals used in telemedicine? What factors influence 'patients' participation in telemedicine? We investigated these questions aimed at assessing the challenges of implementing telemedicine solutions at the PHC level in Ghana as against the prospects of implementing telemedicine using a district with a rural setting.

1.2 Evaluation of Telemedicine Applications

Health evaluation which could be explained as the measurement of a comparative worth of an intervention can be represented in diverse forms. Owens [22] recognizes some of the forms of health evaluation to include; process and impact. While process evaluation is concerned with how, why, and what conditions are needed for an intervention to occur [23], impact evaluation focuses on the efficacy of the intervention [24]. In telemedicine the most common form of evaluation identified in the literature is impact evaluation [25]. In this study, we focused on process evaluation because we intended to identify the barriers to implementation and to offer reasons for the potential of telemedicine application at the PHC level. With respect to the tools for evaluation, the literature presents several evaluation tools used in assessing telemedicine and shows that just a few of the wide range evaluation tools has been used comprehensively [25]. One telemedicine evaluation tool that has widely been used to measure the effectiveness and quality of care is the Model for Assessment of Telemedicine (MAST). The model presents multiple processes for assessing the economic, social, medical and ethical benefits of telemedicine [26]. A scoping review of published studies [27] shows that even though the MAST offers the opportunity to assess a telemedicine application in seven domains, there is the need for more authenticated tools such as the use of mixed methods to assess user experiences and impact on organisations.

1.3 Conceptual Framework

Based on the synthesis of the literature, we adopted a conceptual framework that brings together three key concepts to assess telemedicine application at the PHC level; network infrastructure and equipment; capacity in the form of knowledge and application of telemedicine; and participation during implementation from the perspectives of both providers and clients (See Fig. 1 below).

We explain these concepts using five propositions. First, we argue that the effective implementation of telemedicine is based on the availability of network connectivity, infrastructure and equipment to both health workers and clients. Second, we define capacity (knowledge and skills) needed by providers to be the understanding and application of the technology and national policy or strategy on telemedicine. Third, we define the capacity (knowledge and skills) needed by clients to be knowledge on reimbursements of cost for the use of service as well as ability to operate the technology. Fourth, we assume that the extent of participation during implementation depends on the perception of quality of services and telemedicine coverage from both provider and client. Finally, we propose that the application of telemedicine depends strongly on regulation and ethical issues since regulation has the potential to shape the prospects and address all the challenges likely to affect telemedicine implementation.

2. MATERIALS AND METHODS

2.1 Research Design

This study employed both qualitative and quantitative field research design. The aim was to solicit for in-depth information from respondents and to allow the research team to bring together qualitative and quantitative data to assess the problem under investigation [28,29]. The researchers adopted 'Creswell's four approaches to mixed-method research [30] which include timing, weighting, intergration and theorizing. On timing, the researcher collected the qualitative and quantitative data from one facility at the same time before moving to the next facility. With regards to weighting, the researchers analyzed the results by using the qualitative data to explain the quantitative data in some cases. With regards to integration, the researchers integrated the results from both qualitative and quantitative data in the discussion and offered intepretrations to the results by using the conceptual framework in Fig. 1. In terms of theorising, the researchers used both quantitative and qualitative data to test the propositions made in the conceptual framework.

2.2 Study Area and Population

The study was undertaken at the Ahafo-Ano North District of the Ashanti region with a total population of about 103,936. The district health system is divided into five sub-districts with one district hospital, four health centers, one private

maternity home, one private clinic, and three Community Health Planning Service (CHPS) compounds. The analysis showed that the health centers and the CHPS compounds make up the PHC facilities in the district. The population of the study comprised of health professionals in the selected health centers and patients who attended those facilities. The unit of analysis of the research was participants from the four health centers. For the sake of confidentiality, the facilities are labelled by numbers instead of facility names in this paper.
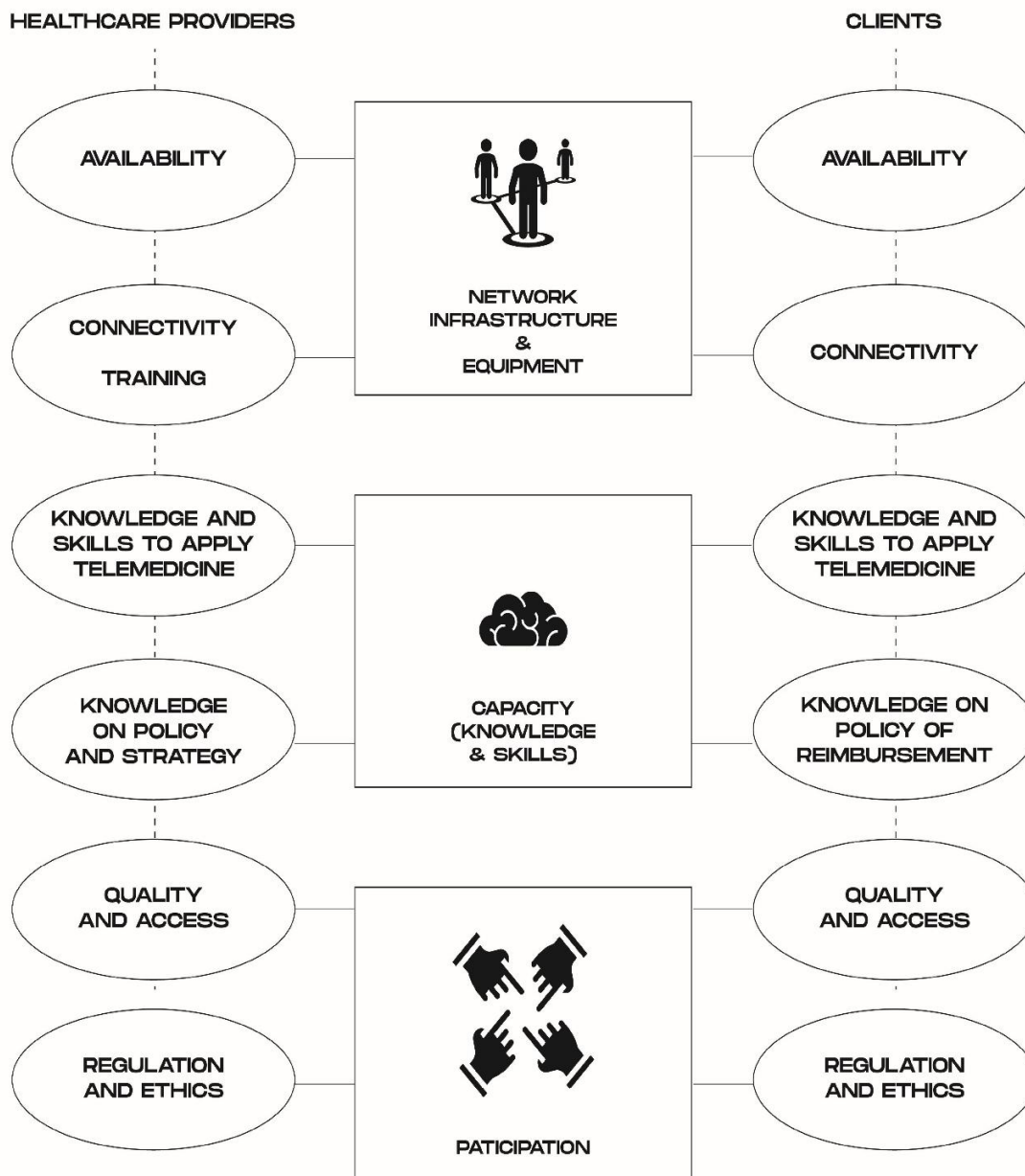

Fig.1. Conceptual framework

2.3 Sampling Techniques

Our aim was to select four facilities for the study. We therefore, wrote the names of the health centers and CHPS compounds on pieces of paper, folded the papers, and conducted simple random sampling to select four facilities for the study. Interestingly, 4 health centers were randomly selected for the study. We then used a convenient sampling technique to select healthcare professionals and patients for the study. First, per the staffing norm of the health centers, we noticed that each health center operates with a maximum of 20 core health workers. We therefore sampled all the 20 health workers per facility to participate in the study given a total of 80 health workers from the four facilities. Second, per the facility records, we realized that each facility has an average of 30 clients or patients attending OPD per day; facility one (31), facility two (30), facility three (30) and facility four (29). We therefore decided to recruit 31 patients from facility one, 30 patients from facility two, 30 patients from facility three and 29 patients from facility four. In all, 120 patients were recruited to participate in the study making a total sample size of 200 respondents. This comprised of 80 healthcare providers and 120 patients. Out of the 80 healthcare providers, 3 senior managers from each facility management team were randomly selected to take part in the interviews: Facility one: Midwife, Medical Assistant and a Health Service Administrator; Facility two: Nurse, Pharmacist and a Medical Assistant; Facility three: Pharmacist, Health Service Administrator and a Midwife; Facility four: Medical Assistant, Health Service Administrator, and a Nurse. Again, one patient from each facility was randomly selected to take part in the interview.

2.4 Data Collection Procedures

Data collection was done through field observation, administering questionnaires and interviews. We adopted well-structured open-ended and closed-ended questions to solicit views on telemedicine from patients and health care providers. The choice of using both open and close-ended questionnaire was based on the flexibility they offer and also to allow for some specific information to be generated [31]. Each facility was assigned a date for the data collection, and these dates were agreed upon with the facility management teams. All the key participants were given prior notice ahead of the dates for the data collection. This made the data collection process less stressful and less time-consuming, although a few changes were made to the meeting times. We used a period of two weeks to collect all the required data. We spent a maximum of three days in each facility. During the survey, healthcare providers and patients were given survey questionnaires to enable the collection of relevant data. The questionnaire had knowledge and understanding, capacity, infrastructure and network, and challenges of telemedicine implementation as core elements expected to be covered by health workers. The questionnaire of patients was designed to find out client participation in telemedicine.

The semi-structured interview guides were designed for senior managers at the health facilities and selected number of patients. This was to find out senior managers' and patients' views on the prospects and challenges associated with telemedicine. The interview guide for providers focused on questions like: Do you have a policy on ICT? Do you conduct training on ICT for your workers? Do you have budget for network infrastructure to support telemedicine? How do you understand telemedicine? Are providers certified to operate telemedicine applications? What are the benefits of telemedicine? What type of telemedicine application are you familiar with? The interview guide for patients focused on challenges associated with telemedicine implementation. However, the interviews occasionally drifted away from the interview guide to give the participants the time and freedom to reflect on other subjects that were important to them. In this regard, the participants were able to communicate at their own pace. The interviews lasted between 28 minutes and one hour. The research team used non-participant observation technique in this study to find out the state of network infrastructure in all the facilities and information recorded as field notes. The research team made their observation by going round all the departments to record the available infrastructure using structured observation approach based on national standards for network infrastructure designated for e-health.

2.5 Data Validity and Reliability

In order to ensure validity and reliability, the questionnaire and semi-structured interview guide were given to three experts to validate all the items against the research questions. The needed modifications were made to make the questionnaire and the interview guide valid. The areas that needed explanation were

subsequently explained to respondents during the course of administering the questionnaires.

2.6 Data Analysis

2.6.1 Quantitative data analysis

Data from the closed and open-ended questionnaire were coded, assigned numbers, and then collated, using a statistical package for social sciences (SPSS) version 25 in order to make relevant deductions and to establish relationships among the study variables. The data were cleaned and validated by comparing the contents of the appropriate hard copies (questionnaire) with coded numbers. To determine 'patients' participation in telemedicine, the analysis first focused on the entire data set, and then highlighted on the frequency distribution of the socio-demographic characteristics of the respondents. The dependent variable was 'patient's participation in the telemedicine concept, whereas the independent or explanatory variables were the factors that will influence participation.

Also, point estimates were computed and presented as means or percentages. Nominal 2-sided p-values were reported with statistical significance defined at p-value <0.05, at 95% confidence interval. In estimating the factors that were likely to determine the decision of a patient to accept to participate in telemedicine, a logistic regression analysis was run setting *alpha* at 0.05 to test for the significance. Inferential comparisons using chi-square of association between the socio-demographic characteristics and the decision to participate in the telemedicine was used to determine which variable derived from the conceptual framework should be included in the regression models for control purposes. The logistic regression is represented as below:

$$Y = \frac{P}{1-P} = \beta_0 + \beta_i X_i + \varepsilon$$

P-Probability of patient participating in Telemedicine
1-P-Probability of patient not participating in Telemedicine

$\frac{P}{1-P}$ -Odd ratio

β_0 -Constant term

β_i -Coefficient of explanatory variables

X_i -Explanatory variables

ε -Error term i.e. an unobserved factor that can affect patient participation in telemedicine.

In performing descriptive analysis, we summarized and displayed in frequency distribution table, the characteristic of the respondents as well as their responses. The questionnaire used holds affirmative comments related to the prospects and challenges of telemedicine concept at the primary healthcare level. Some questions were provided with responses based on the level of agreement scale. This approach gives credence to the frequencies of the responses. The software for the analysis was statistical package for social science research (SPSS) version 25

2.6.2 Qualitative analysis

We used 'Yin's [32] approach to case study analysis to analyze the data collected in the qualitative study. Yin proposes the use of both general strategies and specific strategies in case study analysis and argues that through the analytic steps and techniques, researchers are able to reach the objective truth about the case or the most approximated one. Detailed transcriptions of the recordings were made and categorized under each thematic area. These were; knowledge and understanding, integration and regulation. We then subjected the data collected from the interviews to different levels of categorization and mapping to further clarify roles and perceptions to reveal how the different study units address the themes selected. The above steps were done to ensure that all the evidence gathered, including rival hypotheses or propositions, were attended to and therefore the significant part of case study was addressed.

3. RESULTS AND ANALYSIS

3.1 Demographic Characteristics of Health Professionals

All the 200 questionnaires distributed were retrieved giving 100% response rate. Table 1 provides the demographic characteristics of 80 healthcare providers who participated in the study.

The demographic characteristics are categorized into four main issues; educational background, professional status, work experience and number

of years at current facility. Regarding education of the respondents, 25 providers representing 31.25% of total respondents had acquired first degrees in various fields. This is followed by 22 HND/Diploma holders, representing 27.5% of the respondents and then 21 certificate holders representing 26.25% of respondent, with 7 NVTI holders, representing 8.75% of respondents and the least represented was postgraduate degree holders representing 6.25% of the total respondents. On the whole, the educational status of the respondents appears to be high with 52(65%) of respondents having completed tertiary education. Therefore it is anticipated that the providers had appreciable level of knowledge in their fields of healthcare delivery and were in a position to respond adequately to the survey questionnaire. In terms of professional categorization, Table 1 shows that 42(52.5%) of the respondents were nurses, midwives and health assistants' (enrolled nurses). With regards to respondents experience in healthcare, Table 1 again reveals that, 48(60%) of respondents had been in the health service for less than five years. Concerning, respondents length of service with their current facilities, 45(56.25%) of respondents had been working in their facilities for less than five years; whilst 32(40%) of respondents

answered they have been at their current facilities from 5-10 years.

3.2 Capacity for Implementation of Telemedicine at the PHC Level

This section presents the analysis of data on capacity for implementation of telemedicine at the PHC level. The capacity for telemedicine implementation is characterized into two main areas; health workers knowledge and understanding of telemedicine and its application; availability of network infrastructure to facilitate telemedinice implementation.

3.2.1 Knowledge and understanding of telemedicine

Healthcare 'providers' responses to knowledge and understanding of telemedicine were categorised into two parts. The first part dealt with finding out about healthcare 'professionals' familiarity with telemedicine and its application in healthcare delivery services. The second part dealt with their familiarity with different fields of telemedicine application and integration (see Table 2).

Table 1. Demographic characteristics of health professionals

Variable	Category	Frequency	Percentage
Education	MSc/MBA/MA	5	6.25
	BSc	25	31.25
	HND/Diploma	22	27.50
	Certificate	21	26.25
	NVTI	7	8.75
Professional status	MD	None	Nil
	Medical Assistant /PA	4	5.00
	Pharmacist	2	2.50
	Midwife/Nurse/Health Assistants	42	52.50
	Laboratory technician	8	10.00
	Medicine counter assistant	8	10.00
	Administrator	4	5.00
	Others	12	15.00
Work experience	Less than 5 years	48	60.00
	5-10 years	29	36.25
	11-15 years	2	2.50
	16-20 years	1	1.25
	Above 20 years	None	Nil
Number of years in current facility	Less than 5 years	45	56.25
	5-10 years	32	40.00
	11-15 years	3	3.75

Source: Survey data

Table 2. Health providers' knowledge on telemedicine

Variable	Category	Frequency	Percentage
Have you heard of E-health	Yes	68	85.00
	No	12	15.00
Have you heard of Telemedicine	Yes	64	80.00
	No	16	20.00
Do you embrace Telemedicine concept	Yes	62	77.50
	No	18	22.50
Do you think it should be integrated into the existing Healthcare delivery system	Yes	45	56.25
	No	35	43.75

Source: Survey data

Table 2 shows that majority 68(85%) of the health professionals have heard of e-health before and similarly a higher percentage of respondents representing 64(80%) have substantial knowledge about telemedicine. The survey data also reveal that majority 62(77.5%) of the respondents are willing to embrace the concept. In terms of integration, Table 2, shows that 45 (56%) of respondents are of the view that, telemedicine concept should be integrated into the existing main stream healthcare delivery system. The qualitative data have also shown appreciable levels of knowledge of telemedicine by healthcare professionals. Interestingly, health 'professionals' knowledge and understanding of telemedicine provides an in-depth account of what telemedicine is all about. The data appear to explain telemedicine from four main perspectives; 'healthcare 'delivery' 'technology', 'distance' and 'application in rural communities' as expressed by some healthcare professionals:

"I know of telemedicine, it is the use of ICT to deliver healthcare between two entities separated by distance' {Midwife, Health Center 1}

"*Telemedicine is the use of electronic information to support long-distance clinical healthcare, patient and professional health-related education' {Nurse, Health Center 2}*

"Telemedicine is the use of electronic technology to offer patients care over a distance and possibly across our borders' {Nurse, Health Center 4}

Some of the health professionals went further to explain telemedicine and how it could be delivered as indicated by a pharmacist and a medical assistant in the quotations below:

"Telemedicine is connecting health workers in small communities usually lacking in health equipment and capacity to experts in

city health centers through mobile phones and, in some cases, the internet, wireless and satellite technologies." {Pharmacist, Health Centre 3}

Telemedicine is the provision of medical services to the remote areas through the use of mobile telephony, i.e it enables people in the rural areas to receive care from doctors, nurses and other specialist who are far away from them' {Medical Assistant, Health Center, 4}.

In terms of integration of telemedicine into the main stream health care provision, the qualitative data appear to support the analysis of the quantitative data which indicates that telemedicine is not properly integrated into the main stream healthcare delivery. In the interviews, a Medical Assistant expressed views about how telemedicine integration can expand information sharing to enhance healthcare delivery:

"Telemedicine integration will expand the sharing of information towards improving healthcare delivery' {Medical Assistant, Health Centre 4}

The use of telemedicine to increase access to healthcare delivery was highlighted by respondents in the interviews. Respondents used phrases such as 'address shortage of competent health workers' and 'improve access to healthcare in rural areas' to show the importance of telemedicine in healthcare delivery. Below are some of the views expressed by health professionals:

"Telemedicne integration will help address the shortage of competent health professionals' {Midwife, Health Center 3}

"Geographical barriers and lack of access to healthcare services by remote communities

could be resolved through the integration of telemedicine concept' {Pharmacist, Health Centre 2}

"Using electronic mails or faxes to transmit medical data via telephone lines could be done easily' {Health Service Administrator, Health Center 3}

"It could help improve service delivery by enabling people in rural areas have access to specialist in the urban areas without stress, time and travelling distance and cost' {Medical Assistant, Health Center 1}

3.2.2 Telemedicine applications (skills)

Table 3 indicates the various types of telemedicine applicationin that health workers have an idea and can operate. The survey data revealed that the most commonest application in telemedicine is 'teleconsultations and this is represented by 19(23.75%) of the total health workers surveyed whilst the least applied technology is teledermatology represented by10(12.50%) of respondents.

This data is again represented by a radar in Fig. 2. The figure clearly shows that the commonest telemedicine application known by healthcare providers is teleconsultations. This finding is not surprising because at the PHC level, consultations constitute daily routine taks of providers whilst services such as dermatology are more specialised services that are not commonly found at the PHC level.

3.2.3 Network infrastructure in telemedicine

This section examines the capacity of healthcare providers and availability of network infrastructure at the facilities to ascertain the readiness of both health professionals and systems infrastructure in the implementation of telemedicine at the PHC level. The capacity of health professionals to implement telemedicine was assessed using survey data while the

network infrastructure was evaluated using both survey data and researcher observation techniques. Table 4 provides data from the survey questionnaire.

Table 4 evaluates the capacity of health professionals regarding the use of information, communication and technology tools for telemedicine and the availability of network infrastructure to support the implementation of telemedicine (ICT). First, Table 4 reveals that the capacity of healthcare professionals regarding the use of ICT in delivering medical services is low. Majority 55(68.75%) of the respondents do not have adequate training and knowledge on the use of ICT and a significant portion 65(81.25%) of same respondents disclosed that they do not receive any external support to boost ICT infrastructure. Majority 59(73.75%) of the respondents saw the need to undergo a refresher training to enhance their knowledge in ICT. Second, regarding basic tools, majority 69(86.25%) of the respondents indicated that they do not have adequate basic ICT tools to support telemedicine implementation and 71(88.75%) showed that they do not have quality internet services for telemedicine application.

Table 5 provides information on availability of network infrastructure in the facilities using researcher observation techniques.

The table refers to basic ICT tools and network infrastructure in the facilities. Our observations revealed that most of the basic ICT equipment such as servers, switches, internet bundles, telephones and faxes required for effective deployment of telemedicine were not in existence in many facilities. This finding corroborates the survey data which shows inadequate network infrastructure in the health facilities(see Table 4). Computers and printers were however available in all the facilities though not in large quantities and the reason for the availability of those equipment is perhaps for administrative work and not necessarily for telemedicine deployment.

Table 3. Telemedicine applications

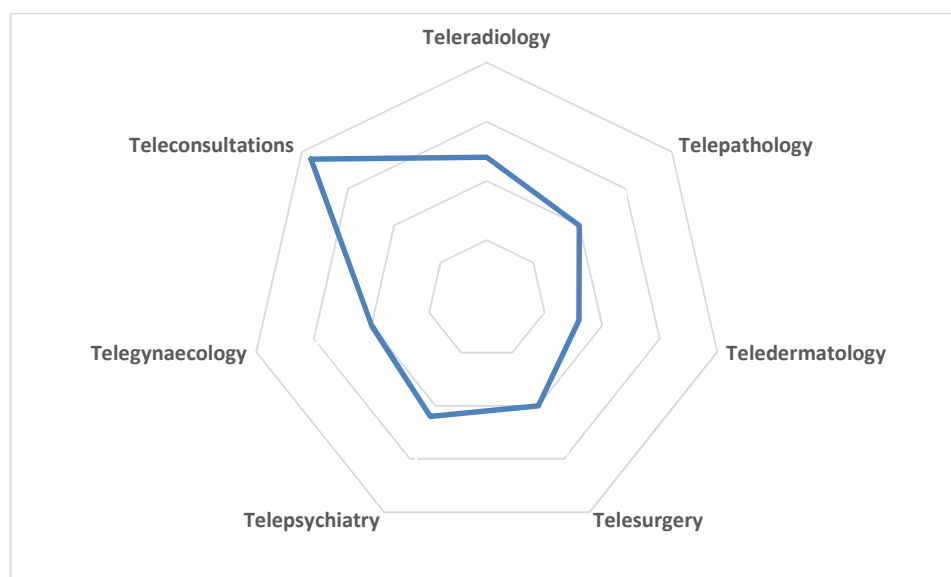| Fields of Telemedicine	Frequency	Percentage
Teleradiology	12	15.00
Telepathology	10	12.50
Teledermatology	8	10.00
Telesurgery	10	12.50
Telepsychiatric	11	13.75
Telegynaecology	10	12.50
Teleconsultations	19	23.75

Source: Survey data

Fig. 2. Types of telemedicine applications known at the PHC level
Source: Field data

Table 4. Telemedicine network infrastructure

Variable	Category	Frequency	Percentage
Does your training adequately equip you to use ICT in delivering healthcare	Yes	25	31.25
	No	55	68.75
Do you receive any external support to boost ICT infrastructure	Yes	15	18.75
	No	65	81.25
Do you think you need refresher training on ICT	Yes	59	73.75
	No	21	26.25
Do you have adequate ICT tools	Yes	11	13.75
	No	69	86.25
Do you have quality internet services/accessibility	Yes	9	11.25
	No	*71*	*88.75*

Source: Survey data

Table 5. ICT infrastructure in healthcare facilities

Equipment/Tools							
Facility	#Computer	#Server	#Switch	#LCD	#Printer	#Router	#Tele/Fax	Number
Health Centre 1	1	1	1	0	1	1	0	5
Health Centre 2	1	0	0	0	1	0	0	2
Health Centre 3	1	0	0	0	1	0	0	2
Health Centre 4	1	0	0	0	1	0	0	2
Total	4	1	1	0	4	1	0	11

Source: Field Notes

3.3 Participation in Telemedicine Implementation - Perspective of Service Providers

This section shows the views expressed by health professional on the implementation challenges of Telemedicine. This was to allow objective reflection of the issues perceived to be a hindrance to the implementation of the telemedicine concept. The issues identified as obstacles included; regulatory framework, confidentiality, liability, ethical, reimbursement and infrastructure. The response from respondents is presented in Table 6.

Table 6 indicates that 41(51.25%) of the respondents held the view that there could be challenges associated with telemedicine implementation. Most of the respondents representing 31.25% percentage attributed the challenges to legal and regulatory issues, while 25% of the respondents attributed the challenges to reimbursement issues. Again, 18.75% of the respondents attributed the challenges of implementation to confidentiality issues as well as slowness in scaling up telemedicine implementation, while 12.25% attribute it to infrastructure and 6.25% to both liability and ethical issues respectively. On legal and regulatory challenges, the findings from the qualitative data support the survey data. The qualitative data provide account of both health providers and patients and the evidence suggest that both providers and patients prefer the certification of providers who are involved in the use of telemedicine solutions as shown in the quotations below.

> "*I believe the nurses were certified to provide one to one care so it is important that they are again certified to provide care using technology' i don't think the use of the so called telemedicine was part of their training'* (Patient, Health Center 2)

> "*Health authorities need to quickly set up a regulatory body to regulate healthcare providers who are already applying telemedicine to deliver healthcare in order to ensure standards and quality'* (Health Services Administrator, Health Centre 1)

> "*The use of telemedicine is emerging strongly, even in private institutions, it is widely accepted so why is it that we do not have any regulatory framework to regulate practitioner?'* (Nurse, Health Centre 4)

> "*I think certification of professionals will help patients so that we do not have quack practitioners because, we may even not know those who are taken care of us…you know this thing is virtual and we cannot see the people involved. Certification of the professionals will help us trust the system and we can fully embrace it'* (Patient, Health Center 4)

On ethics, our aim was to find out if societal believes and cultural values about healthcare delivery could affect telemedicine acceptability because it deals with high technology than the traditional human contact and face to face form of healthcare delivery. Our results did not show that societal believe about healthcare delivery with technology was a challenge as reflected in only 6.25 % of respondents from Table 6.

3.4 Participation in Telemedicine Implementation – Clients' Perspective

In this section, the researchers were trying to find out the demographic relationship of patients or clients' on telemedicine participation. Table 7 therefore provides the demographic characteristics of patients in terms of age, education, occupation and sex and the relationship with telemedicine participation.

Out of the four variables (age, education, occupation and gender), one statistically significant correlation was found when relationship between demographic characteristics of respondents and patient participation variables were explored. This relates to education and participation. Education was highly significant (p < *0.016)* in determining patients participation in telemedicine. These findings support the arguments that educated individuals understand health issues better and are likely to take part in new health interventions and programs that could improve their health status [33,34]. These findings are consistent with the argument that, the educational status of a person can influence the acceptance rate of health programs that promotes healthy life style [33]. This implies that lack or inadequate education can sometimes impede access to health care. To test whether if the level of education has a correlation on participation (access to specialist care and traveling cost), we further disaggregated education into two main levels; primary and secondary. Our intention was to determine the minimum level of education that one needs to be able to participate in

telemedicine. The results are shown in the regression analysis in Table 8.

Table 8 shows the likelihood ratio test conducted on patient's participation of telemedicine at the PHC level. The table shows a strong relationship between independent variables; primary education, access to specialist care at home, reduction in travelling cost and the dependent variable (Patient participation). The findings clearly show that access to specialist care at home with (OR=3.460, p<0.012) reduction in patients travelling cost (OR=3.682, p<0.042) and primary education (OR=0.223, p<0.025) were statistically significant in determining patients participation of telemedicine concept. On primary education, the findings surprisingly show that the minimum education level that one requires to participate in telemedicine is primary education. Therefore, higher education cannot significantly influence telemedicine participation. The reason could probably be attributed to the already widespread use of mobile telephony – where utilisation may not necessarily require higher education.

4. DISCUSSION

The findings of this study have provided evidence to show that there are prospects of telemedicine implementation at the PHC level in Ghana. The prospects are found in areas such as; adequate knowledge and understanding of the concept by providers and the minimum educational levels required of clients to participate in telemedicine implementation. The findings show that majority (85%) of providers have adequate knowledge about e-health whilst 80% have specific knowledge about telemedicine and 77.50% are ready to embrace the concept. Providers for instance demonstrated their knowledge from three thematic areas; healthcare delivery, technology and distance. Indeed the expression of words like 'distance' 'healthcare delivery', 'access' show how providers understand e-health or telemedicine which is clearly in line with the various definitions provided in the literature [1, 2] and actually portrays the emerging nature of the concept.

Nonetheless, it is not only a question of knowledge and understanding but also the skills of both providers and patients on how the technology could be applied as 68.75% of providers in the study indicated that they do not receive adequate training to sufficiently equip them in the application of telemedicine. This finding was also evident in our field observations

as our observations in all the health centres showed that health providers' share patients' records on paper because the skills required to appropriately use the internet and other forms of technology appear complicated for most of the providers. It also appears that some providers were not able to effectively access, analyse, evaluate and communicate patient data from e-health platforms while most of the patients were also not able to access and understand information communicated to them from e-health platforms. Thus, the implementation of telemedicine remains a critical concern in terms of technical capacity of both providers and patients. The results from this study are similar to a cross country assessment of e-learning training for health workers in Ghana and Zambia which revealed inadequate technical capacity, and cultural challenges [35, 36, 37].

Another prospect of telemedicine implementation is the low minimum educational (primary school education) necessary for a client or patient to participate in telemedicine implementation at the PHC level which was evident in our study. A primary educational level of p<0.025 is very significant. This is surprising finding but an encouraging outcome and provides implications for policy and practice in the case of telemedicine implementation in rural communities since most of the people living in rural areas may not have higher education. In terms of practice, this is likely to influence participation of clients/patients in telemedicine at the PHC level and also to increase access to healthcare for people living in rural areas as the literature has alluded to [4].

Certainly, what appears instrumental in the implementation of any new technology is knowledge and understanding of that technology as well as the nature of the technology – either simple or complex. Our observations suggest that application of telemedicine at the PHC level could be centered on mobile technology because of the widespread use of mobile phones by both healthcare providers and clients. All the healthcare providers who participated in the study had access to 'smart' and android phones. This finding is consistent with the literature that shows that despite the huge benefits of telemedicine to healthcare delivery and health outcome [38], the technology has concentrated on telephone communication over the years with a rather limited application in other aspects of technology [38, 39]. This suggests that the use of complex technology in telemedicine could be a challenge at the PHC level, and therefore telemedicine implementation would be most

Table 6. Challenges of telemedicine implementation

Variable	Category	Frequency	Percentage
Do you envisaged any implementation challenges	Yes	39	48.75
	No	41	51.25
Areas identified	Legal/Regulatory	25	31.25
	Confidentiality or slo scale up	15	18.75
	Liability	5	6.25
	Ethical/moral	5	6.25
	Reimbursement	20	25.25
	Infrastructure	10	12.25
Do you know of any TM Center	Yes	35	43.75
	No	45	56.25
Will you embrace any link with Tertiary care hospitals and clinics	Yes	52	65.00
	No	28	25.00

Source: Survey data

Table 7. Patients' demographics and participation in telemedicine

Variable	Patients Part icipation			P-value
	Category	Frequency	Percentage	
Age	15-20	2	1.67	0.400
	21-30	56	46.67	
	31-40	31	25.83	
	40+	31	25.83	
Education	Primary	38	31.67	0.016
	JHS	55	45.83	
	Secondary	27	22.50	
	Tertiary	Nil	0.00	
Occupation	Artisan	35	29.17	0.825
	Civil servants	5	4.17	
	Farming	42	35.00	
	Trading	38	31.67	
Gender	Male	84	70.00	0.325
	Female	36	30.00	

P = Statistical test of significance of difference   χ2 = Pearson chi squared test Mean age=Max age= 55 Min age=19. Source: Survey data

Table 8. Logistic regression estimates on participation

Telemedicine	OR	Std. Err.	Z	P>z	[95% C.	Interval]
Age	1.021	0.041	0.530	0.599	0.944	1.104
Primary	0.223	0.150	-2.240	0.025	0.060	0.830
JHS & SHS (secondary	0.444	0.415	-0.870	0.385	0.071	2.778
Farming	0.557	0.350	-0.930	0.352	0.162	1.909
Artisan	0.615	0.387	-0.770	0.440	0.180	2.108
Civil Servants	1.012	1.226	0.010	0.992	0.094	10.883
Access to Specialist Care at Home	3.460	1.711	2.510	0.012	1.313	9.121
Reduction in Travelling Cost	3.682	2.359	2.030	0.042	1.049	12.928
Constant	0.464	0.773	-0.460	0.645	0.018	12.125
Number of Observation	120.000					
Log likelihood	-65.731					
Prob > chi2	0.001					
Pseudo R^2	0.167					

Source: Survey Data

appropriate using simple technology. Indeed, Johnson et al. [40] definition of telemedicine provides an indication that telemedicine could either involve a simple or complex Information and Communication Technologies (ICT) to offer healthcare and exchange medical information between two points separated by distance. The results of this study also indicate that tele-consultation is the most commonly known telemedicine application at the PHC level.

Even though our field notes indicated that most health care providers in the study had knowledge about the use of computers, they were not strongly familiar with the use of telemedicine application using the internet due to limitations to internet in most of the facilities and lack of other ICT infrastructure. Clearly, using ICT resources to deliver healthcare services to remote areas has become the means of resolving barriers to accessibility in some cases. Its ultimate aim is to provide medical care to prospective patients who are in one way or the other segregated from specialist care due to distance. Telemedicine applications have the potential to improve quality healthcare delivery in remote areas and improve patients' access to specialist care without leaving their vicinity and also avoiding long queues, long waiting times and booking of appointments that may take several weeks and months as a result of congestion at the tertiary hospitals.

The findings of this study show that participation in the implementation of telemedicine is faced with some challenges such as inadequate capacity, poor integration, limited infrastructure, regulation regarding licensure and malpractices. These concerns have been discussed in the literature [11].Indeed, medical liability and concerns about the inadequacies of national laws to protect the privacy and confidentiality of personal medical information, and difficulties with integrating telemedicine into traditional health care system have been discussed as barriers to telemedicine implementation [11]. Again, the study has shown that, financial, technological and organizational challenges are some of the challenges likely to serve as barriers to telemedicine implementation at the PHC level and these findings support the study by Darkwa [41].

The evidence from our study shows that scaling up telemedicine to rural areas has been slow in Ghana despite the vast use of mobile phones in most rural communities as (18.75%) of health providers indicated in the survey. This is consistent with findings from reviews of other

countries e-health strategies following the formation of the Global Observatory on e-health. The literature shows that even though many countries have set up national e-health agencies to promote telemedicine, they have not been able to scale up its application to underserved or rural communities where its application is mostly needed [4]. The reasons assigned to the slow pace in scaling up telemedicine solutions to underserved communities include; licensure, regulatory and legal challenges in many countries, inability to conduct physical examinations by providers, patient privacy concerns, limitations to technology and internet connectivity in certain areas, inappropriate usage of the technology by providers, huge anticipated investment cost, and cultural issues [42, 43].Traditionally, displeasure with the use of any e-health technology has been linked to cultural barriers created between developers of the technology, healthcare providers, patients' and donors because all the stakeholders apart from the developers are not most often part of the initiation of the technology. That is why the prospects of e-health in Ghana largely depend on the type of technology and how both providers and patients culturally embrace it. The question still remains as to what level of quality is needed to justify e-health applications in healthcare?

The qualitative findings of the study show that some patients remain sceptical about the quality of telemedicine because of certification issues. This concern was also evident in the quantitative data where 31.5% of healthcare providers indicated regulatory and legal issues as major challenges. In Ghana, certification of healthcare providers is enshrined in the broader legal and regulatory framework of the Health Professions Regulatory Bodies Act, 2013, Act 857. This framework ensures standardisation and has the potential of increasing patients' confidence to embrace healthcare delivery at all levels. In the case of telemedicine one may argue that there is no need to certify practitioners who use telemedicine because; first, it is not a medical field on its own; and second, it is only a tool that could be applied by already certified healthcare providers [16]. However, certification of providers is important because the traditional training of healthcare providers is more 'hands on' with limited technology especially in low income countries such as Ghana. It could be argued that certification of providers has the potential to address all the inherent challenges in the implementation of telemedicine. Certification which falls within the broader framework of legal and regulation will ensure that the appropriate

network infrastructure and appropriate equipment are available, protocols for privacy and confidentiality of patients are adhered to and adequate capacity of providers in terms of competencies is assured. The researchers recommend lessons from similar practices in some Asian and European countries [7, 8] where certification of telemedicine practitioners is being implemented. Effective regulation can ensure collaboration among different professional groups and within the various sector ministries and agencies involved in e-health.

Even though there has not been comprehensive studies on telemedicine, only a few studies have focused on the evaluation of telemedicine to bring to light the challenges, as against prospects. Our study contributes to this gap by providing a framework to assess both health providers' and clients' needs for telemedicine especially in rural communities [44]. Furthermore, this study found that funding for training of health workers, inappropriate application of technology, maintenance of equipment and poor network infrastructure were some of the challenges likely to affect telemedicine implementation. These findings are consistent with similar challenges experienced during the implementation of telemedicine projects in some parts of Africa [17, 45]. From the analysis, it appears that the successful implementation of telemedicine projects depend on; acceptance of the new technology by both providers and patients; the integration of the technology into health professional education; collaboration between the various professional or stakeholder groups; and the creation of a common platform for exchange of best practices across facilities.

Following the introduction of the national e-Health strategy in Ghana, Yusif and Jeffrey [46] reviewed literature on telemedicine to find that the adoption of Ghana's e-health strategy was bound to face major challenges because of limited health workforce knowledge on e-health as well as network infrastructure issues. Our findings confirm the network infrastructure challenge but contradict the knowledge and understanding gap as detected by Yusif and Jeffrey [46]. It is seemingly clear that though many health facilities especially, those in urban settings have basic ICT infrastructure such as computing equipment, multimedia devices, imaging and printing system, communication and internet system, the infrastructure have not been fully integrated and networked [46]. Therefore

most of the systems operate in 'silos' [47] and thus making it difficult to achieve effective referral of patients using telemedicine application.

5. CONCLUSION

The results show that providers' and patients' knowledge and education about telemedicine, easy access to specialist care at home, wide-spread use of mobile telephony and reduction in travel cost due to telemedicine significantly influence both providers and patients' participation in telemedicine at the primary health care level. On the other hand, inadequate infrastructure, legal issues such as non-certification of practitioners, reimbursement and confidentiality challenges are some of the factors that impede telemedicine implementation. The prospects of implementing telemedicine at the PHC level in developing countries may proof difficult because of the number of challenges that continue to exist. However, the wide spread use of mobile telephony in many developing countries can serve as a big leap for countries to implement telemedicine. This could be the starting point – by identifying mobile telephony as an appropriate technology which is already in use to drive telemedicine implementation at the PHC level to increase access to healthcare in rural areas. The authors argue that telemedicine has the potential to significantly transform healthcare delivery especially in rural communities in Ghana - requiring attention in public health crisis situations such as COVID-19 pandemic when conclusive actions are needed for the delivery of health services. Indeed, this has implications on regulation and reinforces the debate for certification of providers by providing insights into what is practically acceptable by both providers and clients. The authors therefore recommend the need for certification of care providers as a major step towards effective application and integration of telemedicine. This is strongly adaptive to local needs, responsive to emergency situations and the demands of both healthcare professionals and patients especially in rural communities.

CONSENT

The purpose of the study was thoroughly explained to each participant and informed consent signed before the commencement of interviews and administering of survey questionnaire. Copies of the informed consent signed were kept by the research team for documentation purposes. Other relevant

documents submitted by participants were screened and also used to support the research. Participants were asked to read and sign the study information sheet after it had been explained to them again. Participants who agreed to take part in the study were made to complete a personal consent form before the study.

ETHICAL APPROVAL

Permission was solicited from selected facilities and approval accordingly secured before the investigations begun. Respondents were assured of privacy and confidentiality regarding the information they provide.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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