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The Influence of Technology on Pharmaceutical Care Access at Primary Health Care Facilities in Bahati Sub-County, Nakuru County, Kenya

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Abstract

Technology has increasingly become part of pharmaceutical service delivery through tools such as telemedicine, e-prescriptions, mobile health applications, and electronic health records. This study examined the influence of technology on access to pharmaceutical care at primary health care facilities in Bahati Sub County, Nakuru County, Kenya. A mixed-methods design was adopted, combining a patient survey with key informant interviews across fourteen primary health care facilities. Data were collected from 241 patients living with non-communicable diseases (73.5% response rate) and 24 key informants (80.0% response rate), comprising heads of pharmacy, heads of hospitals, the Sub County Pharmacist, and the Sub County Medical Officer of Health. Quantitative data were analysed using descriptive statistics, Pearson correlation, and multiple regression, while qualitative data from interviews were analysed thematically. Patients rated the overall role of technology at a mean of 3.44 (SD = 0.54), indicating modest agreement that digital health tools supported access to medication. Technology showed a positive but modest correlation with pharmaceutical care access ($r = 0.243$, $p < 0.01$) and emerged as a statistically significant independent predictor in the regression model ($\beta = 0.156$, $p = 0.015$), after healthcare facility status and socioeconomic factors. Key informants linked technology to improved drug inventory management, faster prescription processing, and improved patient record handling, while patients cited limited access to devices and connectivity as constraints. The study concludes that technology plays a significant but currently constrained role in pharmaceutical care access in Bahati Sub County, and recommends investment in digital infrastructure, structured digital-literacy training for patients and providers, and standardised e-prescription and electronic health record use across facilities.

Keywords: *Technology, telemedicine, e-prescriptions, mobile health, electronic health records, pharmaceutical care access, Kenya*

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1. Introduction

Technology in healthcare refers to the use of digital tools, systems, and innovations, including telemedicine, electronic health records, and mobile applications, to enhance the delivery of healthcare services. Where properly implemented, technology improves pharmaceutical care by widening access to information, facilitating e-prescriptions, and enabling remote consultations (WHO, 2020). Challenges such as inadequate digital infrastructure, low internet penetration, and digital illiteracy, particularly among patients in rural and peri-urban settings, can limit the effectiveness of these tools. In Bahati Sub County, both patients and providers encounter barriers to adopting technology, making investment in digital infrastructure and user training important considerations for realising its potential contribution to pharmaceutical care.

Pharmaceutical care access remains a central concern in healthcare delivery, since it determines whether patients receive appropriate medications and counselling for optimal health outcomes. In Bahati Sub County, disparities in access persist, and only a minority of facilities across the wider health system consistently guarantee a full medication supply. As digital health tools such as telemedicine, e-prescribing platforms, mobile applications, and electronic health records become more available in primary health care, understanding how far these tools are actually improving patient access, rather than simply being present in facilities, becomes an important empirical question.

This study was guided by the objective of determining the influence of technology on pharmaceutical care access at primary health care facilities in Bahati Sub County, Nakuru County, Kenya, and by the corresponding research question: how does technology influence pharmaceutical care access in Bahati Sub County, Nakuru County, Kenya? Technology has increasingly become a component of healthcare service provision through systems such as telemedicine, electronic medical records, and digital pharmaceutical management platforms; however, limited technological infrastructure and low adoption of healthcare technologies may constrain the efficiency and accessibility of pharmaceutical services. Assessing the role of technology, therefore, offers insight into how digital solutions can improve access to pharmaceutical care in a peri-urban Kenyan setting.

2. Literature Review

2.1 The Role of Technology in Healthcare

The role of technology in healthcare encompasses the application of advances in information technology, digital tools, and medical devices to improve service delivery, patient outcomes, and administrative efficiency. Technology in healthcare includes electronic health records, telemedicine platforms, wearable devices, artificial intelligence applications, and other digital health tools (Topol, 2019). These innovations support the collection, storage, and analysis of patient data, helping providers make informed decisions and deliver more personalised care, while also reducing medical errors and improving communication among healthcare teams (Jiang, Jiang, & Zhi, 2020).

Telemedicine uses telecommunications technology, including video conferencing and remote monitoring tools, to provide healthcare services without an in-person visit, allowing providers to consult with patients, diagnose conditions, and monitor treatment progress remotely (Hollander & Carr, 2020). Its contribution is particularly notable in rural or underserved areas,

where geographic distance would otherwise limit access to medical expertise, and it additionally reduces travel time and cost while supporting continuity of care through regular follow-up (Portnoy, Waller, & Elliott, 2020). E-prescriptions, the digital transmission of prescriptions between providers and pharmacies through electronic health record or e-prescribing systems, remove the need for paper-based prescriptions and improve medication management and safety (Bates, Leape, & Cullen, 2014), enabling real-time access to medication histories, allergy information, and potential drug interactions (Patanwala et al., 2018).

Mobile health applications support patient engagement and health management through medication reminders, adherence tracking, and telemedicine consultations, and extend healthcare access to patients who might otherwise struggle to reach a facility (Kumar & Nayar, 2019; Ventola, 2018). Electronic health records, the digital equivalent of patients' paper charts, store comprehensive information on medical history, diagnoses, medications, and laboratory results, and support care coordination by making patient information accessible across providers and settings (Office of the National Coordinator for Health Information Technology, 2020; Adler-Milstein, DesRoches, & Kralovec, 2017).

2.2 Theoretical Framework

This study was anchored on the Pharmaceutical Care Model (Cipolle, Strand, & Morley, 2012), which frames pharmaceutical care as a patient-centred practice requiring the systems and tools, including digital ones, necessary to identify, resolve, and prevent medication-related problems. It was complemented by the Theory of Planned Behavior (Ajzen, 1991), which explains patients' technology-related behaviour through the interaction of attitude, subjective norm, and perceived behavioral control; a patient may hold a favourable attitude toward telemedicine or mobile health tools, yet fail to use them consistently where perceived behavioral control is undermined by limited device access or unreliable connectivity.

2.3 Technology and Pharmaceutical Care Access

A systematic review and meta-analysis of 25 studies on telehealth in pharmaceutical care found that telehealth technologies significantly improved access to pharmaceutical services by overcoming geographical barriers, with patients in rural areas benefiting from virtual pharmacist consultations, remote adherence monitoring, and timely access to pharmaceutical advice and prescriptions (Pathak, Blanchard, Moreton, & Urick, 2021). A qualitative study using focus groups and interviews with 100 patients found that mobile health applications supported medication adherence through personalised reminders, educational resources, and real-time feedback, with patients reporting improved adherence and better chronic-condition management through user-friendly apps (Armitage, Kassavou, & Sutton, 2020).

A case study of blockchain technology in the pharmaceutical supply chain found that it enhanced traceability, counterfeit detection, and transparency of medication transactions, reducing the risk of counterfeit medicines entering the supply chain (Musamih et al., 2021). A related study on artificial intelligence in personalised medicine found that AI-enabled decision-support algorithms improved medication selection, dosage optimisation, and adverse-event prediction by tailoring treatment plans to individual patient characteristics (Chalasani, Syed, Ramesh, Patil, & Pramod Kumar, 2023). Barriers to realising these benefits are well

documented: limited digital health literacy among patients and staff, difficulties with remote medication management, and ineffective communication constrain telepharmacy implementation (ElGeed et al., 2022), while inconsistent connectivity, limited physical assessment during virtual visits, and varying user confidence with digital platforms constrain technology uptake more broadly in healthcare (Kruse et al., 2022).

Taken together, the reviewed literature establishes that digital health tools can meaningfully improve access to pharmaceutical care, but that their actual contribution is contingent on infrastructure, connectivity, and digital literacy rather than on the mere presence of the technology. Much of this evidence, however, derives from high-income or urban health systems; comparatively little empirical work has examined how telemedicine, e-prescriptions, mobile health applications, and electronic health records jointly influence pharmaceutical care access for patients with non-communicable diseases in a peri-urban Kenyan sub-county, a gap this study addresses.

3. Methodology

The study adopted a mixed-methods design, combining quantitative and qualitative approaches to provide a comprehensive account of how technology influences access to pharmaceutical care at primary health care facilities in Bahati Sub-County. The quantitative component supported objective measurement of the relationship between technology and access to pharmaceutical care, while the qualitative component, drawn from key informant interviews, provided depth on providers' and patients' experiences with digital health tools.

The target population comprised heads of pharmacy, heads of hospitals, the Sub County Pharmacist, the Sub County Medical Officer of Health, and 1,803 patients with non-communicable diseases across fourteen primary health care facilities in Bahati Sub County. Patients were selected through random sampling using the Yamane (1967) formula, yielding a sample of 328 patients, while key informants were purposively selected. Data collection ultimately achieved 241 completed patient questionnaires (73.5% response rate) and 24 key informant interviews (80.0% response rate).

The technology construct was measured using a 13-item scale covering telemedicine, e-prescriptions, mobile applications, and electronic health records, on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scale returned a Cronbach's alpha of 0.737, exceeding the recommended 0.70 threshold and indicating acceptable internal consistency (Hair et al., 2019; Nunnally & Bernstein, 1994). Quantitative data were analysed using descriptive statistics, Pearson correlation, and multiple linear regression in SPSS version 25, with the status of healthcare facilities, socioeconomic factors, and geographical predisposition entered alongside technology as independent variables and pharmaceutical care access as the dependent variable, allowing the independent contribution of technology to be isolated from that of the other determinants. Multicollinearity diagnostics returned a tolerance of .746 and a VIF of 1.340 for technology, within acceptable limits. Qualitative interview data were analysed thematically. Ethical approval was obtained from the KeMU Scientific and Ethics Review Committee and the National Commission for Science, Technology and Innovation (NACOSTI), and county-level authorisation was secured from Nakuru County before data collection; informed consent was obtained from all participants and confidentiality maintained throughout.

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4. Results

4.1 Descriptive Statistics on the Role of Technology

Respondents indicated their level of agreement with statements on telemedicine, e-prescriptions, mobile applications, and electronic health records. Descriptive statistics are presented in Table 1.

Table 1: Descriptive statistics on the role of technology

Statement	N	Mean	SD
Able to use telemedicine services comfortably for medication consultation	241	3.06	0.44
Telemedicine is helpful in obtaining advice or prescriptions without a physical visit	241	3.35	0.58
E-prescriptions make it easier to access medication	241	3.31	0.48
Electronic prescriptions reduce errors and speed up dispensing	241	3.53	0.52
Mobile apps help in managing medications (reminders, refill tracking)	241	3.50	0.62
Easy to use a mobile app or online system to communicate with pharmacist/provider	241	3.87	0.57
Has the devices and connectivity needed to use health technology	241	2.96	0.67
Electronic health records keep medication history accurate and up to date	241	3.41	0.56
Confident using digital tools (apps, patient portals) without assistance	241	3.71	0.46
More confident managing medication regimen when using health-related technology	241	3.25	0.56
Medication information moves smoothly between providers through digital records	241	3.62	0.53
Using health technology increases confidence in managing treatment	241	3.37	0.42
Healthcare providers actively use technology to help access medications	241	3.73	0.62
Overall mean score		**3.44**	**0.54**

Respondents generally viewed technology as an important enabler of access to pharmaceutical care, with an overall mean score of 3.44 (SD = 0.54), at the lower boundary of the Agree range. Findings on telemedicine indicated indifferent patient engagement, with only neutral ratings for comfort using telemedicine for medication consultations (Mean = 3.06, SD = 0.44) and for

its helpfulness in obtaining advice or prescriptions without a physical visit (Mean = 3.35, SD = 0.58). By contrast, patients agreed that mobile apps helped them manage medications through reminders and refill tracking (Mean = 3.50, SD = 0.62), that a mobile app or online system was easy to use for communicating with a pharmacist or provider (Mean = 3.87, SD = 0.57), and that healthcare providers actively used technology to help them access medications (Mean = 3.73, SD = 0.62). Access to the devices and connectivity needed to use health technology recorded the lowest rating overall (Mean = 2.96, SD = 0.67).

4.2 Correlation Analysis

Technology recorded a positive but modest correlation with pharmaceutical care access ($r = 0.243$, $p < 0.01$), indicating that telemedicine, e-prescriptions, mobile apps, and electronic health records contributed positively to access where they were available and functional. Technology also correlated positively with the status of healthcare facilities ($r = 0.409$, $p < 0.01$) and with geographical predisposition ($r = 0.225$, $p < 0.01$), while recording a small negative correlation with socioeconomic factors ($r = -0.093$, $p < 0.01$), consistent with a digital divide in which patients with lower socioeconomic status were less likely to engage with digital health tools.

4.3 Regression Analysis

In the multiple regression model, technology emerged as a statistically significant independent predictor of pharmaceutical care access ($\beta = 0.156$, $p = 0.015$), behind the status of healthcare facilities ($\beta = 0.334$, $p = 0.000$) and socioeconomic factors ($\beta = 0.250$, $p = 0.000$), and ahead of geographical predisposition ($\beta = 0.117$, $p = 0.043$). The overall model explained 48.5% of the variance in pharmaceutical care access ($R^2 = 0.485$), confirming that technology contributed an independent pathway to access beyond the influence of facility status, socioeconomic conditions, and geography.

5. Discussion

Findings on telemedicine indicate that the documented capacity of telehealth to improve access by overcoming geographical barriers (Pathak et al., 2021) remains largely unrealised in Bahati Sub County. Within the Theory of Planned Behavior, this reflects a situation where patients hold no particular objection to telemedicine, yet utilisation does not follow because perceived behavioral control is undermined by poor digital infrastructure, limited connectivity, and low digital literacy, conditions well documented in peri-urban settings (ElGeed et al., 2022). HH4 noted that technology improves tracking and availability of medicines, while HH13 observed that it reduces delays and enhances service delivery efficiency.

Findings on e-prescriptions and electronic health records suggest that patients perceived these tools as beneficial for reducing dispensing errors, maintaining accurate medication records, and supporting continuity of information between providers, even while remaining neutral on whether e-prescriptions currently make access easier. Accurate, digitally shared medication histories reduce the risk of adverse drug interactions and support the longitudinal patient-pharmacist relationship envisioned by the Pharmaceutical Care Model (Cipolle et al., 2012), and these gains are consistent with the efficiency and error-reduction benefits reported for electronic records and decision-support tools more broadly (Topol, 2019; Jiang et al., 2020).

HP9 affirmed that technology supports telemedicine and faster prescription processing, while HP1 noted that it improves drug inventory management and reduces stockouts.

Findings on mobile health applications showed that patients valued digital tools for medication self-management and provider interaction, though confidence in managing medication regimens through technology and access to the devices and connectivity required to use it remained only neutral. Within the Theory of Planned Behavior, this reflects broadly favourable attitudes and subjective norms toward technology use, constrained by insufficient perceived behavioral control arising from device and connectivity limits, consistent with barriers to technology uptake documented elsewhere in healthcare (Kruse et al., 2022). HP8 noted that digital systems improve supply chain coordination, while HH6 confirmed that technology enhances patient record management and service efficiency; the Sub County Pharmacist and Sub County Medical Officer of Health both indicated that technology supports reliable storage and retrieval of information and has enhanced inventory tracking and ease of dispensing. Mobile health applications improve adherence through reminders and education (Armitage et al., 2020), and further gains are achievable through supply-chain traceability and AI-enabled personalisation as digital infrastructure matures (Musamih et al., 2021; Chalasani et al., 2023).

Findings on technology as a predictor confirm it as a significant independent contributor to pharmaceutical care access beyond the influence of facility status, socioeconomic conditions, and geography, even though its standardised coefficient was smaller than that of facility status and socioeconomic factors. Its strong inter-variable correlation with facility status ($r = 0.409$) indicates that facility capacity and technology adoption move together, so that technology adoption in primary health care is not independent of the underlying infrastructure that supports it. As digital infrastructure strengthens and adoption deepens, the independent predictive contribution of technology to access to pharmaceutical care is expected to grow (WHO, 2023).

6. Conclusion

The study concludes that technology plays a significant but currently constrained role in access to pharmaceutical care in Bahati Sub County, Nakuru County, Kenya ($\beta = 0.156$, $p = 0.015$). Patients acknowledged the value of telemedicine, e-prescriptions, mobile health applications, and electronic health records in supporting access, but neutral ratings on telemedicine use, device and connectivity access, and confidence in technology-assisted treatment management indicate that infrastructural and access limitations continue to constrain the full benefit of these tools. Qualitative findings further point to digital literacy and infrastructure gaps among both patients and providers, suggesting that improvements in technological capacity and user readiness are necessary to maximise the contribution of digital health to pharmaceutical care access.

7. Recommendations

To optimise the benefits of technology in pharmaceutical care, healthcare authorities in Bahati Sub County should invest in expanding digital infrastructure, including reliable internet and telehealth equipment at primary health care facilities. Training programmes for both providers and patients should be implemented to improve digital literacy and system navigation, and e-prescription and electronic health record use should be standardised across facilities to ensure continuity of care. Introducing user-friendly mobile applications and accompanying support

channels would help patients manage medications more effectively, thereby strengthening the usability and impact of digital health tools on access to pharmaceutical care and patient health outcomes.

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