East African Medical Journal Vol. 102 No. 6 June 2025
INFLUENCE OF INTEGRATED HEALTHCARE INFORMATION SYSTEMS ON HEALTHCARE SERVICE DELIVERY TENETS AT KENYATTA NATIONAL HOSPITAL, KENYA

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ABSTRACT

Background: **Health Information Systems (HIS) is one of the pillars of a functional health system. However, efforts to expand HIS and Digital health technology in sub-Saharan Africa are hindered by many factors including weak health information system governance and inadequate infrastructure. The main objective of this study was to determine the influence of integrated healthcare information systems on healthcare service delivery tenets in Kenyatta National Hospital, Kenya.**

Methodology: **This study adopted a cross-sectional study design. Stratified and simple random sampling were used in this study. Data was collected using a self-administered questionnaire. SPSS version 29 was used for quantitative data analysis. Both descriptive and inferential statistics were done including chi-square were done. Statistical significance was set at P ≤0.05.**

Results: **There were 210 respondents with the majority (56.2%, n=118) of being female. Nurses (30.5%, n=64) constituted the highest number of respondents in the study, followed by health information officers (25.7%, n=54). A bigger proportion (61.4%, n=129) of respondents had a diploma**

level of education, followed by those with a bachelor's degree (30.5%, n=64) with a majority of study participants (60.5%, n=127) having less than 8 years of work experience. Mobile health technology ($\chi 2(2)=27.347, p=0.001$), telehealthcare technology ($\chi 2(2)=12.944, p=0.000$), telemedicine technology ($\chi 2(2)=7.105, p=0.029$), and cloud computing technology ($\chi 2(2)=16.219, p=0.000$) were significantly associated with service delivery satisfaction. Electronic medical health records (EMHR) system use($\chi^2(2)=16.222, p=0.001$), Electronic Health Records (EHR) systems ($\chi^2(2)=20.137, p=0.000$), Clinical Decision Support Systems (CDSS) ($\chi^2(2)=44.504, p=0.000$), and Patient Administration Records Systems (PARS) ($\chi^2(2)=29.745, p=0.000$) had a significant association with service delivery satisfaction .

***Conclusion*: In conclusion the integration of Clinical Decision Support Systems, mobile health technology, efficient patient administration record systems, and telehealthcare technologies significantly enhanced healthcare service delivery. These findings underscore the importance of adopting digital medical technologies as well as healthcare information systems in hospital settings.**

INTRODUCTION

The World Health Organization places Health Information Systems (HIS among the pillars of a functional health system. It is a mechanism for the collection, storage, analysis, dissemination, and utilization of health-related data to support decision-making at all levels of a healthcare system (1). Digital health technologies are the various ways in which Information technology is used to support and improve health and health related outcomes. Globally HIS and digital health technology have been demonstrated to enhance patient management and improve continuity of care in non-communicable diseases (NCD) (2).

However, efforts to expand HIS and Digital health technology in sub-Saharan Africa are hindered by many factors including weak health information system governance and inadequate infrastructure i.e. limited access to technology and digital platforms (1).

With nearly 40 million individuals living in rural regions, Kenya is putting forth extra efforts to enhance the health of its citizens. Healthcare digitization efforts have gained traction over the last decade. For instance, the Ministry of Health transitioned from an Excel-based system to web-based District Health Information Software (DHIS2) in 2010, significantly improving data collection and reporting processes. The government has also moved to digitize the national health insurance and roll out of health information systems in its secondary level healthcare facilities. By broadening the National Hospital Insurance Fund (NHIF) contribution schemes, which now target

both ambulatory and hospital patients, recent initiatives to reform the NHIF have increased its operations to provide substantial benefits to a sizable portion of the Kenyan population especially in remote areas (3).

Although the adoption of Information and Communication Technology (ICT) in Kenyan healthcare has shown promising results, challenges remain. These include fragmented systems, limited interoperability between departments (e.g., pharmacy and records), and a lack of training for healthcare workers, as 73% of DHIS staff lack proper training (4). Addressing these gaps is crucial to achieve fully integrated health information systems, improve service quality, and enhance patient outcomes. The increasing demand for specialty medical services at tertiary level facilities including Kenyatta National Hospital (KNH) calls for an efficient Health Information System (5). Without well-functioning systems for healthcare in place, medical professionals are less able to deliver high-quality services. Few studies have been conducted on the integration of health information systems into Kenyan public health institutions. Therefore, this study sought to assess the impact of integrated health information systems on service delivery at Kenyatta National Hospital.

METHODOLOGY

Study design

This study adopted a cross sectional design.

Study area

The study was conducted at Kenyatta National Hospital (KNH) in Nairobi County, Kenya. KNH is the country's main teaching and referral hospital, with 50 wards,1800 beds, 24 operating theaters, 22 outpatient clinics, and an accident and emergency department. KNH lies at an elevation of approximately 1,795 m (5,889 feet) above sea level, at latitude 1.2921° S and longitude 36.8219° E.

Target population

The target population consisted of 480 Kenyatta National Hospital staff. They included general practitioners i.e nurses, clinical officers, and medical doctors, hospital ICT officers, health information officers, laboratory technologists, pharmacists, finance, and reception staff.

Sampling technique

The hospital was purposively selected as it is the largest public health facility not only in Kenya but also in East and Central Africa. Stratified and simple random sampling were used in this study. The staff members were stratified into seven categories based on their cadres. A staff register was requested from each of the seven strata, and the respondents were selected through simple random sampling.

Sample size determination

The sample size of the study was calculated using the Taro Yamane formula given below:

$n = N / (1 + N (e)^2)$

Where n = Sample size

N = population under study
e = margin error (0.05)
I = constant

Therefore;

$n=480/ (1+480 (0.05)^{2)}$

n= 218

Data collection

Quantitative data were collected using self-administered questionnaires over a 1 month period. The questionnaire was modified and pretested on 22 of potential participants before the study rolled out. The questionnaire had 4 sections with questions on sociodemographic factors, state of health care service delivery at the facility, digital medical technologies and healthcare information systems. The questions were designed so the participants could choose responses on a likert scale. The questionnaires were distributed both physically in hardcopy and online via email with follow up visits and phone calls.

Data analysis

Quantitative data was cleaned in Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 29. Descriptive statistics including frequencies, percentages, mean and standard deviation were done. Inferential analysis including chi-square test for independence was done. Statistical significance threshold was set at $p \leq 0.05$.

Ethical consideration

This study was approved by the Mount Kenya University Ethics and Review Committee Approval No. MKU/ISERC/2504 and The National Commission for Science, Technology, and Innovation via research permit No. NACOSTI/P/22/22579. Permission to conduct the study at the investigation location was obtained from Nairobi County government health department. Participation in this study was voluntary, and participants signed a written informed consent form before data collection. Participants' anonymity was rigorously protected, and each respondent's full name was substituted with a unique number.

RESULTS

Social demographic characteristics

218 questionnaires were distributed, with a response rate of 96%(n=210). The majority (56.2%, n=118) of respondents were female as shown in figure 1. Nurses (30.5%, n=64) constituted the highest number of respondents in the study, followed by health information officers (25.7%, n=54) and clinical officers (11.4%, n=24). The others were hospital ICT officers (9%, n=19), laboratory technologists (9%, n=19), medical doctors (5.2%, n=11), pharmacists (3.8%, n=8), finance officers (3.3%, n=7), and reception staff (1.9%, n=4). A bigger proportion (61.4%, n=129) of respondents had a diploma level of education, followed by those with a bachelor's degree (30.5%, n=64). 6.2% (n=13) had a master's degree, while only 1.9%(n=4) had a certificate level qualification. This are shown in Table 1. The majority of study participants (60.5%,

n=127) also had less than 8 years of work experience with only 2.4%(n=5) having more than 33years of work experience as shown in figure 2.

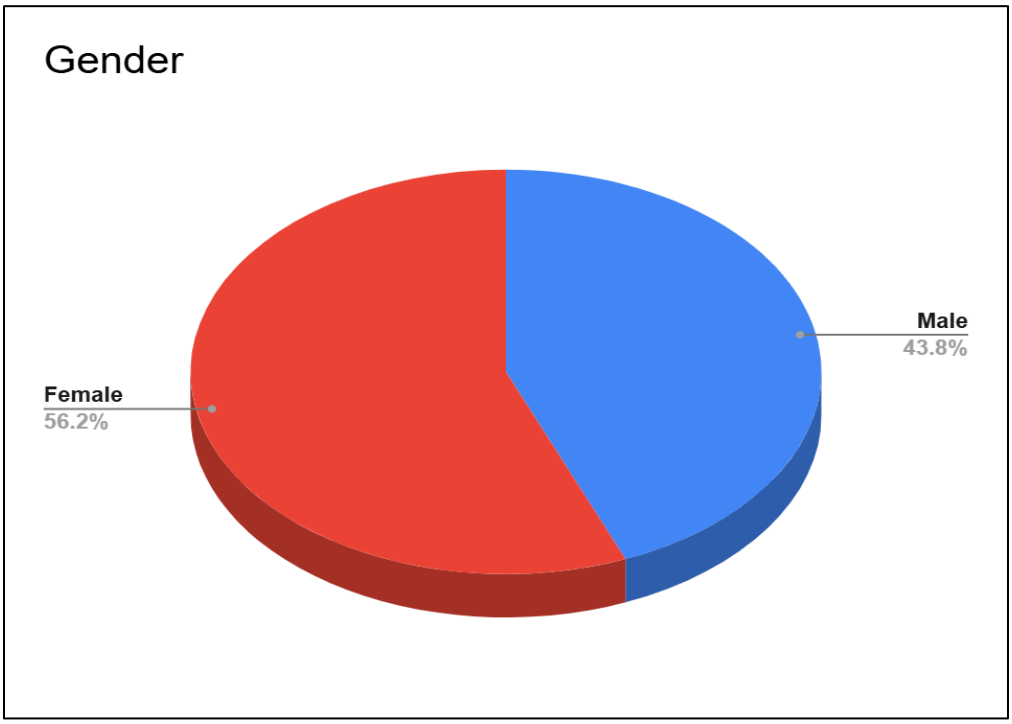

Figure 1: Gender

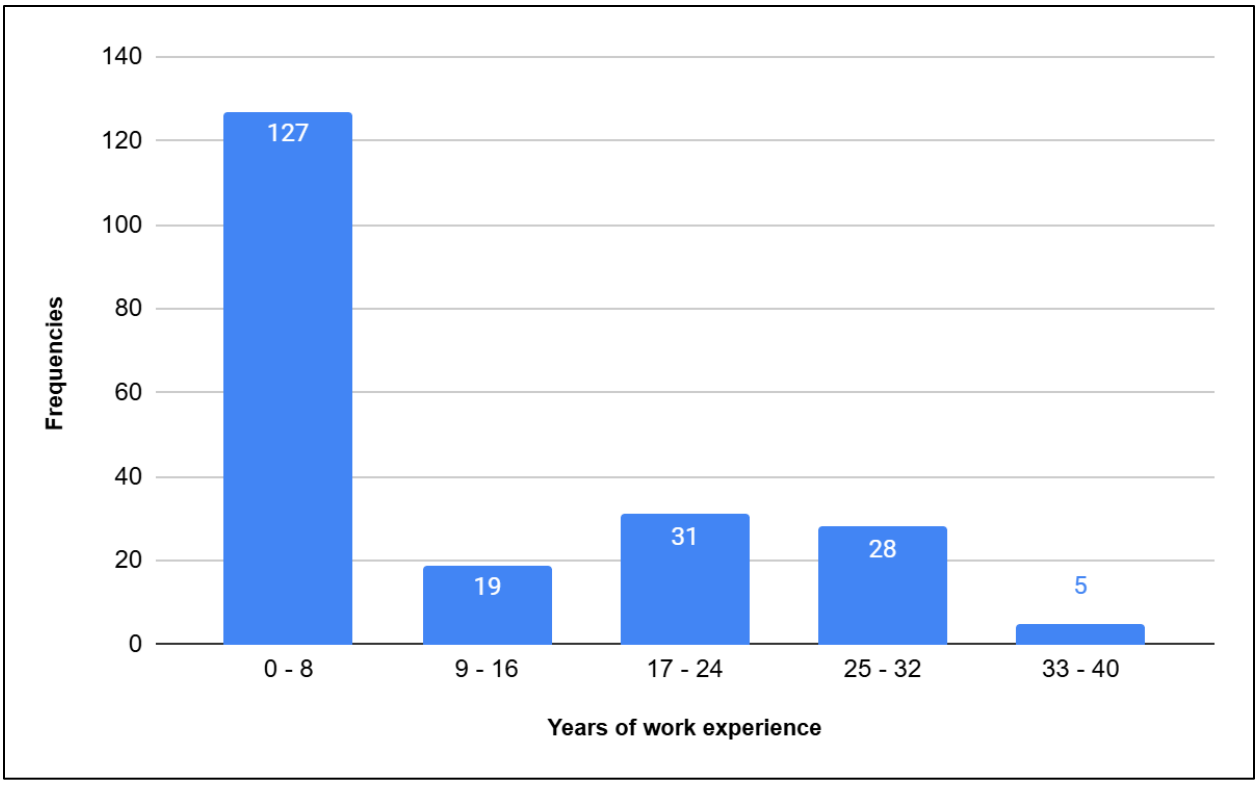

Figure 2: Years of work experience

Table 1

Socio-demographic characteristics of the respondents

Variable	Measure	Frequency	Percent (%)
Gender	Male	92	43.8
	Female	118	56.2
Education	Certificate	4	1.9
	Diploma	129	61.4
	Degree	64	30.4
	Masters	13	6.2
Years of employment	0 – 8	127	60.5
	9 – 16	19	9.0
	17 – 24	31	14.8
	25 – 32	28	13.3
	33 – 40	5	2.4
Job title	Clinical officer	24	11.4
	Health information officer	54	25.7
	Lab technologist	19	9
	Nurse	64	30.5

	Reception staff	4	1.9
	Finance	7	3.3
	Hospital ICT	19	9
	Medical officer	11	5.2
	Pharmacist	8	3.8

Healthcare Service delivery

Majority (89.5%,n=188) of the respondents agreed or strongly agreed that there was high satisfaction and trust of services offered at the facility, with the responses to the question having the lowest coefficient of variation at 18.94%. 77.6%(n=163) of the respondents agreed or strongly agreed that services at the facility were prompt and timely with a coefficient of variation of 22.97%. A high number (80.9%,n=170) of respondents agreed or strongly agreed that services offered at the facility comprehensively met patients' needs with a coefficient of variation of 22.80%, while only 6.2%(n=13) of the respondents disagreed or strongly disagreed. 68.1%(n=143) of respondents agreed or strongly agreed on the ease of access of services at the facility, with a coefficient of variation of 26.20%.

Table 2

Summary statistics for Service delivery constructs

N=210	**S.A %**	**A %**	**N %**	**D %**	**S. D %**	**Mean**	**Median**	**SD**	**CV (%)**
In our facility, services are delivered to patients promptly, as evidenced by the low number of patients waiting at any given time	23.3	54.3	13.8	6.7	1.9	3.90	4.0	0.90	22.97
Patients are pleased with the care they receive at our facility, as shown by the high rate of repeat visits and returning patients, indicating their trust and satisfaction with our services.	34.3	55.2	6.7	1.9	1.9	4.18	4.0	0.79	18.94
The services provided at our facility comprehensively meet patients' needs, as evidenced by the wide array of services available	33.3	47.6	12.9	3.3	2.9	4.05	4.0	0.92	22.80
It is easy for patients to access services at our facility, as shown by the steady	22.4	45.7	21.4	7.1	3.3	3.78	4.0	0.99	26.20

increase in the number of patients visiting our facility.									
Composite Score						**3.92**	**4**	**0.94**	**24.07**

Abbreviations
S.A-Strongly Agree
A-Agree
N-Neutral
D-Disagree
S.D-Strongly disagree
SD- Standard Deviation
CV- Coefficient of Variation

Influence of digital medical technologies on healthcare service delivery

Mobile health technology ($\chi 2(2)=27.347, p=0.001$), telehealthcare technology ($\chi 2(2)=12.944, p=0.000$), telemedicine technology ($\chi 2(2)=7.105, p=0.029$), and cloud computing technology ($\chi 2(2)=16.219, p=0.000$) were significantly associated with service delivery satisfaction. These are shown in Table 3.

Table 3
Influence of digital medical technologies on healthcare service delivery

Variables	Chi square	P. value
Mobile Technology	27.347	.001
Telehealth Care Technology	12.944	.000
Telemedicine Technology	7.105	.029
Cloud Computing Technology	16.219	.000

Influence of healthcare information systems on healthcare service delivery

Electronic medical health records (EMHR) system use($\chi^2(2)=16.222, p=0.001$), Electronic Health Records (EHR) systems ($\chi^2(2)=20.137, p=0.000$), Clinical Decision Support Systems (CDSS) ($\chi^2(2)=44.504, p=0.000$), and Patient Administration Records Systems (PARS) ($\chi^2(2)=29.745, p=0.000$) had a significant association with service delivery satisfaction. This are shown in table 4.

Table 4

Influence of healthcare information systems on healthcare service delivery

Variables	Chi square	P value
Utilization by the Healthcare provider	.207	.684
Electronic Health Records Systems	16.222	.000
Clinical Decision Support Systems	44.504	.000
Patient Administration Records Systems	29.745	.000

DISCUSSION

In this study, respondents found Clinical Decision Support Systems to have a statistically significant impact on service delivery ($\chi^2(2)=44.504, p=0.000$). Similarly, the results demonstrated that Patient Administration Record Systems had a significant impact on healthcare service delivery($\chi^2(2)=29.745, p=0.000$). These findings are similar to research done in German institutions, which highlighted the beneficial effects of Clinical Decision Support Systems(CDSS) on patient care as well as interprofessional shared decision making(7). Studies in the Netherlands and U.SA. also found enhanced decision making and cost saving when CDSS were used (8,9). A similar Kenyan study on the adoption of digital health systems in public hospitals found improved monitoring, accountability and efficiency with EHR use. The study also found that EHR systems improve care coordination, reduce medical errors, and enhance patient outcomes, particularly in large healthcare institutions (10). These studies, just like our findings support, demonstrate that the implementation of healthcare information systems can significantly contribute to better healthcare service delivery and overall performance in clinical settings. However, numerous studies have underscored the importance of healthcare information security cannot be overstated. Strong information security enhances service quality by ensuring data privacy, accuracy, and accessibility(11).

This study revealed that the use of mobile health technology ($\chi2(2)=27.347, p=0.001$) and telehealthcare technology($\chi2(2)=12.944, p=0.000$) were associated with significant improvement in health service delivery. Recent studies and reviews have had similar findings showing the potential of mobile technology and telehealth in improving patient monitoring, provision of timely interventions as well as contributing to better plans adherence and outcomes (12,13). Other technologies like cloud computing have also been shown to significantly enhance data management capabilities and interoperability as well as

supporting the proliferation of telemedicine (14). Moreover, telemedicine has been shown to play a crucial role in delivering medical services through video conferencing and other digital technologies as well as reducing costs to the patients with chronic illnesses that require long term follow up. These advancements have enhanced patient satisfaction and outcomes, demonstrating the complimentary role medical technologies play in optimizing healthcare service delivery and improving overall patient care.

Limitations of the study

The study's generalizability was limited, as it focused on a single tertiary hospital whose setting may not reflect other healthcare facilities. Additionally, reliance on self-reported data may have introduced bias, and the cross-sectional design limits causal inference between system use and service delivery. Future studies should adopt a multi-site approach involving diverse healthcare settings, use triangulation methods, and consider longitudinal designs to better assess causal relationships over time.

CONCLUSION

The integration of digital medical technologies and healthcare information systems in the hospital significantly improves healthcare service delivery. The use of Clinical Decision Support Systems, mobile health, telehealth technologies, and efficient patient administration record systems enhances satisfaction, accessibility, and timeliness of care. To build on these findings, healthcare institutions and policymakers should prioritize the widespread adoption of health technologies. These actions are essential for sustaining improvements and achieving more efficient, reliable, and patient-centered care.

Recommendations

The study recommends that healthcare institutions and policymakers prioritize the scale-up and sustained investment in health information technologies to improve efficiency, patient outcomes, and overall service delivery.

Investment should also be made in continuous staff training, enforcement of strong data protection measures, and promotion of system interoperability

Acknowledgments: The author's acknowledge the study participants' for volunteering to take part in this research.

Authors' Contributions

NSN, JK, and JN participated in the entire research process. NSN and JK participated in the data analysis process. NSN and JN played a key role in drafting the manuscript. All authors read and approved the final manuscript.

Funding: No funding sources.

Conflict of interest. None declared.

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