

Use of Information and Communication Technologies in Enhancing Health Care Delivery for HIV Patients in Bamenda Health District, North-West Region of Cameroon

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Abstract

The human population is being traumatized by various diseases every year, despite advances in medical practice and enormous efforts invested in global health. There is a need for ICT in managing health issues such as malaria, diabetes, vaccine-preventable diseases, neglected tropical diseases, Corona virus disease (COVID-19), and human immunodeficiency virus (HIV). The objective of this study was to assess the use of information and communication technologies (ICT) in enhancing healthcare delivery for HIV patients in Bamenda Health District. Methods: It was a descriptive-analytic cross-sectional study consisting of 388 participants recruited consecutively amongst health personnel and HIV patients from public and private health institutions involved in HIV management. The data was analyzed using the Statistical package of social sciences (SPSS vs 23.0). Data on socio-demographic variables, the use of ICT tools, and associated challenges were collected using structured questionnaires. Descriptive statistics was used to determine proportions and statistical analysis was set at $p < 0.001$. Results: Of the 263 HIV participants, 60 (22.8%) agreed that a computer was used during the consultation at the local hospital, and 150 (57.0%) reported receiving a text message or alert on when to take their medication. One hundred and nine (41.5%) participants

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utilized ICT to notify healthcare professionals when supplies were needed while 120 (45.6%) used at least one ICT tool to inform healthcare providers when need arose. Of all the ICT tool 39.3% personnel attested that they use computers. Most (97.6%) of the healthcare personnel utilized ICT tools to provide care to HIV clients, but 52 (41.6%) still used papers or logbook associated with an HIV patient to save or retrieve data. Amongst the ICT tools, Dama was most reported 32 (25.6%) in collecting, storing and retrieving HIV patient data. Excel (32.0%) and DHIS2 tool (22.4%) were the most used ICT tool used for analysis of HIV patient data while SPSS (2.4%) were the least used ICT tool. The healthcare providers were mostly in interested in training DHIS2 tool (23.2%) and Dama (18.4%). The main challenges in using ICT tool by HIV patients were lack of ICT tools (76.8%), poor network (54.4%) and high cost of data bundles. Lack of training in ICT tools (68.8%), no electricity (60.8%) and high cost of data bundle were common challenges faced by healthcare professionals. The utilization of ICT tools was not too encouraging because of several challenges including lack of training on these tools. The Ministry of Public Health should strengthen the implementation of the National Digital Health Strategic Plan through increased investment in ICT infrastructure within health facilities.

Keywords

Use, ICT Tools, HIV Patients, Health Personnel, Health Care Delivery

1. Introduction

Research Background

The rapid advancement of information and communication technologies (ICTs) has transformed healthcare systems globally by improving communication, patient monitoring, disease surveillance, data management, and access to healthcare services [1] [2]. ICT in healthcare, commonly referred to as eHealth or digital health, involves the use of electronic technologies such as computers, mobile phones, internet platforms, electronic medical records, telemedicine, health information systems, and mobile health applications to support healthcare delivery and public health practices [3] [4]. The World Health Organization (WHO) recognizes digital health as an essential component for strengthening health systems and achieving universal health coverage, particularly in low- and middle-income countries where access to healthcare services remains limited [5].

Globally, infectious diseases such as HIV/AIDS, malaria, tuberculosis, and more recently COVID-19 continue to place enormous pressure on healthcare systems [6]. HIV/AIDS remains one of the most significant public health problems, especially in sub-Saharan Africa, which bears the highest burden of the disease worldwide [7]. According to UNAIDS, millions of people continue to live with HIV, and achieving sustained access to treatment, adherence monitoring,

counselling, and surveillance remains a major challenge in many developing countries [8]. In response, healthcare systems have increasingly integrated ICT tools to improve HIV prevention, diagnosis, treatment, monitoring, and patient follow-up [9] [10].

ICT tools have demonstrated significant benefits in healthcare delivery. Electronic medical records improve data storage, retrieval, confidentiality, and continuity of care [11]. Telemedicine enables remote consultations between healthcare professionals and patients, especially in underserved and rural communities [9]. Mobile health technologies such as text messaging, mobile applications, and social media platforms have also improved communication between healthcare providers and patients by supporting appointment reminders, medication adherence, health education, and psychosocial support [12] [13]. Furthermore, district health information systems such as DHIS2 have strengthened disease surveillance, reporting, monitoring, and decision-making processes within healthcare institutions [14].

In developed countries, digital health systems have contributed immensely to improving the quality, efficiency, accessibility, and coordination of healthcare services [15]. However, in many developing countries, including Cameroon, the implementation and utilization of ICT tools remain limited by poor infrastructure, unstable electricity supply, high internet costs, inadequate technical support, poor network connectivity, and insufficient ICT literacy among healthcare providers and patients [16] [17]. These limitations continue to affect healthcare delivery and health information management.

Cameroon has made progress toward integrating ICT into healthcare delivery through the adoption of the National Digital Health Strategic Plan and the implementation of health information platforms such as DHIS2 [18]. In HIV care, ICT tools have increasingly been introduced to support data management, disease surveillance, patient monitoring, and communication between healthcare providers and patients [19]. Despite these efforts, evidence suggests that the level of ICT utilization in HIV healthcare delivery remains suboptimal in several health districts, particularly in resource-limited settings [20].

The Bamenda Health District is one of the health districts in Cameroon with a substantial HIV burden and increasing demand for quality healthcare services [21]. Understanding the level of ICT utilization in HIV healthcare delivery within this district is essential for improving digital health interventions and strengthening patient care. Although some ICT tools have been introduced into healthcare facilities in the region, limited information exists regarding the extent of their utilization, the challenges faced by healthcare providers and HIV patients, and their contribution to healthcare delivery.

Assessing the use of ICT tools in HIV healthcare delivery is important because effective digital health systems can enhance communication, improve medication adherence, facilitate disease surveillance, strengthen patient monitoring, and support evidence-based decision-making [12] [15]. In addition, identifying

barriers to ICT utilization can guide policymakers and healthcare administrators in designing interventions aimed at improving digital health implementation [5] [17].

Therefore, this study aimed to assess the use of information and communication technologies in enhancing healthcare delivery for HIV patients in the Bamenda Health District, North-West Region of Cameroon.

2. Materials and Methods

2.1. Study Area

This study was carried out in the Bamenda Health District to assess the use of ICT tools in enhancing healthcare delivery for HIV patients. The North West Region is found in the western highlands of southern Cameroon. It is bordered to the west by the South West Region, to the south by the West Region, to the east by the Adamawa Region, and to the north by the Federal Republic of Nigeria. Bamenda is the capital of the region. The region comprises 7 divisions: Momo, Ndonga Mantung, Mezam, Bui, Boyo, and Ngoketunjia. There is a 1028-person staff workforce in the region. At the level of the regional delegation, there are 58 health workers. The region has a population of 2,278,503 and a total surface area of 17,300 square kilometres. The region comprises 19 health districts, each engaged in performance-based financing activities. This is one of the 19 health districts in the North West Region. It is located at the heart of the North West Regional Head Quarter, with a population of about 429,419 by 2019 [21]. The Bamenda Health District is comprised of 18 health areas and 48 health facilities. The health areas, facilities, and establishments selected for the study were: Regional Delegation for Public Health North West, Bamenda District Health Service Alakuma (St Mary Soledad), Atuakom (Atuakom IHC), Azire (Azire IHC, Mezam Polyclinic, Regional Hospital), Mulang (Mulang IHC), Ntamulung (PHC Ntamulung), and Nkwen Baptist (Nkwen Baptist IHC) [21].

2.2. Study Design

This was a descriptive analytical cross-sectional study. Data was collected for two months, from April to May 2020. The study used information from HIV-positive individuals and health personnel from selected health facilities.

2.3. Ethical Consideration

Ethical approval was obtained from the institutional review board of the Faculty of Health Sciences at the University of Buea to carry out the study in Bamenda Health District. Administrative clearance was obtained from the Regional Delegate of Public Health for the North-West, the director, general supervisors, and managers/heads of health facilities. For confidentiality, the participants were asked to complete the questionnaires in private consultation rooms and places. Participants were told that they are free to withdraw from participating in the study whenever they feel uncomfortable.

2.4. Data Management and Analysis

The data was keyed in using Epi Info version 7.2 and cleaned in Microsoft Excel. Before, the quantitative data were analyzed using the statistical package for social science (SPSS) which has built-in consistency and validation checks. They were used to enter the data with the questionnaires assigned with serial numbers. The reason for coding and assigning each questionnaire a serial number was to ensure that on the database, one should easily trace the individual responses of participants and to ease verification in areas of uncertainty if they arise. Further consistency, data range, and validation checks were also performed in SPSS version 23.0 (IBM Inc., 2015) to identify invalid codes (data cleaning) with the aid of exploratory statistics. After the data was thoroughly checked for possible errors, the data were analyzed using descriptive statistical tools. The descriptive statistical tools used were frequency counts, percentages, and multiple response sets, which aimed at calculating the summary of findings for each variable where applicable. Finally, findings were presented using frequency distribution tables, thematic tables, bar charts, and pie charts. Statistical analysis was performed at 95% confidence and probability was set at $p < 0.005$.

2.5. Sample Size Determination

The sample size was determined using the Cochran's formula [22],

Where:

- n is the desired sample size (if the target population is $>10,000$);
- z is the standard normal variate for the corresponding confidence level ($z = 1.96$ for 95% CI);
- p is expected value for the proportion of the conditions of interest in the population ($p = 50\%$ was used);
- e is the error margin ($e = 5\%$). Therefore, $n = 385$ individuals.

2.6. Sampling Technique

A consecutive sampling technique was used to select the participants for the study. A technique in which every participant meeting the criteria of inclusion was selected until the required sample size was achieved. That is, the participants recruited for the study were selected following the required criteria until the sample size of 385 was reached. 125 health personnel and 263 HIV patients were considered for the study.

2.7. Study Procedures

The study procedure began with the development of the research protocol, which was closely supervised and submitted with all the necessary documents to the Institutional Review Board (IRB) of the Faculty of Health Sciences, University of Buea, for ethical approval. Authorization was provided by the Dean of the Faculty of Health Sciences, and administrative clearances were obtained from

the Regional Delegate of Public Health for the North West Region, Heads of Health Facilities.

2.8. Data Collection

A total of 388 participants (125 health personnel and 263 HIV patients) were consecutively selected from each health establishment involved in HIV/AIDS management. Data were collected through self-administered questionnaires. Questions were explained to the participants. For HIV patients, the questionnaire was filled out in the presence of the old staff who were familiar with them.

3. Results

3.1. Socio-Demographic Characteristics of the HIV-Positive Participants

Socio-demographic characteristics of the HIV-positive participants were presented on **Table 1**. The mean age was 39.22 ± 10.34 years (mean $\pm$ SD). From the results, 3 (1.2%) were less than 25 years old, 48 (18.3%) were within the age range 25 - 34, 84 (31.9%) were 35 - 44 years old, 86 (32.7%) were 45 - 54 years old, and 42 (16.0%) were above 54 years old. Out of 263 HIV/AIDS clients, 187 (71.1%) are female and 76 (28.9%) are male. Concerning marital status, of 263 HIV/AIDS clients, 68 (25.9%) were single, 166 (63.1%) were married, 5 (1.9%) were divorced, and 24 (9.1%) were widowed. For the level of education of participants, 89 (33.8%) were primary school leavers, 93 (35.4%) have attained a secondary level of education, 45 (17.1%) have attained high school, and 36 (13.7%) had attained tertiary level of education (university). For the occupation, 74 (28.1%) were traders, 59 (22.4%) were farmers, 43 (16.3%) were teachers, 17 (6.5%) were applicants, drivers, 49 (18.7%) were artisans and 4 (1.5%) were health personnel.

Table 1. Distribution of participants (HIV patients) by demographic information.

VARIABLE	CATEGORY	n (%)
Age range (years)	<25	3 (1.2)
	25 - 34	48 (18.3)
	35 - 44	84 (31.9)
	45 - 54	86 (32.7)
	55 and above	42 (16.0)
Sex	Female	187 (71.1)
	Male	76 (28.9)
Marital status	Single	68 (25.9)
	Married	166 (63.1)
	Divorced	5 (1.9)
	Widowed	24 (9.1)

Continued

Level of education	Primary	89 (33.8)
	Secondary	93 (35.4)
	High School	45 (17.1)
	Tertiary Education	36 (13.7)
Occupation	Business	74 (28.1)
	Farmer	59 (22.4)
	Teacher	43 (16.3)
	Unemployed	17 (6.5)
	Driver	17 (6.5)
	Artisan	49 (18.7)
	Health personnel	4 (1.5)

3.2. Sociodemographic Characteristics of Health Personnel

Table 2 summarizes the socio-demographic characteristics of the 125 health personnel enrolled in this study. The mean age was 35.77 ± 7.60 years (mean $\pm$ SD). Out of the 125 health personnel, 4 (3.2%) were less than 25 years of age, 53 (42.4%) were between 25 and 34 years of age, 55 (44.0%) were between 35 and 44 years of age, 10 (8.0%) were between 45 and 54 years of age, and 3 (2.4%) were above 55 years of age. Describing the health personnel by gender, 83 (66.4%) were female. Regarding the distribution of health personnel by occupation or profession, 39 (31.2%) were nurses, followed by 15 (12.0%) data managers, 7 (5.6%) data collectors, 19 (15.2%) community health workers, 12 (9.6%) counsellors, 2 (1.6%) chiefs of centres, 17 (13.6%) laboratory scientists, 8 (6.4%) medical doctors, and 6 (4.8%) support staff. For the distribution of health personnel by level of education, 13 (10.4%) had attained secondary school, 27 (21.6%) had gone to high school, and 84 (67.2%) had attained tertiary education.

Table 2. Distribution of health personnel by demographic information.

VARIABLE	CATEGORY	n (%)
Age range (years)	<25	4 (3.2)
	25 - 34	53 (42.4)
	35 - 44	55 (44.0)
	45 - 54	10 (8.0)
	55 and above	3 (2.4)
	Total	125 (100)
Sex	Male	42 (33.6)
	Female	83 (66.4)
	Total	125 (100)

Continued

Job description	Nurse	39 (31.2)
	Data managers	15 (12.0)
	Data collectors	7 (5.6)
	Community health workers	19 (15.2)
	Counselors	12 (9.6)
	Chiefs of center/Bureau health	2 (1.6)
	Lab scientists	17 (13.6)
	Medical doctors	8 (6.4)
	Support staff	6 (4.8)
	Total	125 (100)
Level of education	Primary	1 (0.8)
	Secondary	13 (10.4)
	High School	27 (21.6)
	Tertiary Education	84 (67.2)
	Total	125 (100)

3.3. Use of ICT Tools to Receive Healthcare

From **Table 3**, 60 (22.8%) of the HIV patients accepted that their hospital used a computer during consultation, while 203 (77.2%) were not familiar with this process. It was noted that 150 (57.0%) of the HIV patients received messages or alarms from ICT tools or healthcare providers on when to take their drugs, while 113 (43.0%) did not. Furthermore, findings showed that 142 (54.0%) of the HIV patients accepted that they used social media such as Facebook, WhatsApp, Instagram, Twitter, and text messages to seek health advice from their healthcare provider, such as for side effects of the drugs.

Table 3. Distribution of HIV patients according to usage of ICT tools to interact or receive care from health care providers.

VARIABLE	YES n (%)	NO n (%)	TOTAL (%)
Local hospital using a computer during consultation	60 (22.8)	203 (77.2)	263 (100)
Use of social media, text messages, or alarm to take a drug	150 (57.0)	113 (43.0)	263 (100)
Use of social media and text messages to seek health advice from Healthcare provider	142 (54.0)	121 (46.0)	263 (100)
Use of social media and text and “Bip-me” messages to notify healthcare providers for the supply or refill of drugs or other materials	109 (41.5)	154 (58.5)	263 (100)

Continued

Use internet for information on HIV prevention and treatment	141 (53.6)	122 (46.4)	263 (100)
Use of ICT tools	120 (45.6)	143 (54.4)	263 (100)

Results equally from **Table 3** showed that 109 (41.5%) of the HIV patients accepted that they inform their healthcare provider through ICT tools when their drugs are about to be finished and for a refill to be done. Finally, 141 (53.6%) of the HIV patients accepted that they browsed the internet to seek information about HIV prevention and treatment. In summary, 45.6% of the HIV patients received part of their healthcare through ICT, while 54.2% did not.

As shown on **Figure 1** below, health workers used computers to collect HIV patients' information during registration and consultation. Out of 125 health personnel, 74 (60.7%) did not use them, while 48 (39.3%) effectively used computers in collecting HIV patient's information during registration and consultation.

Use of computer to collect HIV client information

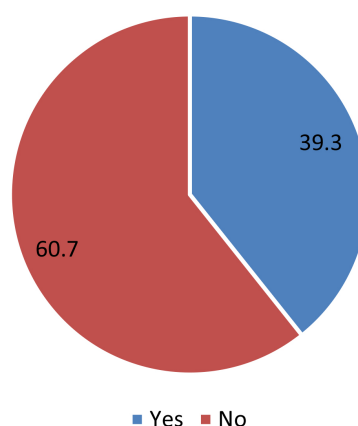


Figure 1. Distribution of health personnel who used computers to collect HIV client information during registration/consultation.

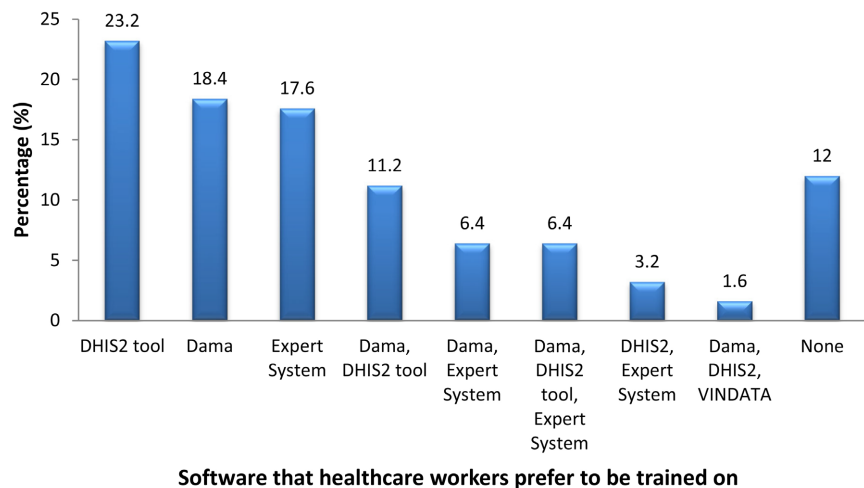
Table 4 presents the use of instruments in collecting, storing, retrieving and analyzing HIV patient information and it was revealed that 52 (41.6%) healthcare used paper or book (files) in collecting, storing and retrieving HIV patient information while 32 (25.6%) of the healthcare providers used Dama in collecting, storing and retrieving HIV patient information. More so, 15 (12.0%) used both Dama and patient files (books or papers in collecting, storing and retrieving HIV patient information. The use of VINADATA (0.8%) DHIS2 tool (3.2%) were the least used instrument.

Amongst the softwares used in analyzing patient data, the most commonly used was EXCEL (32.0%) followed by DHIS2 tool (22.4%). The least commonly used tool were SPSS (2.4%), the combined use of DHIS2 tool and Epi Info (0.8%) and WhatsApp (0.8%).

Table 4. Software/hard copy (papers or book) used by health workers to store/retrieve and analyze HIV client health information.

Software/hard copy (paper or book) used to store/retrieve HIV client health information			Software used in analyzing HIV patient data	
Software	Frequency	Percentage (%)	Software	n (%)
Patient's file	52	41.6	Excel	40 (32.0)
Dama	32	25.6	DHIS2 tool	28 (22.4)
Patient's file and Dama	15	12.0	DHIS2 and Excel	8 (6.4)
DHIS2 tool	4	3.2	Dama	7 (5.6)
DHIS2 tool and Dama	1	0.8	Epi Info	4 (3.2)
Dama and Vindata	1	0.8	Dama and Excel	4 (3.2)
VINDATA	1	0.8	SPSS	3 (2.4)
None	19	15.2	WhatsApp	1 (0.8)
			DHIS2 tool and Epi info	1 (0.8)
Total	125	100	None	29 (23.2)
			Total	125 (100)

Interestingly, most healthcare workers preferred that they should best be trained on DHIS2 tools (23.2%) or Dama (18.4%) separately than a combination of many programs like Dama+DHIS2 tool + expert system (6.4%) or Dama + DHIS2 tool + VINDATA (1.6%) (**Figure 2**).

**Figure 2.** Distribution of participants (Health personnel) on software they prefer to be trained on.

3.4. Challenges Faced When Using ICT Tools in Enhancing Health Care Delivery

Table 5 presents the distribution of participants (HIV patients) on the challenges

faced using ICT tools. Out of the 263 HIV patients enrolled, 202 (76.8%) said a lack of the ability to effectively use ICT tools and devices was the problem. Poor network stood at 143 (54.4%), high cost of credit was at 132 (50.2%), and inadequate training of ICT tool usage was at 118 (44.9%).

Table 5. Distribution of participants (HIV patients) on the challenges they faced using ICT tools.

VARIABLES	YES [n (%)]	NO [n (%)]
Lack of the ability to effectively use ICT tools/devices	202 (76.8)	61 (23.2)
Poor network services	143 (54.4)	120 (45.6)
The high cost of credit or bundle	132 (50.2)	131 (49.9)
Inadequate training in ICT applications	118 (44.9)	148 (55.1)
Unavailability of electricity	94 (35.7)	169 (64.3)
Difficulty in accessing the nearest health center when out of town	93 (35.4)	170 (64.6)
The high cost of gadgets	29 (11.0)	234 (89.0)
Lack of ICT infrastructure	11 (4.2)	252 (95.8)
No internet services	10 (3.8)	253 (96.2)

Healthcare provider also presented with several challenges in using ICT tools on providing healthcare to patients. These challenges were presented on **Table 6** and among which, 86 (68.8%) of the 125 participants stated that using ICT tools was hampered by the lack of application expertise while 76 (60.8%) made reference to the absence of infrastructure and power and 70 (56.0%) revealed that bundles or credit had a high cost. More so, 48 (38.4%) claimed that the one main problem the faced was high price of technological gadgets while 30 (43.5%) of respondents spoke about inadequate networks. The administration's lack of financial support [27 (21.6%)] prohibited them from adopting ICT tools and gadgets and excessive workload (19.2.8%) posed a serious challenge in using ICT tool. Also, 20 (16.0%) participants showed that travelling long distances to the closest ICT facility was posing a barrier to use of ICT tools while 13 (10.4%) stated fear of the ICT application, lack of curiosity 12 (9.6%), low voltage 0.8% and no ICT device provision 7 (10.1) by the administration were challenges faced by healthcare providers.

Table 6. Challenges health surveillance assistants faced using ICT in HIV care.

VARIABLE	YES [n (%)]
Inadequate training in ICT applications	86 (68.8)
Unavailability of electricity	76 (60.8)
Lack of infrastructure	76 (60.8)

Continued

High cost of credit/bundles	70 (56.0)
The high cost of gadgets	48 (38.4)
Poor Network	30 (43.5)
Lack of support from the administration	27 (21.6)
Workload	24 (19.2)
Long-distance to nearest ICT center	20 (16.0)
Lack of interest	13 (10.4)
Fear of ICT applications	12 (9.6)
ICT Gadget not provided	7 (5.6)
Inconsistency of electricity	3 (2.4)
Malfunction software	1 (0.8)
Poor Documentation in hard copy	1 (0.8)
Lack of Maintenance	1 (0.8)
Complex ICT applications	1 (0.8)
Low Voltage	1 (0.8)

4. Discussion

The present study assessed the use of information and communication technologies (ICTs) in enhancing healthcare delivery for HIV patients in the Bamenda Health District of Cameroon. Findings revealed that despite increasing global adoption of digital health technologies, ICT utilization among HIV patients and healthcare personnel in this setting remains suboptimal.

Nevertheless, there is evidence of gradual integration of ICT tools into HIV service delivery.

Only 22.8% of HIV patients reported that computers were used during consultation and registration processes in their healthcare facilities. This finding indicates a relatively low implementation of electronic medical record systems and digital consultation practices in the Bamenda Health District. Similar findings have been reported in many low- and middle-income countries where healthcare institutions continue to rely heavily on paper-based systems because of inadequate infrastructure, poor internet connectivity, unstable electricity supply, and insufficient technical expertise among healthcare workers. Studies conducted in Ethiopia and Nigeria similarly reported limited computer utilization in healthcare settings due to lack of training and poor institutional support [16] [23].

More than half of the HIV patients (57.0%) reported receiving text messages or alarms reminding them to take their medications. This demonstrates the increasing importance of mobile health (mHealth) interventions in HIV care. Mobile phone reminders have been shown to improve medication adherence, clinic attendance, and retention in HIV care programs. A systematic review by Finitsis *et*

al. reported that mobile phone text messaging interventions significantly improve antiretroviral therapy adherence among people living with HIV [12]. Likewise, studies in Kenya and South Africa demonstrated that SMS reminders contributed to improved adherence and viral suppression among HIV patients [13] [24].

The use of social media and internet platforms by HIV patients to seek health information and communicate with healthcare providers observed in this study further highlights the growing relevance of digital communication in healthcare delivery. About 54.0% of respondents used social media platforms such as WhatsApp, Facebook, and text messaging to seek health advice from healthcare providers. This aligns with recent evidence suggesting that digital communication platforms can enhance patient-provider interaction, facilitate remote counselling, and improve continuity of care, especially in resource-limited settings [15]. During the COVID-19 pandemic, telemedicine and social media platforms became essential tools for sustaining HIV care services globally [24].

Among healthcare personnel, 97.6% reported using at least one ICT tool in healthcare delivery. However, only 39.3% used computers during registration and consultation. This discrepancy suggests that although health workers may possess mobile phones or basic ICT devices, the utilization of advanced digital health systems remains limited. Most health workers still relied on hard-copy patient files (41.6%) for storing and retrieving patient information. The persistence of paper-based documentation systems increases the risk of data loss, duplication, delays in reporting, and poor continuity of care. Electronic health records and DHIS2 systems have been associated with improved health information management, timely reporting, and better patient monitoring in HIV programs [14].

The use of DHIS2 among healthcare workers in this study remained relatively low. Only 22.4% reported using DHIS2 for data analysis. This finding is important because DHIS2 is the official national health information management platform adopted by the Ministry of Public Health in Cameroon. Limited utilization may indicate inadequate training opportunities, insufficient institutional support, and limited availability of infrastructure necessary for digital health implementation. Similar barriers have been identified in studies conducted across sub-Saharan Africa, where insufficient capacity building and inadequate digital literacy continue to hinder effective use of health information systems [17].

The major barriers to ICT utilization identified among HIV patients included poor ICT skills, poor network connectivity, high internet costs, inadequate training, and unstable electricity supply. These findings are consistent with previous studies conducted in developing countries. In Uganda, low digital literacy and poor access to smartphones significantly affected the implementation of mobile health interventions among HIV patients [25]. Similarly, unstable electricity and poor internet connectivity remain major obstacles to digital health implementation in many African countries [5].

Among healthcare workers, inadequate training on ICT applications was the most commonly reported challenge. This finding highlights the urgent need for

continuous professional training in digital health technologies. Adequate ICT training improves confidence, competence, and acceptance of digital health systems among healthcare professionals. Furthermore, healthcare institutions require investments in infrastructure such as computers, internet access, stable electricity, and technical support systems to improve digital health adoption.

The findings of this study have important implications for HIV healthcare delivery in Cameroon. Digital health technologies can improve communication between patients and healthcare providers, strengthen adherence monitoring, enhance data management, and facilitate timely reporting and surveillance. Expanding digital health initiatives may contribute significantly to achieving the UNAIDS 95-95-95 targets by improving access to care and retention in HIV treatment programs.

Despite the valuable findings generated by this study, some limitations should be acknowledged. The cross-sectional design limits causal inference between ICT utilization and healthcare outcomes. Additionally, self-reported responses may be subject to recall bias and social desirability bias. The study was also limited to selected facilities within the Bamenda Health District and may not fully represent all regions of Cameroon.

5. Conclusion

The utilization of ICT tools in enhancing healthcare delivery for HIV patients in the Bamenda Health District remains suboptimal despite evidence of gradual integration into HIV care services. While mobile phones, text messaging, social media platforms, and selected digital systems are increasingly being used by both patients and healthcare providers, reliance on paper-based systems and limited use of advanced ICT applications persist. Major barriers identified included inadequate ICT knowledge and training, poor network connectivity, unstable electricity supply, and the high cost of internet and communication services. Strengthening ICT infrastructure, improving digital literacy, and expanding training opportunities are essential to optimize the integration of digital health technologies and improve HIV healthcare delivery outcomes in Cameroon.

6. Recommendations

Based on the findings of this study, the following recommendations are proposed:

6.1. To the Ministry of Public Health

- The Ministry of Public Health should strengthen the implementation of the National Digital Health Strategic Plan through increased investment in ICT infrastructure within health facilities.
- Continuous training programs on DHIS2, electronic medical records, tele-

medicine, and other digital health applications should be organized for healthcare workers.

- Policies promoting integration of digital health technologies into HIV prevention, treatment, and monitoring programs should be reinforced.
- Government should collaborate with telecommunication companies to reduce the cost of internet bundles and improve network coverage in rural and semi-urban areas.

6.2. To Health Facilities and Administrators

- Health facilities should improve access to computers, internet services, and reliable electricity supply to facilitate effective use of ICT tools.
- Hospitals should establish electronic medical record systems to reduce dependence on paper-based documentation.
- Healthcare administrators should encourage regular supervision and technical support for healthcare workers using ICT systems.
- Facilities should promote patient education programs on the use of mobile phones and social media platforms for health communication and adherence reminders.

6.3. To Healthcare Workers

- Healthcare workers should improve their digital literacy and actively participate in ICT related training opportunities.
- Health personnel should encourage HIV patients to utilize mobile health technologies for appointment reminders, adherence support, and health education.
- Healthcare workers should ensure confidentiality and data security when using digital platforms for patient communication.

6.4. To Researchers

- Further studies should evaluate the effectiveness of specific ICT interventions such as telemedicine, SMS reminders, and electronic medical records on HIV treatment outcomes.
- Longitudinal studies should be conducted to assess the long-term impact of ICT utilization on adherence, viral suppression, and retention in HIV care.
- Future research should include multiple regions of Cameroon to improve generalizability of findings.

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Author Contributions

WCA conceived, designed, and provided major contributions and drafted manuscript, LBA & DSN participated in supervision and designing the project and provided major contributions. AJN participated in designing the study questionnaire and supervision of the project. HFM contributed in data analysis, provided major contributions and drafting of the manuscript. All authors have read and approved the final manuscript and agree to be accountable for the quality of the data.

Availability of Data and Materials

The data that support the findings of this study are available from the corresponding author upon reasonable request. Due to privacy and ethical restrictions, the data are not publicly available. Competing interests the authors declare that they have no competing interests.

Conflicts of Interest

The authors declare that they have no competing interest.

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