

Community Pharmacists' use of digital technologies to enhance patient care: A cross-sectional study in Nigeria

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Abstract

Background: Digital technologies are transforming healthcare delivery worldwide, yet little is known about how Community Pharmacists across low- and middle-income countries (LMICs) currently utilize digital technologies(DHTs) to enhance patient care. This study aimed to assess the extent, purpose, perceived benefits, barriers, and determinants of digital technologies adoption among Community Pharmacists in Nigeria.

Method: A cross-sectional survey was conducted among registered Community Pharmacists who attended the 44th Annual National Conference of the Association of Community Pharmacists of Nigeria, held in July 2025. A structured self-administered paper-based questionnaire was administered to 400 consenting participants through convenience sampling. Data were collected and analyzed using the R programming language.**Results:** A total of 360 filled questionnaires were retrieved, representing a response rate of 90%. Overall, commercial digital technologies such as Point of Sales softwares were widely used (88.1%) compared to specialized digital health technologies; Electronic Health Records (EHRs), telepharmacy, mobile health (mHealth) applications, and e-prescription softwares (51.4%). The Community Pharmacists primarily used digital technologies for inventory management (77.5%), with the majority reporting efficient data management (71.7%) and improved customer satisfaction (68.6%) as the primary benefits. However, their use of digital tools was limited by inadequate finances and infrastructure. Furthermore, geographic settlement, patients' digital literacy level, and pharmacy ownership type did not significantly determine the use of DHTs ($p > 0.05$). In contrast, geopolitical zones of the participants played a significant role in the use of DHTs ($p < 0.05$).

Conclusion: Despite the high adoption of digital technologies in the Nigerian community pharmacy practice, the use of specialized DHTs remains limited and uneven across regions, due to inadequate finances, infrastructure and technical capacity. These challenges are systemic and continue to hinder the comprehensive integration of DHTs into community pharmacies and the broader health sector. CPs' readiness to adopt specialized DHTs and the global interest in telepharmacy practice position CPs as avenues for driving change in digital healthcare delivery and presents a strategic opportunity for policymakers, regulatory authorities, and professional bodies to accelerate the integration of DHTs into the community pharmacy practice.

Background

Patient-centeredness has emerged as a core principle of patient care, as individualization and responsiveness in healthcare become increasingly critical for optimal health outcomes [1]. While the concept continues to evolve across the world, patient-centered care remains essential for delivering high-quality health services [2]. Pharmacists, as frontline health professionals, play a crucial role in providing effective drug therapy solutions, with patient care at the center of their practice. These practices include medication therapy management, medication reconciliation, patient counselling, and collaboration with healthcare teams, among many others[3]. Despite community pharmacies being the

most prominent area of pharmacy practice and serving as a primary point of care in Nigeria, there is an over-reliance on medication dispensing rather than on patient-centered services, and this is reflected in the limited counseling, follow-up, and monitoring experienced in these premises [4].

Furthermore, the emergence of COVID-19 and the rise of new and recurring diseases in Nigeria have underscored the necessity for robust patient care in pharmacies and highlighted an unmet gap [5]. Amid rapid technological advancements, digital technologies are transforming patient care by offering more accurate and efficient strategies [6]. These strategies include the use of digital technology and connected devices, such as telepharmacy, mobile health applications, and virtual consultations, to enable the delivery of patient care in a timely and remote manner, providing greater efficiency and convenience to achieve better health outcomes [6, 7]. More advanced solutions leverage technologies like artificial intelligence (AI) and data analytics to optimize medication therapy and support personalized care by rapidly analyzing large volumes of patient data, enabling more accurate identification of drug-drug interactions and prediction of adverse drug reactions, thereby enhancing treatment effectiveness, safety, and patient engagement [8,5,9]. Studies show that increased engagement and patient awareness of their health state, along with informed pharmacist decision-making, occur in community pharmacies when digital health technologies are employed [10]. Interoperable systems enable pharmacists to access patient information more comprehensively, thereby further supporting informed clinical decisions and enhancing patient safety [11]. Clinical decision support and e-dispensing systems have conferred quality, safety, and efficacy on pharmaceutical services [12]. Recent research further reinforces the significant role of digital health technologies and tools in modern times, enhancing treatment adherence, healthcare utilization, and community engagement while expanding the technological infrastructure needed to scale interventions [13]. Despite these apparent advantages, the incorporation of digital technologies into community pharmacy practice in Nigeria has faced significant hurdles, and their full potentials have been underutilized. Some of the hurdles preventing the widespread adoption of digital technologies include limited access to patient records, data quality issues resulting from small sample sizes, and inadequate data availability [14]. Additional impediments include poor infrastructure, operational and logistical challenges, unreliable network coverage, power issues, security concerns, inadequate support & training for healthcare workers, and staffing issues [15]. The high cost of setting up and maintaining these technologies, low digital literacy, and a lack of integration are also common causes of the lag in their adoption in Nigeria, posing a challenge to achieving optimum patient care across Nigerian community pharmacies [16].

This study aimed to assess the extent, purpose, perceived benefits, and barriers of digital technologies adoption among Community Pharmacists in Nigeria, and to identify contextual factors associated with their use in enhancing patient care in Nigeria.

Methods

Study design

A quantitative cross-sectional study design was employed to assess the use of digital technologies by Community Pharmacists (CPs) to enhance patient care in Nigeria.

Study population

The study population consisted of the 6220 registered and practicing CPs in Nigeria (PCN, 2024). These pharmacists are also members of the Association of Community Pharmacists of Nigeria (ACPN).

Study Setting

Nigeria is a sovereign country located in West Africa, bordering the Gulf of Guinea. It is also the most populous country in Africa, with a population of about 196 million and a growth rate of 2.6% per year. The country has a total area of 923,769 sq km (a little more than twice the size of California). Its landmass makes Nigeria the third-largest country in Sub-Saharan Africa. Nigeria is divided into six geopolitical zones: the North-West, North-East, North-Central, South-West, South-East, and South-South. English is the official language in Nigeria, by virtue of the country being a former colony of Britain, with Christianity, Islam, and traditional beliefs being the major religions in the country (Onah, 2020).

Study sampling

We conducted a cross-sectional study among CPs who attended the 44th Annual National Conference in July 2025, using convenience sampling, and recruited all CPs who consented to participate. The theme of the conference was 'Technology Integration and Personalized Care: The future of Community Pharmacy Practice. The conference was hosted in Awka, Anambra State, located in the South-Eastern Region of Nigeria. were recruited.

A representative sample size was determined for the community pharmacist population (6220) using the Rao-soft online software, with a 50% response rate, 10% non-response rate, a 5% margin of error, and 95% confidence interval. A sample size of 362 was obtained. However, we administered 400 questionnaires to accommodate attrition.

Instrument for data collection

The survey instrument is a structured, paper-based questionnaire developed from insights from a literature review [4,6,7,8,9,12,13] and consultation with relevant experts. The questionnaire was validated using face and content validity among eight subject matter experts, all CPs with postgraduate degrees and research experience. First, the eight experts reviewed the draft questionnaire. They provided feedback on the relevance of the items to the study objectives, wording, and identified items that may appear ambiguous to the target participants. The questionnaire was revised based on the feedback received from these experts. Pre-testing of the survey tool was subsequently conducted with 30 participants randomly selected from the target population to assess clarity, consistency, and content coverage. Feedback received did not necessitate any significant amendments. Participants in the pilot testing, some of whom also attended the conference, were not included in the data collection.

Data collection

The questionnaire was administered to 400 CPs at the conference who consented to participate. Participants’ responses were anonymous, and informed consent was obtained before administration.

Ethical consideration

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki for research involving human participants. Ethical approval was obtained from the Lagos University Teaching Hospital Health Research Ethics Committee (Assigned Number: ADM/DSCST/HREC/APP/7938). The study was conducted in compliance with the National Code for Health Research Ethics. All participants were briefed on the study’s objectives, the voluntary nature of their participation, and their right to withdraw at any stage without penalty. Personal identifiers were not collected to maintain anonymity.

Data analysis

The obtained data were coded using R (version 4.5.1) (R Core Team, 2025). Descriptive and inferential statistics were generated at a 95% confidence interval and a significance level of 0.05.

Results

Sociodemographic characteristics of study participants

A total of 360 CPs completed the questionnaire, representing a 90.0% response rate (Table 1). The participants consisted of 57.2% males and 42.8% females, with the largest age group being 30–39 years (36.7%), followed by the 40–49 years age group (23.1%). Participants were distributed across all geopolitical zones of Nigeria, with the South-West (34.3%) and South-South (28.0%) regions being the most represented. More than half of the respondents held dual professional roles as both superintendent pharmacists and pharmacy directors (51.7%), while 36.9% held only the superintendent pharmacist role. About half (50.3%) had over 10 years of experience in community pharmacy practice, and the majority operated independent pharmacies (96.1%) rather than chain pharmacy outlets. In terms of geographic settlement, 62.2% practiced in urban areas, 31.9% in semi-urban areas, and only 5.8% in rural areas. Almost all respondents (98.9%) served a mixed clientele. Regarding clients’ digital literacy, 49.7% described their clients as having a mixed literacy level, while 21.9% and 26.4% served primarily literate and semi-literate clients, respectively.

Table 1: Sociodemographic and professional characteristics of respondents (N = 360).

Characteristics	Variable	Frequency	Percentage (%)
Gender	Male	206	57.2
	Female	154	42.8
Age group (years)	20-29	37	10.3
	30-39	132	36.7
	40-49	83	23.1
	50-59	69	19.2
	≥ 60	39	10.8
Geopolitical zone *	North-central	43	12.4
	North-east	4	1.2
	North-west	5	1.4
	South-east	79	22.8
	South-south	97	28.0
	South-west	119	34.3
Professional role in the pharmacy	Both Superintendent pharmacist and Pharmacist director	186	51.7
	Superintendent pharmacist	133	36.9
	Locum pharmacist	16	4.4
	Full-time pharmacist	15	4.2
	Pharmacist director (only)	10	2.8
Years of experience in community pharmacy practice	Less than a year	5	1.4
	1-5 years	87	24.2
	6-10 years	87	24.2
	11-20 years	102	28.3
	21-30 years	50	13.9
	31+ years	29	8.1
Community pharmacy ownership type	Independent (1-4 branches)	346	96.1
	Chain (≥5 branches)	14	3.9

Pharmacy's geographic settlement type	Urban	224	62.2
	Semi-urban	115	31.9
	Rural	21	5.8
Predominant clientele	Mixed population	356	98.9
	Young population	4	1.1
	Elderly population	0	0.0
Rating of predominant clients' digital literacy level	Mixed	179	49.7
	Semi-literate	95	26.4
	Literate	79	21.9
	Illiterate	7	1.9

* = 13 regional data points were missing and excluded from the analysis

Prevalence of digital technology use

Among the CPs surveyed, the use of digital technologies was relatively low compared to the widespread adoption of point-of-sale (POS) systems (see Figure 1). The use of commercial POS systems was reported by 88.1% of respondents. In contrast, fewer pharmacists reported using DHTs like telepharmacy (including tools for video consultations and remote monitoring) (29.7%), Electronic Health Records (EHRs, 24.4%), e-prescriptions (15.6%), and mobile health applications (8.6%).

Table 2 shows the extent and combination of DHTs reported by the respondents. As shown, nearly half of the respondents (48.6%) reported not using any DHT. However, 31.4% used one type, 13.9% used two, and only 5.3% used three. A small fraction (0.8%) had adopted all four digital health tools assessed (EHRs, e-prescriptions, telepharmacy, and mobile health applications). Among those who reported using only one tool, EHRs (39.8%) and telepharmacy (38.1%) were most common. Combinations of EHRs and telepharmacy (44%) or telepharmacy with e-prescriptions (38%) were the most frequently reported dual DHTs used. Lastly, the majority (63.2%) of those who reported using triple DHTs used a combination of EHRs, telepharmacy, and e-prescriptions.

Table 2: Extent and combination of digital health technologies used by respondents (N = 360).

Number of digital health technologies used	Type of digital technologies used	Frequency (%)
None (n = 175, 48.6%)		175
One (n = 113, 31.4%)	EHRs	45 (39.8)
	Telepharmacy	43 (38.1)
	mHealth Apps	14 (12.4)
	E-prescription	11 (9.7)
Two (n = 50, 13.9%)	EHRs + Telepharmacy	22 (44)
	Telepharmacy + E-prescription	19 (38)
	E-prescription + mHealth Apps	4 (8)
	EHRs + E-prescription	2 (4)
	Telepharmacy + mHealth Apps	2 (4)
	EHRs + mHealth Apps	1 (2)
Three (n = 19, 5.3%)	EHRs + Telepharmacy + E-prescription	12 (63.2)
	Telepharmacy + E-prescription + mHealth Apps	4 (21.1)
	EHRs + Telepharmacy + mHealth Apps	2 (10.5)
	EHRs + E-prescription + mHealth Apps	1 (5.3)
All four (n = 3, 0.8%)	EHRs + Telepharmacy + E-prescription + mHealth Apps	3

Note: EHRs = Electronic Health Records; mHealth Apps = Mobile health applications.

The contextual variations in the use of DHTs

Figure 2 presents the contextual variations in the use of DHTs. As shown, the use of DHTs varied across contexts and locations. CPS operating in urban areas and independent pharmacies exhibited the highest adoption rates (53.1% and 51.4%, respectively), whereas those in rural locations or chain pharmacies had lower rates (47.6% and 50%, respectively). Regarding clients' digital literacy levels, pharmacies serving predominantly digitally literate or illiterate/semi-literate clients had higher adoption rates of DHTs than those serving predominantly mixed populations. No statistically significant differences were observed in DHTs' adoption rates between pharmacies' geographic settlement type, major clients' digital literacy level, or type of pharmacy in operation ($p>0.05$). However, there were statistically significant differences between the adoption of DHTs and geopolitical region, with the Northern regions (comprising north-central, north-east, and north-west zones) and the South-west and South-east zones showing

significantly higher adoption rates (57.7%, 55.5% and 51.5% respectively) compared to the South-east zone (36.7%).

The main purposes of digital technology use in the pharmacies

For pharmacists who reported using any form of digital technology, the primary purposes were operational rather than clinical (see Figure 3). Inventory management (77.5%) was the most common function, followed by reporting and documentation (38.5%). In comparison, functions directly supporting patient care—such as patient counseling (36.9%), medication therapy management (28.1%), and prescription filling (26.7%)—were reported less frequently.

Perceived benefits of using digital technologies in community pharmacy practice

As shown in Figure 4, pharmacists expressed strong positive perceptions of digital technologies. The most frequently reported benefits included more efficient data management (71.7%), improved customer satisfaction (68.6%), and enhanced pharmaceutical care (65.8%). Additionally, reduced medication errors (60.3%) and economic advantages (50.6%) were also common responses.

Main barriers limiting the use of digital technologies in community pharmacy practice

Despite the perceived advantages, substantial barriers limit the broader adoption of digital technologies (see Figure 5). High installation and maintenance costs (63.1%) emerged as the most significant challenge, followed by high internet/data subscription costs (52.5%). About one-third (33.7%) reported a lack of technical know-how and inadequate infrastructure (including unstable power supply, insufficient internet access, and insufficient hardware) as the main barriers limiting the use of digital technologies (64.4%). However, regulatory issues were less commonly reported: only 10.8% saw regulatory restrictions as a barrier, and 13.9% noted a lack of enforcement of the Pharmacy Council of Nigeria's regulations on the use of digital technology.

Support measures required to encourage the integration of digital technologies in community pharmacy practice (N = 360)

When asked about the kind of support that will encourage them to integrate digital technologies to enhance patient care in their pharmacies, most respondents identified cost-subsidy/incentives for digital software and hardware (76.9%), training and capacity-building opportunities (67.5%), and; data security and quality assurance of digital platforms (41.9%) while a few identified more explicit regulatory provisions to promote safe and standardized implementation digital technologies (26.1%). See Figure 6 (panel A). Furthermore, when asked about the types of digital technologies they were willing to adopt in their pharmacies, most expressed willingness to embrace digital prescription and dispensing platforms (71.7%), EHRs (68.6%), and technologies for online consultations and counselling (65.8%). See Figure 6 (panel B).

Discussion

This study examined the utilization of Digital Technologies by Community Pharmacists to enhance patient care in Nigeria. Findings revealed that although digital technologies are used in Nigerian community pharmacies, their use is primarily limited to commercial and administrative purposes rather than for direct patient care. While this represents an important step towards technological modernization in community pharmacy practice in Nigeria, it highlights a widening gap in the adoption of specialized DHTs such as EHRs, telepharmacy, e-prescription platforms, and mobile health (mHealth) applications. This finding contrasts with the goals of the International Pharmaceutical Federation (FIP), which aims to advance pharmacy practice globally towards a digitally integrated, patient-centered pharmaceutical care [19]. Also, this study's finding contrasts with those of community pharmacies in some upper-middle-income and high-income countries like Australia, Canada, England, Malaysia, Saudi Arabia, Scotland, the USA, and Wales, which have fully integrated EHR-linked dispensing systems, electronic prescribing, and virtual medication reviews as routine components of community pharmacy practice [6, 20, 21, 22, 23, 24, 25, 26].

However, the low adoption of digital health tools observed in this study is consistent with findings from previous national studies, which showed that the digitalization of community pharmacies in Nigeria remains low and is mainly limited to business and administrative functions[4,27,28]. Other previous studies in Nigeria have demonstrated a moderate level of adoption of DHTs, such as mobile authentication services (MAS) and telepharmacy [29,30]. Several national studies have also shown that the widespread low adoption of DHTs is not limited to community pharmacies but extends to other Nigerian healthcare institutions nationwide. For example, a study observed an 18–23% adoption rate of digital tools, particularly EHRs, among Nigerian hospitals in a comprehensive review [31]. Another study identified a low level of adoption of ICT applications in healthcare delivery in the Niger Delta region of Nigeria [32]. Similarly, a nationwide assessment of ICT infrastructure across all healthcare tiers revealed that the majority of primary healthcare facilities lacked the necessary ICT resources, necessitating their continued use of paper-based tools, which are error-prone and not cost-effective [33]. Additionally, a study found that Nigerian federal tertiary health institutions were at the beginner digital maturity level (2.0) in telemedicine [34].

Consistent with other studies, CPs in this study reported financial constraints, such as the high cost of installation, software maintenance, and internet subscriptions, a lack of technical expertise, inadequate infrastructure, and insufficient regulatory enforcement, as significant barriers limiting their use of DHTs. The limited implementation of such tools in Nigeria, mirrors trends observed in other low- and middle-income countries (LMICs) especially those in sub-Saharan Africa, where erratic power supply, cost implications (including cost of hardware, software, training facilities and maintenance), poor internet penetration and weak digital health governance frameworks continue to hinder scale-up and sustainability of DHTs in healthcare systems [35, 36, 33, 37,38]. Systematic reviews have demonstrated a low level of technology adoption in South Africa and LMICs and revealed that the lack of facilitating conditions (e.g., infrastructure, training, and finance) was the most cited barrier limiting the use of digital technologies in healthcare systems [37,38,41]. The ease of use, perceived usefulness, prior familiarity with technology, and digital tool training are other determinants identified as significantly influencing the

use of technologies among healthcare workers globally [39, 40, 26]. While some studies have reported the influence of regulatory frameworks on the use of DHTs, most respondents in this study ranked regulatory issues as minor barriers, with only 10.8% and 13.9%, respectively, citing regulatory concerns and the lack of enforcement by the Pharmacy Council of Nigeria as significant barriers to their use of DHTs.

Furthermore, this study found no statistically significant association between CPs' use of DHTs and contextual factors, such as geographic settlement (urban, semi-urban, rural), pharmacy ownership type (independent vs. chain), and the perceived digital literacy level of the predominant patients/clients. In contrast, the use of DHTs was statistically associated with geopolitical zone; however, this association was mainly driven by the low adoption of DHTs in the South-east zone. These findings challenge the conventional expectation that pharmacies in urban regions [with denser population, better infrastructure, and greater economic activity] and those with chain pharmacy outlets would have a distinctive statistical advantage in the use of DHTs over their counterparts in other settings, and suggest that the use of DHTs in Nigerian community pharmacies is, to some extent, not significantly determined by geographic settlement, clients' digital literacy level, or pharmacy ownership type, but rather by systemic infrastructural, financial, and policy-related challenges that significantly impact digitalization efforts nationwide.

Notwithstanding the above findings, participants expressed substantial recognition of the potential advantages of digital technologies. They highlighted improved data management, customer satisfaction, pharmaceutical care, and reduced dispensing errors as key benefits. These perceived benefits align with international evidence indicating that digital health systems can reduce medication errors, enhance adherence monitoring, decrease office workload, facilitate continuity of care, and support pharmaceutical care services, particularly in the management of chronic diseases [29, 33]. While this study's respondents reported reduced workload and dispensing errors, some studies reported that pharmacists believed the use of DHTs, such as telepharmacy, could increase pharmacists' workload and commitment, and also increase the rate of errors in medication dispensing and filling [41]. Similarly, [35] expressed concerns that while the national e-Pharmacy initiative in Ghana appears promising, especially in revolutionizing healthcare accessibility, it could worsen health disparities and result in poor-quality healthcare, particularly in poorly resourced rural areas.

Another important dimension concerns pharmacists' readiness and willingness to adopt emerging DHTs. In this study, CPs expressed a strong willingness to adopt DHTs and identified subsidies for software, training, and capacity building, as well as data security, as key motivators required to encourage them to integrate DHTs into their pharmacy practice. These findings confirm pharmacists' readiness to embrace modernization, validate the investment potential of Nigeria's community pharmacy sector, and indicate a positive attitudinal foundation upon which policy and infrastructure interventions can be built. This is consistent with studies from other parts of the world, including Saudi Arabia, Indonesia, and Jordan, where readiness levels were encouraging but constrained by limited resources and a lack of training [42, 43, 44, 45].

Findings from this study reflect a global consensus that pharmacists are open to digital transformation if supported by adequate education, policy, and incentives. However, such willingness has not always translated into actual or sustained use, reflecting the ‘law of attrition’ in digital health—where enthusiasm does not always result in sustained implementation [46]. Therefore, any intervention to enhance patient care by increasing the adoption of digital health technology should include strategies to address long-term engagement and sustained utilization.

Study strengths and limitations

This study adds to the limited body of evidence on the adoption of digital technologies in community pharmacy practice in sub-Saharan Africa. Its major strengths lie in its nationwide sample, which captured CPs across diverse geographic and practice settings, in the inclusion of both commercial and DHTs, and in the exploration of multiple dimensions of digital technology adoption (e.g., prevalence, purpose, benefits, barriers, motivators, and future readiness).

However, the cross-sectional design of this study, while suitable for descriptive analysis, only permitted the identification of associations rather than causal relationships between barriers and adoption status. Also, the reliance on self-reported data may introduce recall and social desirability bias.

Conclusion

Although digital technologies are increasingly used in community pharmacies in Nigeria, their adoption remains primarily limited to commercial and administrative functions, such as inventory management and general documentation/reporting, rather than direct clinical care. Significant barriers, including a lack of financial resources, inadequate infrastructure, and limited technical capacity, continue to hinder the comprehensive integration of specialized DHTs in community pharmacies in Nigeria. However, CPs expressed their willingness to adopt advanced DHTs, such as digital prescription/dispensing platforms, EHRs, and virtual medication therapy management tools. This readiness, combined with the growing global interest in telepharmacy, presents a strategic opportunity for policymakers, regulatory authorities, and professional bodies to accelerate the integration of DHTs into pharmacy practice through targeted investments, standardized digital health policies, and the development of digital skills within the pharmacy workforce. Thus, with adequate policy support, subsidized software, workforce training, improved digital infrastructure, and the integration of digital health courses into pharmacy curricula, community pharmacists could become key contributors to the digital health transformation and the strengthening of primary patient care in Nigeria and other LMICs.

Recommendation for future research

Future studies should integrate quantitative objective usage indicators metrics (e.g. e-prescription records or/and logs from digital health tools) with qualitative interviews to capture both measurable and experiential dimensions of digital technology use, like resistance to change or trust in data security.

Abbreviations

Abbreviations

Meaning

ACPN

Association of Community Pharmacists of Nigeria

AI

Artificial Intelligence

CPs

Community Pharmacists

DHT

Digital Technologies

EHRs

Electronic Health Records

FIP

International Federation of Pharmacists

ICT

Information Communication Technology

LMICs

Low-Middle-Income Countries

m-Health

Mobile Health

MAS

Mobile Authentication Services

POS

Point of Sale

Declarations

Ethicas Approval

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki for research involving human participants. Ethical approval was obtained from the Lagos University Teaching Hospital Health Research Ethics Committee (Assigned Number: ADM/DSCST/HREC/APP/7938). The study was conducted in compliance with the National Code for Health Research Ethics. All participants were briefed on the study's objectives, the voluntary nature of their participation, and their right to withdraw at any stage without penalty. Personal identifiers were not collected to maintain anonymity.

Consent to participate

All participants gave their consent to participate in the study before they could proceed with completing the survey.

Consent For Publication

All the authors consented to the publication of this manuscript

Competing Interests

The authors declare that they have no competing interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author Contribution

U.G. Okafor: Conceptualization, Study design, Methods, Validation, Data Curation, Interpretation of data, Writing – original draft, review & editing. O.P. Eze: Conceptualization, Development of Research proposal, Methods, Validation, Data Curation, Project administration and supervision, Review and editing. J.M. Okwori: Study design, Methods, Validation, Formal Analysis and interpretation of data, Writing of Original draft, review, and editing. I.C. Mbata: Validation, review, and editing. E. Onaji: Data curation, review, and editing. G.N. Chukwujindu: Study design, review, and editing. L.N. Ezenekwe: Data curation, review. E.E. Onwuchuluba: Research proposal, data curation, review. All the authors gave final approval of the version to be submitted.

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Data Availability

All the data collected in this study have been included in the manuscript. The raw data are available on request to the Corresponding Author

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Figures

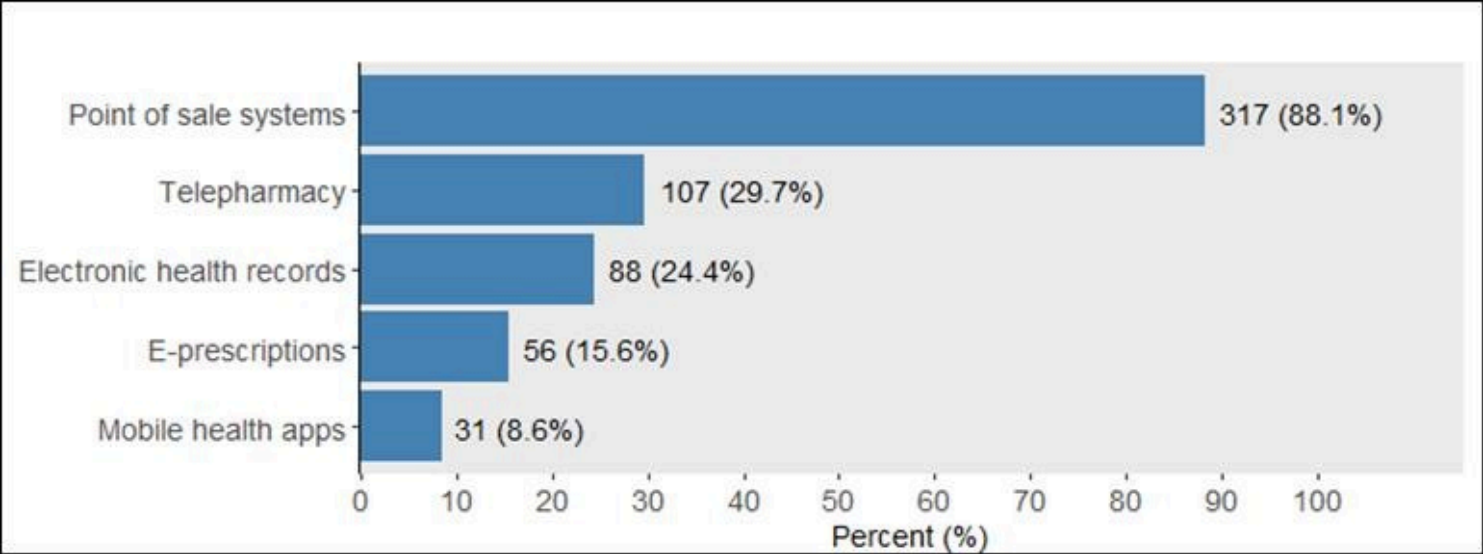


Figure 1

Bars show the percentage of respondents who reported using specific digital technologies. The use of digital health technologies, such as telepharmacy (29.7%) and electronic health records (EHRs, 24.4%), remained limited, whereas commercial point-of-sale systems were widely used (88.1%).

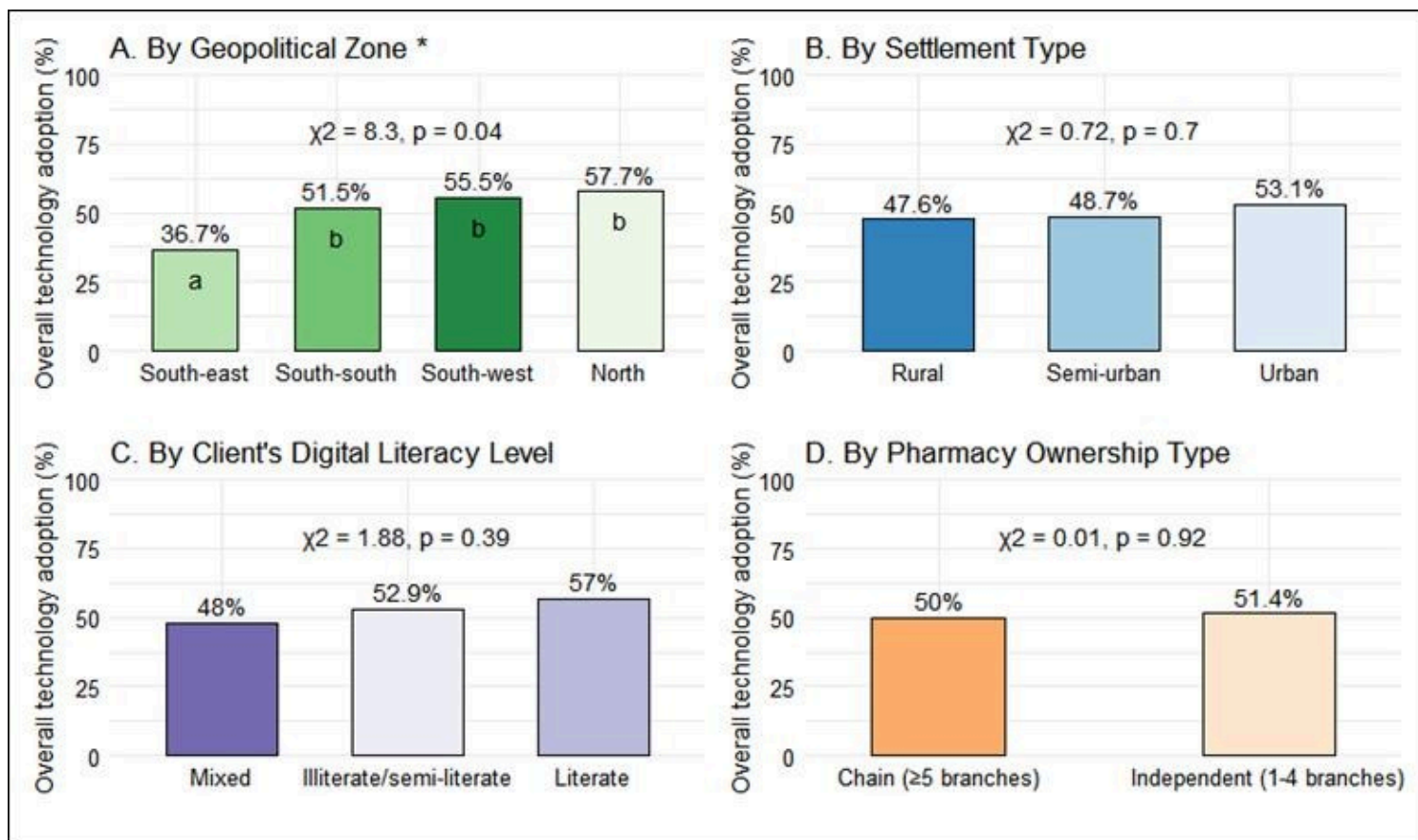


Figure 2

Panels A–D illustrate adoption rates of health-oriented digital technologies (electronic health records, e-prescriptions, telepharmacy, and mobile health applications) by (A) geo-political zone, (B) settlement type, (C) clients' digital literacy level, and (D) pharmacy type. * => 13 geopolitical zone data were missing and excluded from the analysis, letters 'a' and 'b' indicate geopolitical zones that differ significantly according to the chi-square post hoc test with Bonferroni correction (bars with the same letter are not significantly different from each other, $p > 0.05$).

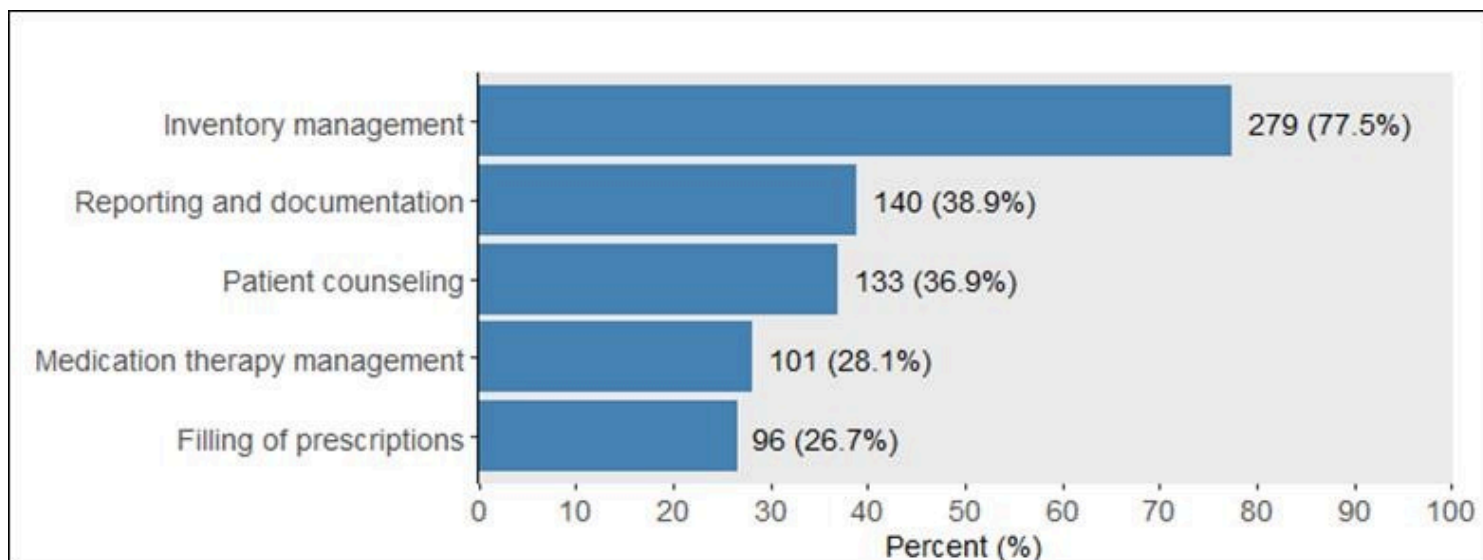


Figure 3

Bars illustrate the percentage of respondents who reported the main purpose for using digital technologies. The majority use digital technologies for inventory management (77.5%) and documentation (38.9) rather than patient care.

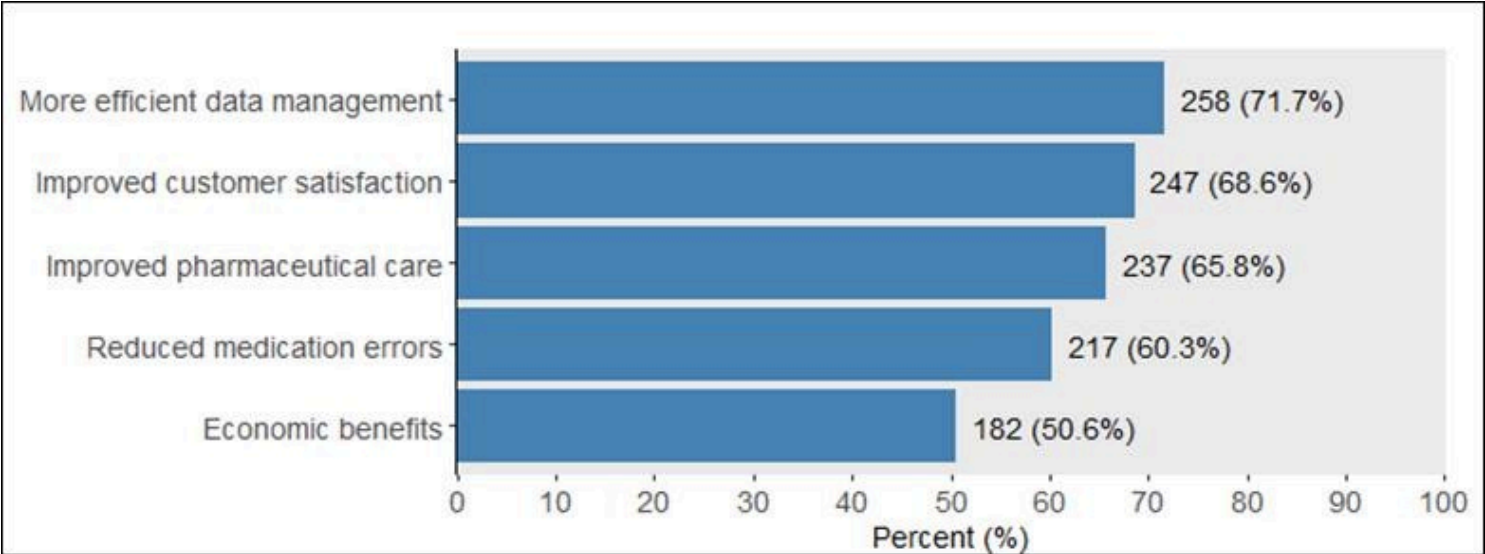


Figure 4

Bars show the percentage of respondents’ perceptions regarding the benefits derived from digital technologies. More efficient data management (71.7%) and improved customer satisfaction (68.6%) were the most widely reported.

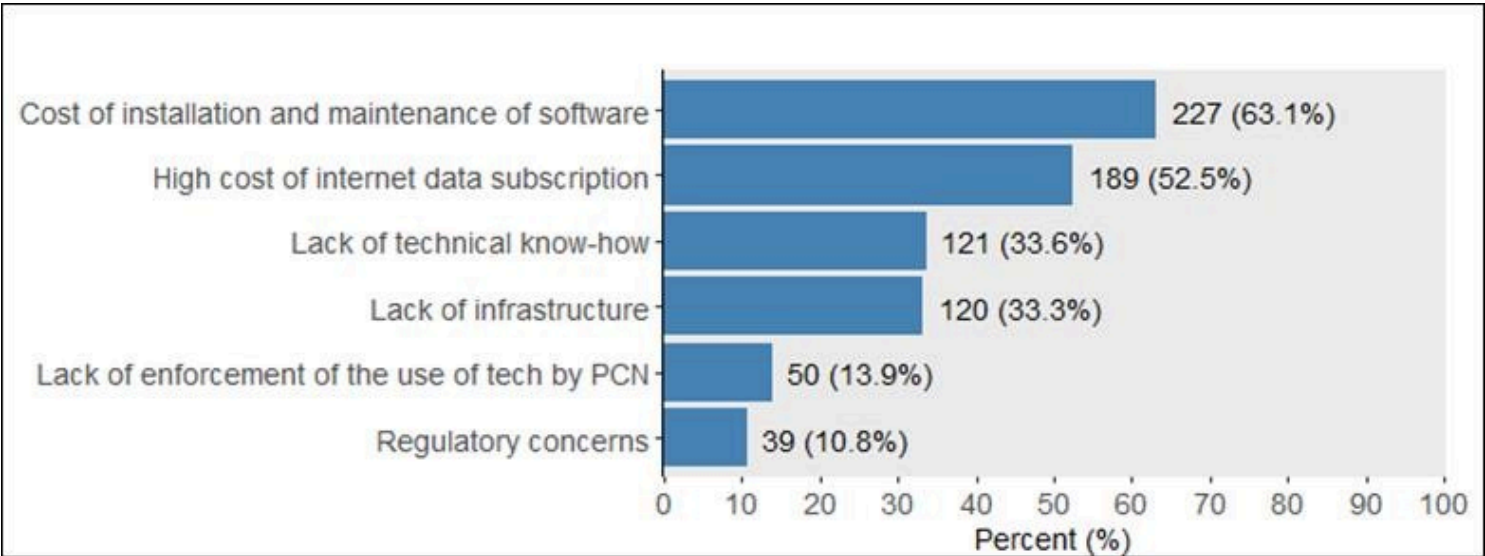


Figure 5

Each bar displays the percentage of pharmacists who identified specific barriers to limiting their use of digital technologies. The major barriers identified include the cost of installation/maintenance (63.1%) and the high cost of internet data subscription (52.5%).

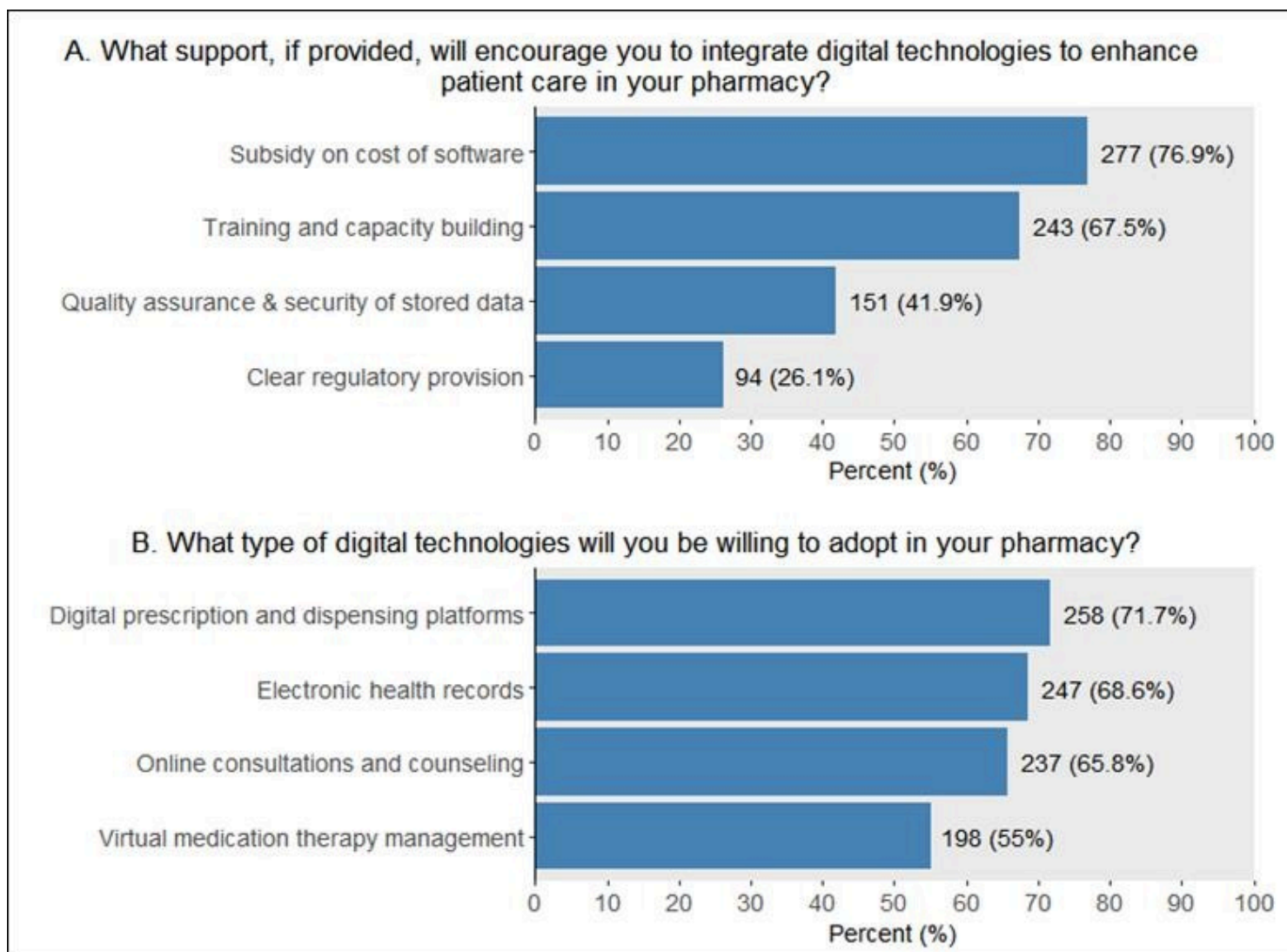


Figure 6

Panel A shows pharmacists' preferred forms of institutional or policy support to enhance integration of digital technologies in community pharmacy practice. The most frequently requested supports were subsidies on software costs (76.9%) and training and capacity building (67.5%). Panel B presents pharmacists' willingness to adopt specific digital technologies in their pharmacies. Respondents expressed strong interest in digital prescription/dispensing platforms (71.7%) and electronic health records (68.6%).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [OkaforUGQuestionnaireCPsUseofDigitalTechnologiestoEnhancePatientCareinNigeria.doc](#)