

## TECHNOLOGICAL FACTORS ASSOCIATED WITH THE IMPLEMENTATION OF A HEALTH MANAGEMENT INFORMATION SYSTEM AT KENYATTA NATIONAL HOSPITAL

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### ABSTRACT

**Objective:** The project aimed to call to mind the technological factors associated with the implementation of a Health Management Information System at Kenyatta National Hospital. **Design setting:** The investigation deployed a cross-sectional study. **Subjects or participants:** A sample total of 169 respondents was calculated using the Krecie and Morgan formula for the quantitative study. A strict inclusion criterion was followed to select the respondents from all trained health personnel in Kenyatta National Hospital. The study utilized an interview schedule. Data were analyzed using SPSS version 21 while qualitative data was analyzed on themes developed. Data presentation was in the form of quantitative statistics such as frequency distribution, percentages and tables. Qualitative results were presented in verbatim form. **Results:** 137 (51.5%) agreed that the ICT infrastructure is conducive to the growth and expansion of HMIS in KNH, while 47 (17.7%) strongly agreed. Additionally, 9 (3.4%) and 25 (9.4%) strongly disagreed and disagreed, respectively, that the ICT infrastructure is conducive to the growth and expansion of HMIS in KNH. A significant association was observed between the variable "HMIS has been fully implemented by the hospital" and the variable "With HMIS healthcare service delivery is faster, better and easier to deliver,"  $\chi^2(8) = 20.759, p = 0.008$ . **Conclusion:** Digital transformation enhances self-care, promotes health, improves collaboration, and addresses healthcare access inequities. A comprehensive digital transformation has the potential to improve health outcomes for all, allowing for a healthier population and a more sustainable future.

**KEYWORDS:** Health System, Digital Transformation, Health Management Information System, Interoperability, Universal Health Coverage, Health Information.

### INTRODUCTION

The landscape of information systems is in a perpetual state of evolution, adapting to the needs of the times. This ensures that they remain relevant and effective in their ability to provide valuable solutions for individuals and organizations alike. The WHO.<sup>[1]</sup> notes that interoperability of health management Information in systems in order to

enhance the effectiveness of interventions against tropical and infectious diseases is imperative to prioritize the improvement of health systems by promoting high-quality standards. Health Information Management Systems (HIMS) serve a critical function in healthcare, including areas of public health, administration, research and education. Expectedly there are significant limitations to all healthcare administrative and public health data. Often this relates to the breadth of data collected, which is frequently determined by the expected HIMS. With the arrival of computer technology to support electronic information capture, storage, and retrieval, coded data became easily searchable and accessible.<sup>[2]</sup>

The WHO framework for globally improving Health systems recognizes seven building blocks that are clearly defined that together constitute a complete health system.<sup>[3]</sup> This was underscored at the G20 meeting in Osaka with the emphasis on a strategic harnessing of the power of data to strengthen healthcare systems that makes rapid and affordable progress towards achieving Universal Health Coverage (UHC).<sup>[4]</sup> In relation to International health concerns majority of the National referral systems in developed countries among them Canada, the United States of America and the United Kingdom have had to budget huge amounts of money for an impetus towards Health Management Information Systems (HMIS) adoption whereas developing countries are still lagging behind and struggling to make do with the old traditional healthcare setups. Health systems are the core foundations of how countries respond to new disease threats and improving health of the people. The iterative nature of the process cannot be further overemphasized; any changes in mission, operations, functions, or information and data needs must be assessed to reveal their impact on analyses already completed since these changes could have a profound effect on the system to be acquired.<sup>[4]</sup> As assessed by the Kenya Health Policy (2014-2030) definition of the Country's long-term intent in health through strengthening of health information, the target of the policy is to attain a level and distribution of health at a level commensurate with that of a middle-income country, with specific impact targets of attaining a 16% improvement in life expectancy; a 50% reduction in annual mortality from all causes; and a 25% reduction in time spent in ill health. According to<sup>[5]</sup>, embracing modern innovations in healthcare technology is one of many ways of improving efficiency and reducing losses within healthcare organizations. The integration of information and health services envisaged benefits cannot be disputed. Still, there are many challenges which affect and determine its effectual adoption. In fact, the majority of organizations have abandoned their newly acquired systems only to go back to their old manual systems. Health management information systems can be the impetus for managing complex health care challenges and addressing growing information needs. A vital approach to the design and implementation of any HIT and health program is to identify the various stakeholders who need to be involved and find mechanisms for including and incorporating their perspectives and concerns while simultaneously finding ways to mobilize their skills, expertise and resources.

In accordance with the Global Health Observatory<sup>[6]</sup>, HIMS has aided in indicating that the spread of a disease doesn't stop at a country's borders. With more people travelling to other countries and living in crowded cities, germs are easier to spread. Infectious diseases that start in one part of the world can quickly reach another.

For digital transformation, healthcare organizations need to prioritize new models, reengineer processes and systems, and understand people's digital skills and behavior. Developing and implementing public policies, regulatory frameworks and national digital literacy programs require a new interdisciplinary approach. A comprehensive digital

transformation has the potential to improve health outcomes for all, allowing for a healthier population and more sustainable future.<sup>[7]</sup>

## DISCUSSION

The implementation of HMIS is crucial for monitoring diseases, allocating resources, evaluating programs, conducting research, and enhancing healthcare systems to achieve optimal public health outcomes. The lack of coordination, transparency, and timely data sharing has severely impeded the progress of HMIS on a global scale.<sup>[8]</sup> Recognizes the critical role HMIS plays in managing and overseeing public health concerns such as Malaria, Polio, TB, pandemics, and other diseases of public health importance. Good health is a fundamental value of all societies and the health system is one of the most important contributors to an improved population health. Amid unprecedented public and political calls for greater resilience in health systems, the World Health Organization launched its position paper: Building Health Systems Resilience for Universal Health Coverage and Health Security during the COVID-19 Pandemic and Beyond. According to<sup>[9]</sup>, health technologies are evidence-based when they meet well-defined specifications and have been validated through controlled clinical studies or rest on a widely accepted consensus by experts and thus become solutions to health problems. The health sector has always relied on technologies. ICT form the backbone of the services to prevent, diagnose and treat illness and disease. HITs are only one category of the vast array of technologies that may be of use. Given the right policies, organization, resources and institutions, HITs can be powerful tools in the hands of those working to improve health. In the summit<sup>[4]</sup>, leaders and the heads of government noted that, change to data driven society where big data and new technologies are anchored in a people driven approach. This approach has been postulated to be the real drivers of change. As digitalization is transforming every aspect of our economies and societies, we recognize the critical role played by effective use of data, as an enabler of economic growth, development and social wellbeing. We aim to promote international policy discussions to harness the full potential of data.<sup>[10]</sup>

ICT plays a key role in as far as HMIS is concerned. It facilitates HMIS in all its processes. According to<sup>[11]</sup>, the biggest barriers to the adoption of electronic health records were reported as the cost of software, hardware and physician participation. Also, the end-user participation in the implementation strategy was the main factor associated with the successful adoption of HMIS, these findings were similar to the study, out of the 266 respondents, the study depicted that 137 (51.5%) agreed that the ICT infrastructure is conducive for the growth and expansion of HMIS in KNH while 47 (17.7%) strongly agreed. Additionally, 9 (3.4%) and 25 (9.4%) strongly disagreed and disagreed, respectively, that the ICT infrastructure is conducive to the growth and expansion of HMIS in KNH. Analysis of whether the cost of ICT equipment and tools affected the application and implementation of HMIS reported that only 9 (3.4%) strongly disagreed, 25 (9.4%) disagreed while 48 (18%) were uncertain and 130 (48.9%) agreed, that the cost of ICT equipment and tools affected the application and implementation of HMIS. With the foregoing, 66 (24.8%) disagreed that the department has an adequate pool of highly HMIS-trained skilled labour, while 92 (34.6%) of the participants were uncertain about the level of trained, skilled labour. Only 79 (29.9%) of the KNH participants did agree that the department has an adequate pool of highly HMIS-trained skilled labour. Availability of resources was likely to catalyze the implementation, whereas their absence was likely to be a constraint. Procurement of new computers, recruitment of records staff and deployment of new statisticians in some hospitals helped to implement the new system. However, inconsistent internet connectivity, inadequate storage files and data security concerns (e.g. outdated antivirus software), were examples of specifics that showed that with limited resources HMIS implementation would face. The

respondents' perceptions of positive influences of HMIS in the study according to key informants, was that availability of different resources and continuous consultations was a positive influence. They further stated and reflected that adequate staff expertise and sufficient time spent by different experts in the field helped to ensure the appropriate design of the new system. Same was echoed by a respondent who noted;

“Am not aware. However, we are moving away from ERP and by December we are expected to go live using SAP4HANA which interfaces the whole hospital. Right now our benchmark is Germany Charite teaching and referral hospital (one of the biggest hospital in the world).”

Achieving UHC required health system strengthening to deliver effective and affordable services to prevent ill health and to provide health promotion, prevention, treatment, rehabilitation and palliation services. The p-value suggested that the association between “KNH management supports trainings in HMIS” and “HMIS has been fully implemented by the hospital” is unlikely to have occurred due to random chance,  $\chi^2 (8) = 49.753$ ,  $p < 0.001$ . Also, a significant association was reported from the test of association between the fully implementation of the HMIS by the hospital and if lack of proper training affected the growth and expansion of HMIS in KNH,  $\chi^2 (8) = 16.302$ ,  $p < 0.001$ . These findings suggested that while the cost of ICT equipment and tools significantly impact the implementation of HMIS, the availability of proper training and a skilled labor pool are important factors for successful implementation and growth of HMIS in the hospital. The findings agreed with<sup>[12]</sup>, that health technologies were evidence-based when they meet well-defined specifications and have been validated through controlled clinical studies or rest on a widely accepted consensus by experts and thus become solutions to health problems. ICT formed the backbone of the services to prevent, diagnose and treat illness and disease. HITs were only one category of the vast array of technologies that may be of use. Given the right policies, organization, resources and institutions, HITs were a powerful tool in the hands of those working to improve health.<sup>[13]</sup> Furthermore, a strong association was observed between the department having an adequate pool of highly HMIS-trained skilled labor and the implementation of HMIS,  $\chi^2 (8) = 56.500$ ,  $p < 0.001$ . The findings also agreed with<sup>[12]</sup>, when they stated that Digital health, or the use of digital technologies for health, had become a salient field of practice for employing routine and innovative forms of information and communications technology (ICT) to address health needs and the “use of the digital revolution to scale up health interventions and engage civil society”. Where health systems particularly in developing countries need to optimize resource use and expand population coverage, the process of improvement and scaling up needs to be based on sound local strategies for quality so that the best possible results are achieved from new investment. A lack of understanding of the specific challenges in the domain is the major contributor to the failure to deliver and fulfill on the big promises. In addition, the KNH digital technologies should have an infrastructure that can support and accommodate emerging strategies which are crucial for evidence-based policymaking and appropriate use of resources.

## RESULTS

As shown in the table 1 below 137 (51.5%) agreed that the ICT infrastructure is conducive for the growth and expansion of HMIS in KNH while 47 (17.7%) strongly agreed. Additionally, 9 (3.4%) and 25 (9.4%) strongly disagreed and disagreed respectively that the ICT infrastructure is conducive for the growth and expansion of HMIS in KNH. Analysis of whether the cost of ICT equipment and tools affected the application and implementation of HMIS reported that only 9 (3.4%) strongly disagreed, 25 (9.4%) disagreed while 48 (18%) were uncertain and 130 (48.9%) agreed that the cost of ICT equipment and tools affected the application and implementation of HMIS. With the

foregoing, 66 (24.8%) disagreed that the department has an adequate pool of highly HMIS-trained skilled labour, while 92 (34.6%) of the participants were uncertain about the level of trained, skilled labour. Only 79 (29.7%) of the KNH participants agree that the department has an adequate pool of highly HMIS-trained skilled labor, as depicted in Table 1.

**Table 1: Technical factors associated with the implementation of HMIS.**

Factors	Strongly Disagree n(%)	Disagree	Uncertain	Agree	Strongly agree
Cost of ICT equipment and tools affects the application and implementation of HMIS	9 (3.4)	25 (9.4)	48 (18.0)	130 (48.9)	54 (20.3)
ICT infrastructure is conducive for the growth and expansion of HMIS	13 (4.9)	40 (15.0)	29 (10.9)	137 (51.5)	47 (17.7)
The department has an adequate pool of highly HMIS-trained skilled labor	19 (7.1)	66 (24.8)	92 (34.6)	79 (29.7)	10 (3.8)
Lack of proper training affects growth and expansion of HMIS	5 (1.9)	30 (11.3)	16 (6.0)	147 (55.3)	68 (25.6)
Have any computers in the department	5 (1.9)	258 (97.0)	3 (1.1)	0 (0.0)	0 (0.0)
KNH has a current and up-to-date ICT infrastructure	33 (12.4)	60 (22.6)	70 (26.3)	75 (28.2)	28 (10.5)

Null hypothesis ( $H_0$ ): There is no association between the HMIS implementation and individual factors.

Alternative hypothesis ( $H_a$ ): There is an association between the HMIS implementation and the individual factors.

A chi-square test of association was conducted to examine the relationship between individual factors and the implementation of Health Management Information System (HMIS).

For the variable, HMIS has been fully implemented by the hospital, a significant association was found with the variable "With HMIS, turnaround time (patient waiting time) has greatly improved,"  $\chi^2 (8) = 44.603$ ,  $p < 0.001$ . Similarly, a significant association was found between the variable "HMIS has been fully implemented by the hospital" and the variable "Workers who have adopted HMIS have self-confidence in productivity,"  $\chi^2 (8) = 27.265$ ,  $p < 0.001$ . Furthermore, a significant association was observed between the variable "HMIS has been fully implemented by the hospital" and the variable "With HMIS healthcare service delivery is faster, better and easier to deliver,"  $\chi^2 (8) = 20.759$ ,  $p = 0.008$ .

However, there was no significant association between the variable "HMIS has been fully implemented by the hospital" and the variable "Do you have any skills or training in HMIS?"  $\chi^2 (8) = 7.865$ ,  $p = 0.447$ , or the variable "For you to effectively carry out your duties you need HMIS,"  $\chi^2 (16) = 17.161$ ,  $p = 0.375$ . Lastly, a significant association was found between the variable "HMIS has been fully implemented by the hospital" and the variable "The past way of doing things has been successful and there is no clear evidence of adopting,"  $\chi^2 (16) = 42.216$ ,  $p < 0.001$  as indicated in table 2.

**Table 2: Test of association between technical factors and the implementation of HMIS.**

Dependent Variable	Independent variables	$\chi^2$ values	DF (degrees of freedom)	p-value
<b>HMIS has been fully implemented by the hospital</b>	Cost of ICT equipment and tools affects the application and implementation of HMIS	8.639	8	0.374
	Lack of proper training affects growth and expansion of HMIS in KNH	16.302	8	0.038
	The department has an adequate pool of highly HMIS-trained skilled labor.	56.500	8	<0.001
	The ICT infrastructure is conducive for the growth and expansion of HMIS	74.475	16	<0.001
	Lack of proper training affects growth and expansion of HMIS	19.591	16	0.239

Similarly, a significant association was found between the variable HMIS has been fully implemented by the hospital and if healthcare service delivery was faster, better and easier to deliver,  $\chi^2 (16) = 56.509, p < 0.001$ . It was therefore deduced that as result of HMIS there was a faster, better, and easier healthcare service delivery as shown in table 3.

**Table 3: Association between HMIS implementation and service delivery.**

	HMIS healthcare service delivery is faster, better and easier to deliver						$\chi^2$ (df)	P-value
		Strongly disagree (n)	Disagree (n)	Uncertain (n)	Agree (n)	Strongly agree (n)		
HMIS has been fully implemented by the hospital	Strongly disagree (n)	4 (0.8)	7 (2.8)	3 (3.24)	6 (10.8)	0 (3.2)	56.509 (16)	<0.001
	Disagree (n)	2 (3.6)	20 (12.2)	5 (10.6)	44 (47.3)	17 (14.2)		
	Uncertain (n)	0 (2.1)	2 (7.0)	11 (6.0)	30 (26.9)	7 (8.1)		
	Agree (n)	5 (3.6)	7 (12.2)	13 (10.6)	51 (47.3)	12 (14.2)		
	Strongly agree (n)	0 (0.8)	1 (2.8)	0 (2.4)	12 (10.8)	5 (3.2)		

A chi-square test of association on the full implementation of HMIS and the effect brought about by HMIS on better up-dating and expertise in healthcare service delivery reported for a significant association between the two variables,  $\chi^2 (16) = 92.256, p < 0.001$ . This implied that the fully implemented HMIS system in the hospital resulted to a better system up-dates for healthcare service delivery as shown in table 4.14 below.

**Table 4: Association between HMIS implementation and better up-dating and expertise in healthcare service delivery.**

	HMIS has brought about better up-dating and expertise in healthcare service delivery						$\chi^2$ (df)	P-value
		Strongly disagree (n)	Disagree (n)	Uncertain (n)	Agree (n)	Strongly agree (n)		
HMIS has been fully implemented by the hospital	Strongly disagree (n)	5 (5.5)	5 (2.0)	5 (3.0)	4 (12.2)	1 (2.3)	92.256 (16)	<0.001
	Disagree (n)	0 (2.3)	18 (8.6)	11 (13.2)	51 (53.6)	8 (10.3)		
	Uncertain (n)	1 (1.3)	1 (4.9)	14 (7.5)	31 (30.5)	3 (5.8)		
	Agree (n)	1 (2.3)	2 (8.6)	10 (13.2)	61 (53.6)	14 (10.3)		
	Strongly agree (n)	0 (0.5)	0 (2.0)	0 (3.0)	15 (12.2)	5 (2.3)		

A good number of key informants interviewed on the question “Would you say HMIS achieved its objectives in KNH?” were in congruent with HMIS achievements, a participant opined;

“Yes, to some extent, however a lot needs to be done e.g., good data entry and analysis. HMIS had reduced patients’ queues and waiting time, cost, and it has achieved patient data set, it is now easier to retrieve records. The services nowadays at KNH are running smoothly and service delivery has since improved...”

Nonetheless, there was a respondent who was for the contrary;

“HMIS has not really achieved its objectives since the hospital was still manual. There are only four processes that were automated; Registration, billing, supplies, and nursing, but 90% of KNH is still manual. Some of the respondents feel uncertain about the achievement of the objectives since the evaluation to compare with the manual is yet to be done. The system was established to help the hospital management in the decision-making process, but this has not been achieved...”

## CONCLUSIONS

Leveraging technology can help provide accessible, efficient, and equitable healthcare services for everyone. The digital transformation should usher in a new era in healthcare that empowers patients and communities by providing better access to care and information, reducing waiting lists and costs, and enabling health services to reach the most vulnerable populations. It also supports collaborative interprofessional practice and facilitates access to health and community resources in general. Governments can improve access to quality health services by implementing secure and interoperable digital solutions and strengthening health information systems. Digital transformation enhances self-care, promotes health, improves collaboration, and addresses healthcare access inequities. A comprehensive digital transformation has the potential to improve health outcomes for all, allowing for a healthier population and more sustainable future.

It is crucial to address the digital divide, especially for vulnerable communities while keeping in mind the principles of gender, equity, and ethnicity. Health equity means providing equal opportunities to everyone and eliminating discriminatory barriers in healthcare. By embracing digital solutions that are inclusive, ethical, and secure, the global health community and governments can transform healthcare models, empower patients and providers, and establish resilient health systems that can effectively prevent and tackle diseases while promoting well-being for all.

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