A Framework for Telemedicine Care: A Case of Nandi County – Kenya

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Abstract:- Telemedicine is one of the technologies that use the knowledge of Information Communication Technologies (ICTs) to curb geographical barriers while increasing access to healthcare services. This study aimed developing a framework for telemedicine care in Kenya. This study was done in health facilities in Nandi County. The specific objectives of the study were: To examine emergency healthcare need suitable for telemedicine care in Nandi County -Kenya; to analyze the readiness for telemedicine care and to design a suitable telemedicine care framework. This study was conducted using cross-sectional descriptive survey research design. The study sampled 4 doctors, 59 nurses, 12 clinical officers, 1 pharmacist and 4 pharmaceutical technologists, making it a sample size of 80 from target population of 650 healthcare workers working at the County hospital two sub county hospitals and 2 health centres. Structured questionnaire and a focused group discussion guide were used to collect the data. Pilot testing for the instruments were done to ascertain to improve on face and content validities. The data collected was analyzed using SPSS software version 20 where both descriptive statistics on emergency healthcare need levels for telemedicine care and the readiness for telemedicine care were computed. Analyzed results were presented using table, pie-chart and bar graphs. From the findings it was evident that 77.5% of the respondents supported that specialist referral services are critically needed. With respect to direct patient care services 82.5% of them supports that these services are critical, 53.8% of the respondents accepted that medical education and mentoring is a critical emergency healthcare need. Concerning remote patient monitoring, 45% of the respondents agreed that it is a critical healthcare need. 51.3% of the respondents perceive that Tele-nursing is a critical healthcare need and on Tele-Pharmacy, 54.5% of them perceive that it is critical. 20% of all respondents perceive that Tele-radiology is a critical emergency healthcare need, with less than 20% perceiving that it is least critical.

I. INTRODUCTION

Telemedicine is the use of medical information exchanged from one site to another via electronic communications for the health and education of the patient or healthcare provider and for the purpose of improving patient care, treatment (American Telemedicine Association[ATA],2012). In 2005, the World Health Organization came up with the Global Observatory for eHealth to survey the importance of ICTs in healthcare sector and patients' well-being. According to the survey, telemedicine has proved to be of great benefit to the WHO member states in solving healthcare problems, which includes accessible, cost-effective and high-quality healthcare services. Projected number of Tele-health patients worldwide from 2013 to 2018 shows a progressive trend, the source further forecasts the number of Tele-health patients to grow to around 7 million in 2018 up from 350,000 in 2013. In the United States, there is a renewed emphasis on the potential role of telemedicine in redressing issues of accessibility, cost, and quality of medical care.

According to the classification proposed by Nelson and Staggers,(2014) telemedicine services or programs are grouped into services based on stored images (store and forward) such as Tele-radiology, Tele-histopathology, Tele-dermatology, etc.; home monitoring programs and systems (home-based services) and real-time specialized care (hospital-based services). However, other authors consider other categories, such as the type of service delivered, Tele-consultation, Tele-monitoring, and Tele-radiology, for different specialties. The unique set of healthcare challenges in Africa has made the use of telemedicine suitable, for example ratio of doctors to patient is very low, the location of the hospitals to where patients are living is far, lack of good roads to the villages and other impediments are factors which makes telemedicine a crucial tool to cater for the needs of patients in Africa, (Nelson & Staggers,2014).On the other hand, the use of telemedicine in Africa healthcare has a long way to go before its full benefits could be realized even in the areas in which it's being used or piloted at the moment. Infrastructures like broadband and stable mobile networks are still not stable or not available where needed (Nelson & Staggers, 2014).

The national referral and teaching facilities are the only well-equipped hospitals to implement the concept of telemedicine. KNH in Nairobi City County and MTRH to represent the Western region form this critical block. Kenya's persistent healthcare crisis has been found to have a big professional's distribution problem that has left Nairobi with nearly half of all practising doctors and more than 70 per cent of dentists, a newly released sector report say. According to Kenya Health Workforce Survey report,(2015) it was found that the country has a total of 5,660 practicing medical doctors and 603 dentists, nearly half of whom are based in Nairobi. The informatics community made significant progress in the past twenty years by coming up with systematic approach to health information technology. Achievements like machine-level infrastructure have acted as stepping-stone for creation of clinical decision support system and electronic records. In January 2004, the then president of the United States of America George W. Bush urged the informatics to adopt telemedicine as a solution to healthcare problems (Capello, Naimoli, &Pilli, 2014). In Africa, countries like Ghana and Mali were to launch telemedicine programs by 2016 after a successful trial. The aim of the program was to improve healthcare in the respective countries by ensuring that patients from rural environments receive adequate medical cover amid accessibility difficulty. However, Kenya is also among the African states to launch Mobile Telemedicine Clinic Project. The project will utilize satellite communications to connect physicians operating mobile clinics in remote environments with experienced doctors in urban areas comprising of 50%.The term telemedicine is derived from a combination of Greek word *Tele* that means from a distance and Latin word *mederi* meaning to heal (Medical Dictionary).Initially, some scholars had perception that telemedicine is experimental and futuristic. Nonetheless, the perception has come to stay because it has become a reality. Other than patient care, there are other applications of telemedicine. These applications include; research, education, public health, and administration. Telemedicine is not a well-defined concept. There are several definitions given by various scholars and agencies, which have brought about varied perspectives of approaches in the treatment of the concept. According to the American Telemedicine Association, telemedicine refers to the use of electronic communications and information technologies to provide clinical services when participants are at different locations, (Wootton, 2006). Concisely, telemedicine means healing at a distance. The concept of telemedicine offers various remote healthcare services which includes; remote patient monitoring, special referral services, medical education and mentoring, direct patient care and consumer medical and health information. The stated services shall be delivered through; point-to -point connections, network programs, web-based e-health patient service, direct patient to monitoring center, and health provider to the home connections in Kenya. For telemedicine to be successful, it is important to note that the respective sites are adequately resourced in terms of equipment,

training, staff, telecommunications, and support. Developed countries have already deployed several telemedicine applications. Countries like Australia, Finland, United Kingdom, USA and Taiwan have reported the use of Telemedicine for 15-20 years. The countries have adequate resources that have geared the implementation of Telemedicine technology in the respective states. For instance, in Australia the program was used mainly for remote education. Medical Specialists provide psychiatric medical education via Telemedicine in Western Australia. Other assistance like wound cases was also provided. In developed countries, the use of Telemedicine proved to be cost-effective in the delivery of healthcare services in the US. The progressive implementation of Telemedicine technology in developed countries is because of having enough capital to initiate the program, (ATA, 2012). In addition to that, these countries are ahead in terms of conducting adequate research to solve problems that hinders the delivery of healthcare services. Developing countries are greatly faced with a shortage of healthcare professionals (MacLean et al., 2014). In addition, the few available healthcare professionals are mainly based in major towns of the country (Androuchko & Nakajima, 2004). As a result, people living in rural areas or the underserved communities have limited access to healthcare. The advancement of technology is another contributing factor to the success of implementing Telemedicine in developed countries. Telemedicine uses the knowledge of information and communication technologies to operate thus, developed countries have an added advantage when it comes to experienced personnel in the field of ICTs. Telemedicine can be beneficial for those people living in remote environment and isolated communities. Patients living in those regions can accurately access medical services from specialist via video conferencing. This technology reduces the time that the patients could spend in queues, and the cost of transport in visiting conventional hospitals. Telemedicine is also useful for a specialist and general practitioner because it acts as a communication tool especially when they are available in remote locations. The technology can improve access to healthcare services especially for patients in remote locations because the technology bridges the gap of inaccessibility through real-time monitoring and provision of adequate solutions to the existing problems. Telemedicine can be used as a teaching tool, through which specialists can advise medical staff on handling a certain problematic situation that can be faced. The teaching tool can be a more effective technique since it is faster. Several studies have shown that the use of telemedicine can increase efficiency and reduce the cost of healthcare through reduced travel times, better management of chronic diseases, shared health professional staffing, and fewer or shorter hospital stays in the counties (Bediang et al., 2014). However, human resource should play a critical role on capacity building to ensure the implementation of Telemedicine in the County becomes achievable. Working towards attaining capacity building in the health sector is inevitable. Human resource capacity building through

training of medical practitioners who in turn shall offer civic education to the residents of Nandi County can be made easier through Telemedicine. The initiative shall provide adequate research   required to solve the cases that hinder the delivery of quality healthcare services. In full realization of health sector goals, Telemedicine shall play a critical role in capacity building through training of personnel. The perspective of medical practitioners can be a challenge. Most of the doctors in the Counties are not well conversant with e-medicine technologies. They cannot understand how e-medicine can perform their jobs effectively and efficiently. The County Government should therefore prioritize the implementation of Telemedicine if they are to meet universal healthcare for all, An agenda initiated by President Uhuru Kenyatta among his big four action plans to improve the lives of Kenyans. Providing funding to offset the training sections by the County government shall help improve the human resource capacity building on the use of Telemedicine. The primary aim of the current study is to develop a better telemedicine framework, borrowing knowledge from the Technology Acceptance Model and the Normalization model. In this context, a new telemedicine framework was developed to help in the adoption and the implementation of technology within the health care setting.

II. METHODOLOGY

➢ *Research Design*

Descriptive cross-sectional survey design was used to conduct this study. This research design was suitable for this study since data about emergency healthcare needs and level of readiness favored comprehensive gathering of information on the critical care and readiness use of Telemedicine as a solution to healthcare problems in Nandi County. The information gathered is also generalizable to the entire population in examining emergency healthcare need levels for telemedicine, analyzing the readiness for telemedicine care and to design a suitable telemedicine care framework in Kenya.

➢ *Study Area*

This study was conducted in Health facilities in Nandi County. The County has one county referral hospital and two sub-county hospitals. It also has six health Centres. Attached as an appendix is the Map of Nandi County.

➢ *Target Population*

The target population comprised of healthcare workers that deal directly with patients. The study targeted 650 healthcare workers offering services in the selected health facilities in Nandi County, including managerial staff. The study was conducted in the County referral hospital and the Sub County hospitals. County health management team & Sub county health management team were involved in the study. The cadres dealing directly with patients participated as listed below:

Doctors	29
Pharmacists	10
Pharmaceutical Technologists	33
Clinical Officers	98
Nurses	480
Total	650

Table 1:- Available clinical staff for Nandi County
Source: DHIS, Nandi County-Kenya

➢ *Sampling Procedure*

Simple random sampling was used to give each element of the target population an equal chance of being selected. Stratified random sampling method was used to select managers and staff based on their ranks in the management level. The stratified random sampling technique was used because it does not provide biased grouping and it gives each participant an equal chance to participate and that the strata developed gave manageable groups. Once the grouping was done, a selection was done within each individual subset of the population, with the use of simple random sampling to guarantee representativeness. This sampling technique gave each participant in every strata an equal chance of participating and that the data obtained can be generalized to the entire population.

➢ *Validity and Reliability of the Research Instruments*

Data gathered was organized and checked for validity and consistency. Experts of research in Rongo University were requested to examine both face validity and content validity of the research instruments. Piloting of the research instruments was done in the neighboring Uasin Gishu County, in randomized selected health facilities, to check whether the instruments collect the required information. The research items in the instruments were restructured, based on the outcome of the pilot study in order for the instrument to collect the required information.

Test-retest method was used to examine the reliability of the instruments. Ten of the respondents from two health facilities in Nandi County were given the instruments to fill them, they were then collected and after two weeks the same respondents were given similar instruments to complete. They gave similar information and hence the instruments were reliable.

➢ *Research Instruments and Data Collection Procedures*

The researcher used majorly a questionnaire to collect the data from the respondents. The questionnaire was divided into three sections. Section A collected demographic information of the respondents, section B collected information on emergency health care needs levels for telemedicine care in Kenya and section C collected information on use of telemedicine. For triangulation purposes, a focused group discussion guide was used to get

views from patients seeking services from the selected health facilities.

➢ *Data Analysis and Presentation*

Categorization of data was done before entering the data into the Statistical Package for Social Sciences (SPSS) software version 20 for analysis. Descriptive statistics were computed using SPSS version 20 computer software. Descriptive statistics i.e. frequencies and percentages was used to examine the emergency healthcare need levels for telemedicine and to analyze readiness for telemedicine care. Data analyzed was presented using tables, pie charts and bar graphs.

➢ *Ethical Considerations*

The researcher sought for an introduction letter from Rongo University, a research permit was obtained from NACOSTI regulatory and ethics committee before

conducting the research. The anonymity of the participants was protected by not exposing their names or those of their institutions so that information will not be traced back to individuals or their institutions. The researcher observed confidentiality and privacy of patients' information. The data collection exercise was done by the principal investigator hence consistency.

III. RESULTS

❖ *Emergency Healthcare needs suitable for Telemedicine Care in Nandi County*

This section presents findings on Demographic information of the respondents selected, Level of criticalness of Emergency Health Care Needs suitable for telemedicine care in Nandi County.

➢ *Demographic Information of the Respondents Selected*

Category		Gender of the respondent		
		Male	Female	Total
Age of the respondent	20-30 Years	23	20	43
	31-40 Years	18	5	23
	Above 40 Years	11	3	14
Total		**52**	**28**	**80**

Table 2:- A cross tabulation of the gender of the respondent and age

The findings reported in Table 2 shows a cross tabulation of the gender of all the respondents and their ages. A total of 43 respondents fall between 20 and 30 years; 23 of them fall between 31 and 40 years while 14 respondents have their ages falling above 40 years. Also, 52 males and 28 females participated in the study, giving a total of 80 respondents.

From above data, it is evident that majority of the health workers who shared their views were below 40 years of age. The researcher therefore, concludes that the most productive group form the biggest team of human resource capacity for Nandi County to implement a strong Telemedicine framework.

➢ *Specialist Referral Services and Direct Patient Services Areas as Perceived by the Respondents.*

Category		Specialist referral services					
		SD	D	Not sure	A	SA	Total
Direct patient care services	**SD**	0	0	1	0	2	**3**
	D	0	0	2	0	0	**2**
	Not sure	0	2	1	3	3	**9**
	A	0	5	2	4	5	**16**
	SA	1	1	3	19	26	**50**
Total		**1**	**8**	**9**	**26**	**36**	**80**

Table 3:- A cross tabulation of direct patient care services and specialist referral services emergency healthcare needs suitable for Telemedicine in Nandi County.

From table 3, total of 62 (77.5%) of the respondents supported that specialist referral services are critical with 36 (45%) of them strongly agreeing and 26 (32.5%) agreeing that these needs are critical. However, 9 (11.3%) of the respondents did not support the idea that these services are critical where 8 (10%) disagreed and 1 (1.3%) of the

respondents strongly disagreed. Nine of the respondents too were not sure whether these services are critical or not, representing 11.3%.

With respect to direct patient care services, a total of 66 (82.5%) respondents supports that these services are critical,

where 50 (62.5%) of them strongly agreed that these services are critical and 16 (20%) agreed. Nine respondents (11.3%) were not sure whether these services are critical or not, with five (6.3%) of the respondents perceiving these services are not critical.

Specialist referral services, involves a specialist trying to assist a general medical practitioner in rendering a diagnosis. This service involves a patient interacting with a specialist live, via remote control or may include the transmission of diagnostic videos or images to a specialist. In such instances, the use of technology helps in advancing the diagnosis, thus improving the quality of care among the patients. Specialist referral services have been on the rise due

to increasing health complications among humans (Mars, 2013). In this regard, it becomes critical to develop the best way of improving such services with telemedicine. Based on the review above, 77.5% of the health workers strongly believe that specialist referral services is very critical to the delivery of health care services in the county, therefore supporting Mars argument. Telemedicine has been proven to increase access to timely and cost effective specialty services for patients who need urgent health information.

➤ *Level of criticalness of medical education & mentoring and remote patient monitoring as emergency healthcare needs in Nandi County.*

Category		Medical education and mentoring					
		SD	D	Not sure	A	SA	Total
Remote patient monitoring	**SD**	4	3	0	0	2	**9**
	D	2	3	4	2	1	**12**
	Not sure	0	5	8	7	3	**23**
	A	1	1	1	3	7	**13**
	SA	2	2	1	6	12	**23**
Total		**9**	**14**	**14**	**18**	**25**	**80**

Table 4:- A cross tabulation of Medical education and mentoring and remote patient monitoring emergency healthcare needs in Nandi County.

Table 4 shows the opinions of the respondents towards medical education and mentoring together with remote patient monitoring towards level of their criticalness as emergency healthcare needs in Nandi County. Forty three (53.8%) of the respondents accepted that medical education and mentoring is a critical emergency healthcare need. Fourteen (18.8%) of them were not sure and a total of twenty three (28.8%) disagreed with these needs.

Concerning remote patient monitoring, 36 (45%) respondents agreed that it is a critical healthcare need, 23 (28.8%) were not sure and 21 (26.3%) disagreed with it and hence pointed out that it is least critical.

Remote patient monitoring enhances the capacity for the physicians to treat more patients. As a result of more patients accessing care, it becomes easy to monitor various diseases due to timely diagnosis and proper care services. Another benefit of the telemedicine in the remote patient monitoring is the fact that it offers patients invaluable assurance that someone is watching out for their health and wellbeing on a daily basis. With their data being managed within the healthcare systems, it becomes easier for the physicians to monitor various patients on matters pertaining such activities as when to go for check-ups (Yellowlees et al., 2010).It is evident that, For Nandi County, medical education and mentoring is considered a critical element for the

provision of telemedicine services .54% of the health workers believe that using devices to take vital signs and management of chronic diseases is of high priority. Remote patient monitoring is another key area to be considered when it comes to the designing of the telemedicine framework.45% of the respondents believe that use of devices can be entrenched to improve patient seeking behavior.

Patients were also asked to briefly explain how telemedicine can help health workers attain continuous medical services in Nandi County and the following were the ways they suggested: Through health education conducted regularly; improves on effectiveness, affordability, efficiency and accessibility of the medical services as it is flexible; it is a cost effective and a cheaper way of learning; reduces patients' waiting time and queuing especially during consultations; it facilitates continuity of care to all clients as it offers a daily access to telemedicine and that through research from the internet clients and attendants can be able to have access to current and up-to date information on their areas of practice. The patients are actually in agreement with health workers views that, telemedicine can promote continuity of care, quality and affordable services.

➤ *Shows the responses of the respondents towards Tele-nursing and Tele-pharmacy as emergency healthcare needs in Nandi County*

Category		Tele-nursing					Total
		SD	D	Not sure	A	SA	
Tele-pharmacy	SD	6	1	0	1	1	9
	D	2	3	3	1	1	10
	Not sure	1	3	10	11	0	25
	A	1	3	1	3	4	13
	SA	0	1	3	3	16	23
Total		10	11	17	19	22	80

Table 6:- A cross tabulation of Tele nursing and Tele-pharmacy emergency healthcare needs in Nandi County.

Table 6 shows the respondents' perception towards the level of Tele-nursing and Tele-pharmacy emergency healthcare needs in Nandi County.

From table 6, it is evident that 41 (51.3%) of the respondents perceive that Tele-nursing is a critical healthcare need, 21 (26.3%) of them perceive it negatively that it is less critical while 17 (21.3%) respondents are not sure on the level of Tele-nursing as an emergency healthcare need.

About Tele-pharmacy, 36 (54.5%) of the respondents perceive that it is critical, 19 (23.4%) think that it is less critical and 25 (31.2%) are not aware of the situation of Tele-pharmacy as an emergency healthcare need.Tele-nursing, refers to the use of information technology in the provision of nursing services whenever physical distances exist between patient and nurse, or between any number of nurses. The types of telemedicine can be categorized as real-time or pre-recorded telemedicine. Examples of real time telemedicine include Tele-consultation, Tele-pathology and Tele-dermatology (Wootton, 2006).From the data from health workers who participated in the study, 51% support wootton's argument of Tele-consultation being a priority area.55% of the respondents also believe that Tele-pharmacy is critical to the delivery of services through provision of remote dispensing sites. Tele-pharmacy is one way that many people living in remote areas will enjoy especially if they are unable to get basic experts in the pharmacy care thus reducing the cost of traveling to other places for the same services. Patients are also counseled, and drug administering is monitored from time to time thus ensuring the medicines are taking place (Hill, Luptak, Rupper, Bair, Peterson, Dailey & Hicken, 2010).Due to poor terrain in some parts of Nandi County, Hill et al argument that drug administering can easily be monitored is valid and can be accelerated to promote Tele-Pharmacy services.
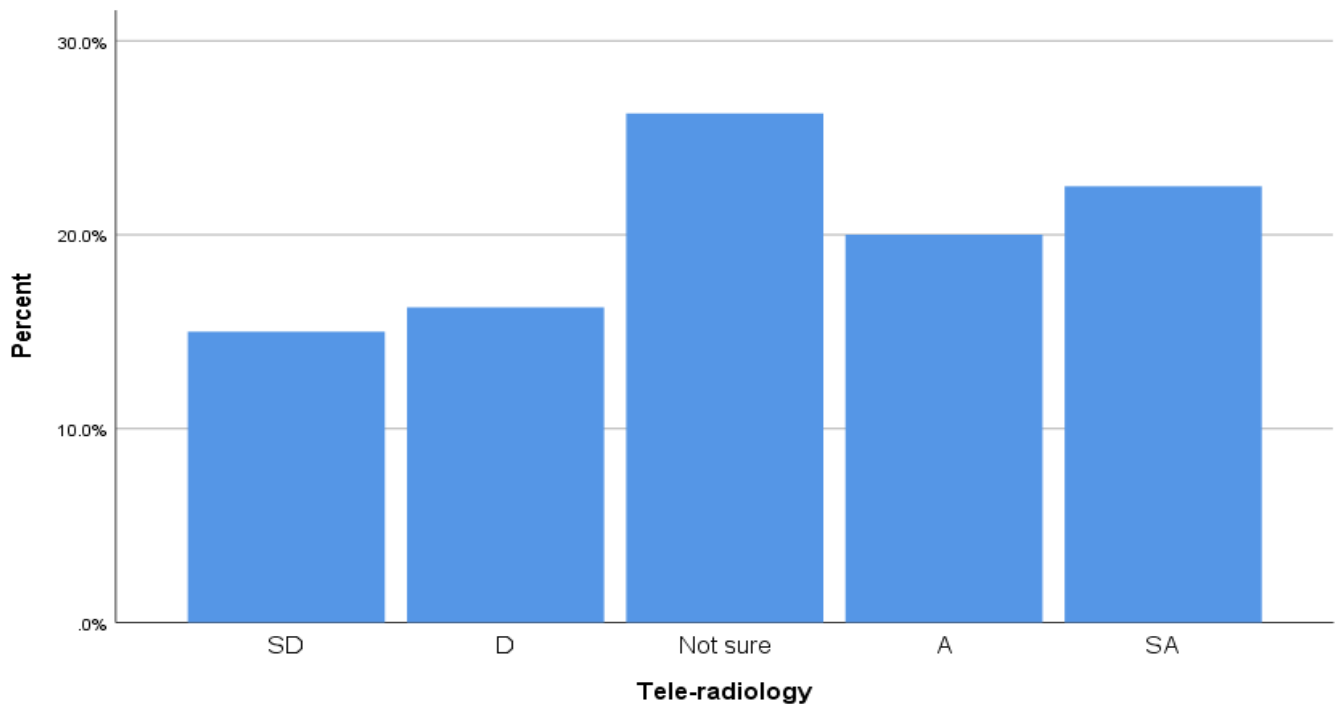

Fig 1:- A bar graph showing the respondents' perception on Tele-radiology as an emergency health care need in Nandi County

It is evident from figure 1 that more than 20% of all respondents perceive that Tele-radiology is a critical emergency healthcare need, with less than 20% perceiving that it is least critical and more than 20% of the respondents are not sure. Though Tele-radiology has continued to impact positively the health care systems by improving diagnosis of various diseases from scanned images, 20% of the respondents believe it is critical when it comes to designing a framework for Telemedicine care in Nandi County. One of the reasons as to why Tele-radiology is unpopular among the health workers is the inadequate number of radiologists in the county. Only 1 radiologist is available at the county referral hospital and the majority of the staff are radiographers. Therefore more specialists are needed to promote Tele-radiology awareness and use. In addition inadequate modern equipment is another challenge within the high volume facilities.

In summary, the most suitable healthcare need in Nandi County is direct patient services where 82.5 % of the respondents perceived that it is a critical health care need. Special referral services and Tele-pharmacy were also rated at 77.5 % and 54.5 % respectively as critical healthcare needs. In conclusion, the county government can plan adequately for the three key areas as discussed above.

IV. SUMMARY

The study sought to establish emergency healthcare need suitable for telemedicine care and to assess the level of readiness on use of telemedicine in Nandi County and design a framework for Nandi County. In the research methodology, the study applied descriptive survey design to gather both qualitative and qualitative data. The target population involved 80 individual health workers and 2 FGDs comprised of 8-12 clients or patients. Stratified and simple random sampling techniques were used for the health workers and FGD guide used for clients seeking health services within Nandi County during the study period. The qualitative data was analyzed using descriptive statistical analysis while qualitative data was analyzed by grouping and summarizing into clusters.

It was found out that; direct patient care services, specialist referral services, Medical education and mentoring, remote patient monitoring, Tele-nursing, Tele-pharmacy and Tele-radiology are critical emergency healthcare need levels for telemedicine care and hence these services are necessary in the health facilities within Nandi County. Information regarding these services was gathered from all the respondents and most of them rated that these services are critical. They strongly agreed and some agreed with the developed items concerning these services. The most suitable healthcare need in Nandi County is direct patient services where 82.5 % of the respondents perceived that it is a critical health care need. Special referral services and Tele-Pharmacy

were also rated at 77.5 % and 54.5 % respectively as critical healthcare needs.

The respondents who were mainly clinical staff, were also asked to briefly explain how telemedicine can help health workers attain continuous medical services in Nandi County and they suggested that it improves on effectiveness, affordability, efficiency and accessibility of the medical services as it is flexible and time saving. They also argued that telemedicine facilitates continuity of care to all clients as it offers a daily access to telemedicine and through research, clients and attendants can be able to have access to current and up-to date information on their areas of practice. Based on these findings, telemedicine therefore is a necessary service within all Facilities in Nandi County.

V. CONCLUSIONS

➢ *Based on the findings of the study, the following are the conclusions drawn:*

First, through the research, it has been demonstrated that, the data obtained on emergency healthcare need suitable for telemedicine care and the level of readiness on use of telemedicine in Nandi County indicate that these services: Direct patient care services, specialist referral services, Tele-pharmacy, medical education and mentoring are critical and the county facilities are adequate to sustain it.

RECOMMENDATIONS

Health care needs suitable for Telemedicine implementation are key priority areas for the country. Direct patient care services, specialist referral services, Tele-pharmacy, medical education and mentoring are ranked most popular respectively in that order by the health workers. There is need for the stakeholders to develop a strategic plan for a national roll out.

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