International Journal of Research Publication and Reviews

The Influence of Quality of Digitized Health Information on Management of Essential Medicine Supply Chain in Public Healthcare Facilities in Kenya

[a] Robert Mugubi N. Nalebe, [b]Prof. George W. Odhiambo-Otieno, PhD; [c]Dr. Caroline Kawila Kyalo, PhD

[a] Department of Health Systems Management, Kenya Methodist University, Kenya, bobnalebeson@yahoo.com*

[b] Department of information Science, Health Records and Systems, Rongo University, Kenya

[c] Department of Health Systems Management, Kenya

Doi: https://doi.org/10.55248/gengpi.5.0424.0932

A B S T R A C T

The aim of this study was to investigate the influence of quality (accurate, reliable, complete, relevant, and timely) of digitized health information on essential medicine supply chain management in public healthcare facilities in Kenya, as a mitigation measure against essential medicine stockout. The study employed both quantitative and qualitative research design in Kajiado, Makueni and Mombasa Counties. 150 healthcare workers were sampled through simple random sampling and 14 key informants through purposive sampling. 143 completed semi structured questionnaires and 14 key informant guides were analyzed using NVivo, Qualitative Data Analysis (QDA) Miner and SPSS software. Multiple regression analysis, hypothesis testing (Inferential statistics) and qualitative information were applied to describe data, draw inferences and conclusion on the findings. Study findings show that a majority of public healthcare facilities in Kenya do not have an end-to-end functional digital health information system (HIS) to support the management of essential medicine supply chain. Information generated by the existing electronic health information systems in public healthcare facilities in Kenya is not timely, is unreliable and incomplete. The study concludes that; quality digitized HIS has positive and significant influence on timely management of essential medicine supply chain in public healthcare in Kenya. The study is significant as it provides evidence for strengthening digital health information systems in public healthcare facilities in Kenya.

Keywords: Quality digitized health information, Management, essential medicine supply chain , public healthcare facilities, ICT infrastructure

1. Introduction

Health information system is part of the six building blocks of the health systems (health workforce, access to essential medicines, leadership and governance, health information systems, healthcare service delivery and health systems financing) critical for management of essential medicines supply chain (WHO 2007, WHO 2021, Oreni, *et al,* 2021 and Aila and Kithuka 2021). Availability of safe and effective essential medicines is considered by World Health Organisation as a basic human right and a priority under Kenya vision 2030 (MOH Kenya 2020, WHO 2019). However, stock out of critical essential medicines are still a critical concern globally (MOH Kenya 2020, WHO 2019). Notably drug shortage highly affects middle- and low-income countries causing severe health and economic crises. In Sub Saharan Africa essential medicine shortages are known to have diverse impacts on public hospitals and patients (Ogollah *et al,* 2022 and Shukar *et al,* 2021). Essential medicine stock out in relation to supply occur when supply of health products, vaccines and medicines is considered insufficient to satisfy the needs of patients, while on demand side it may happen when the demand for essential medicine exceeds the capacity to supply (Shukar *et al,* 2021). Patients are exposed to treatment failure, cancellation or delay of care, extended period of hospitalization with risks of disabilities or death when public healthcare facilities experience essential medicine stockout. (Shukar *et al,* 2021). With regards to viability of using digital health interventions for medical stock availability, qualitative evidence reference to limitations such as workforce skills and supportive supervision for health workers, lack of access to electricity, connectivity and network, lack of integration of the information systems and usability of digital tools (WHO,2019).

Health information systems digitalization is among innovations that are influencing health sector performance including the management of essential medicines and medical products. Digital information technology has been found to be an enabler for disseminating real-time information to support health service delivery including medicine stock management in hospitals (Jason, 2021). In 2019 the World Health Assembly recognized information and communication technologies as being able to handle new challenges and opportunities (WHO, 2021). There is a growing agreement that use of digital technology will aid towards ensuring that 3 billion people receive help from universal health coverage and are better protected from public health emergencies (WHO, 2021). It is argued that to succeed, digital health initiatives should be guided by organizational leadership, robust strategy, technological and human resources (WHO, 2021). Secondly that digital health initiative should well be coordinated because fragmented digital initiatives

lead to disjointed information and inadequate service delivery (WHO,2021). As digital health initiatives grow broadband and internet connectivity, access to ICT equipment, information literacy and information and communication technologies are becoming more widespread to address essential medicines (WHO, 2019 and WHO,2021). Digital health technologies offer opportunities to address concerns about essential medicines (WHO,2019). Digital health intervention may be used to provide health workers with timely information for managing essential medicine supply chain (*ibid*). Unfortunately, often, health sector decisions on the management of essential medicine supply chain in most low- and middle-income countries (LMICs) are rarely based on information from facility information system (HIS) (Karijo *et al*, 2021).

Significant number of resources have been devoted globally on digital health information systems to support evidence-based service delivery in the health sector. Slovenia, Estonia, the Netherlands, Denmark, Sweden, Norway, Finland, the United Kingdom, Scotland, and Wales are just a few of the nations that have successfully implemented digital health information systems that have the capacity to collect, process and dissemination information across other information systems. In 2017 the European stakeholders on medicine supply chain advocated for early detection of shortages of essential medicines through improved essential medicine data infrastructure, access to essential medicines information, consistency in reporting and collaboration (European Association of Hospital Pharmacists, 2022).

Governments in developing countries have also put efforts in developing digital health information systems (HISs) to facilitate real-time information dissemination however poor planning, fragmentation, and lack of integration have hampered successful implementation of the majority of HISs more specifically for managing essential medicines at the facility (Bagayoko *et al,* 2020). Consequently, two billion people globally suffer from preventable diseases and death due to lack of timely access to essential medicines (United Nations Human Rights Commission, 2015 and WHO, 2017). In Africa nearly 800,000 children under four years die of malaria yet early treatment with efficacious essential medicines could save lives (Management Science for Health, 2012). Diseases that can be treated or alleviated using cost effective essential medicines still are the main causes of disabilities and death in developing countries (Management Science for Health, 2012). While millions of people do not have regular access to essential medicines and those who manage to receive, receive either wrong or little treatment (*ibid*). Many patients in Africa, especially those from poor household face difficulties to access essential medicines (Adebisi *et al* ,2022).

African governments would therefore think about investment in effective digital information system, policies on digitalization and health workforce that can promote essential medicine availability at the hospital (Ogollah, *et al,* 2022). However, due to poor leadership, inadequate technical infrastructure, low levels of digital skill, lack of trained personnel, poor data quality and weak information analysis at facility level, information systems in Africa are incapable to produce information that can effectively support the management of essential medicine supply chain (Ogollah *et al,* 2022; Jason,2021, WHO 2008). Within East African Region digital health information systems are characterized by fragmentation, information errors, duplications, and inadequate information to support essential medicine supply chain management (Ibeneme *et al,* 2022 and Neumark and Prince, 2021). However, despite these challenges in East Africa the use of mTrac, a mobile device, for medical data collection, analysis, and communication among health personnel has proven to be successful in Uganda.

Noteworthy progress and investment in digital health solutions have been made in Kenya (Ministry of Health, Kenya, supply chain strategy 2020-2025). However, Kenya's digital health information initiatives are fragmented, and not all are connected to Kenya health information system network. At the public health facilities level, the Kenya Health Information System (KHIS) face challenges of unreliable and untimely health information to support efficient management of essential medicines supply chain at facility level. A study in Kitui County showed that health information generated at the healthcare facility is not used to detect essential medicine stock outs within the facility (Karijo *et al,* 2021).

Numerous studies have cited gaps in digitalization of health information that can support management of essential medicines supply chain to mitigate against medicine stockout (WHO 2008; Kanfe *et al,* 2020). It is alleged that digital health information technology transformation in hospitals can significantly improve quality and timely information for essential medicine supply chain management to mitigate against medicine stockout (Kim and Song, 2022). Several studies have been undertaken around health products and technologies supply chain focusing on access, availability and costing however studies that explore use of digital health information linked to essential medicine supply chain management to mitigate against essential medicine stockout is inadequate (MoH, Kenya Supply Chain Strategy, 2020-2025). The aim of this study was to assess the quality of quality of digitized health information on essential medicine supply chain management in public healthcare facilities in Kenya.

2. Literature Review

A well-functioning information system ensures prompt, quality, correct and reliable production, analysis, and dissemination of information on health system performance, health determinants and health status to improve healthcare service delivery (WHO, 2007; PAHO ,2021; Lemma et al ,2020). Quality data refers to data accuracy, completeness, timelines, and consistency for processing into information easier for seamless dissemination and use at the health facility. Lugada et al (2022) notes that dependable and quality information is critical for ensuring responsiveness and better planning of the supply chain at the facility level. However, WHO (2021) states that currently health information systems (HIS) in many countries are deficient in supplying information that can support efficient management of essential medicine supply chain.

Globally about 40% of the country's information quality guarantee does not meet the standards required of quality to support informed service delivery (WHO, 2021). Smith (2019) opine that in United Kingdom (UK) successful availability of medicines in health facilities is dependent on the quality of information from medicines information management system. Smith (2019) points out that this includes information about dispensing, administration of medicines and correct documentation of transfer of medication across the facility. Smith (2019) argues that the information supplied should support evidence-based management of medicines and care. Smith (2019) states that through electronic transfer of information on medicine dose, England has

created opportunities for further interconnectivity of information systems handling medicine information. WHO (2017) states that efforts to enhance the capacity of HIS to collect quality, comprehensive and reliable information is critical for strengthening the health systems globally.

WHO, OECD and World Bank (2018) observed that continuous monitoring and assessment of health care services depend on timely and quality information. MoH Kenya Supply Chain Strategy (2020-2025) notes that data quality on essential medicine in private and public health facilities in Kenya is poor. WHO, OECD and World Bank (2018) also notes that inadequate review on the quality of essential medicine data in facilities in Kenya compromise the quality of information that could support effective management of essential medicines supply chain in facilities. Lugada et al (2022) stress that those responsible for managing essential medicine inventory and purchasing require information on essential medicine consumption to be able to quantify, forecast and mitigate against essential medicine stock outs. Lugada et al (2022) observes that digitalization creates opportunities and value addition in essential medicine supply chain system through improved information generation, quantification, information quality, and seamless information dissemination. However, Lugada et al (2022) reference several gaps at health facilities such as information accuracy, reliability, prompt reporting, and availability to support and improve essential medicines inventory management in the supply chain.

WHO (2021) and UNDP (2022) call upon countries to strengthen reliability of information to support evidence-based procurement and supply of essential medicines). WHO (2021) states that reliability of health facility information is greatly reliant upon the consistency and completeness of reporting generated from facilities. Ngusie et al (2022) and Kanfe et al (2021) articulate that effective use of timely, reliable, and accurate information is essential for the delivery of quality healthcare services.

Aila and Kithuka (2021) and Kuyo et al. (2018) posit that the global community pledged to support the improvement of information relevance, quality, and timeliness however errors and insufficiency in reports due to use of paper-based data collection and storage systems are still dominant in Sub-Saharan Africa. Waithira et al. (2019), conjecture that one of the fundamental conditions for efficient information sharing is assurance that the data and findings given are reliable and correct. GSMA Intelligence (2017) mentions that most Africa countries depend on paper-based recording in management and control of medicine stocks causing medicine stock out issues. The Ministry of Health Kenya (2020) show that having a reliable mechanism to collect, collate and report consumption of information is critical in ensuring more correct matching of demand and supply of commodities in hospital setting.

The short messaging service (SMS) provided by Life Program has shown promise in monitoring and controlling the supply of important medications, including those for the treatment of malaria, in primary health facilities. Hospital commodities information is crucial for forecasting, resupply quantities need and procurement (Tiye and Gudeta, 2018). For instance, prompt and correct information on health commodities using the available information systems infrastructure positively impact on the availability of drugs like for treatment of Malaria (Tiye and Gudeta, 2018 and Ogollah et al, 2022). Automated or electronic information systems in essential medicine management at the hospital level use information communication technology to collect and process data to increase efficiency, reduce errors and improve planning (ibid). However, Koumamba et al (2021) observe that many African countries are still struggling to achieve quality information due to unreliable, inadequate, incomplete, inconsistent, and untimely data. In the Caribbean Region (Barbados, Saint Vincent, Belge, Jamaica, Grenada, Suriname, and the Grenadines), PAHO (2021) alludes that 62 % of the counties do not have wide availability of technology and basic tools (internet connectivity, software, and hardware) to produce reliable information.

Managing Science for Health (2012) alludes that reliable information is essential for coordinating medicine information flow and distribution networks. Managing Science for Health (2012) observed that forms, reports, and records of movement of medicines and pharmaceutical needs as core of supply information system kept in computer databases or card files, ledger or folder should move within units in the facility. Regularly summarized medicine consumption reports in health facilities are used to estimate medicine needs, assess medicine use, and monitor trends in use of medicine (Management Science for Health 2012). Managing Science for Health (2012) states that health personnel should be trained in the use of medical information forms otherwise documented medicine consumption and quantification will not be reliable. MoH Kenya Supply Chain Strategy (2020-2025) observed that reliability and accuracy of health products and technologies is a challenge in Kenya. MoH Kenya Supply Chain Strategy (2020-2025) further noted that the link between quantification of health products and technologies annual budget estimates and procurement plans are weak resulting in huge variations between quantification and the medicines that are made available in the facility. Quantification gaps of 46% in public health facilities in the counties of Nairobi, Homa Bay, Marsabit, Kilifi, Mandera and Lamu resulted in essential medicine stockout and disruption of health services (MoH Kenya Supply Chain Strategy ,2020-2025). MoH Kenya Supply Chain Strategy (2020-2025) opine that fragmentation of information systems used for reporting various health commodities produce reports that are released at varied rates.

Kuyo et al. (2018) postulate that improved and unified health reporting system can produce timely data for accurate planning essential medicine supply chain management and service delivery. Teklegiorgis et al. (2016) also observed that accurate and timely information is critical for public health planning in supply chain management. Timely and accurate information is an essential tool to essential medicine stocking and restocking   and any distortion of information may have adverse effect on supply chain management and health service delivery (Ogollah, et al, 2022). WHO (2021) states that tracking Universal Health Coverage (UHC) progress through accesses to essential medicines requires accurate and timely information. However, there are worries that timely reliable information is not consistently collected to support the management of essential medicine supply chain despite the growing demands for information and evidence (WHO, 2021).

GSMA Intelligence (2017) argues that digitization of health information improves timely production and sharing of essential medicine stock levels visibility to facilities timely quantification, forecasting and resupply of medicines when needed. Phalange (2017) remarks that digitalization has most profound impact to increase the ability of the information system to communicate transparent, real-time data that enables ongoing monitoring of essential medicines, efficient medicine inventory and supply chain management at the facility. GSMA Intelligence (2017) further illustrates that timely visibility of essential medicines stock level information facilitates timely replenishment to mitigate against essential medicine stock outs at the facility. GSMA

Intelligence (2017) states that slow transition from paper-based system to digital solution infrastructure affects timely availability of data which causes essential medicine supply chain inefficiencies.

World Health Organization (2021) observes that data routinely reported by health facilities may be incomplete to support planning, supply chain management and service delivery. Koumamba et al. (2021) claim that health system effectiveness in planning and service delivery is tied to the completeness of information produced by the information system. Information use in the healthcare sector has been hampered by information systems that produce low information quality, incompleteness and untimeliness, inaccuracy, and inconsistent data. Ngusie et al (2022) assert that incomplete information contributes to low utilization of the information among health professionals for planning and service delivery. They further allude that incomplete, inaccurate, and erratic information affect the confidence in managers to use the information produced from non-digital information systems for planning and service delivery.

Digitalization of hospital information systems bring about benefits such as (i) access to quality information, (ii) increased productivity by healthcare professional (iii) more accurate and efficient quantification (iv) quality healthcare delivery, (v) improved essential medicine and clinical management (Little, 2020). Despite proven benefits of digitization many hospitals are still slow towards adoption of digitized solutions for management of essential medicine supply chain. Progressing toward digital health solutions helps to improve performance of healthcare services in general (OECD and The World Bank, 2018). Digitalization in hospitals requires digital tools to seamlessly send large volumes of complex health information that can support planning and service delivery (Little, 2020).

3. Methodology

A nested mixed method research approach combining qualitative and quantitative methods was applied to complement each other, bring about comprehensiveness, in- depth understanding of multifaceted phenomena, address shared research problem and common conclusions through deeper insights into context and numerical data. Correlation quantitative research design was applied in this study for numerical data gathering and analysis to establish whether there was a strong influence or not of the digital health information on essential medicine supply chain in public healthcare facilities in Kenya. Data was collected through interviews with a representative sample population using semi structured standardized questionnaires. Numerical data was statistically analyzed to measure the relationship between independent variables and the dependent variable using correlation and regression analysis.

Study population included clinical officers, medical officers, pharmacist and health records and information officers from level 4 and 5 public healthcare facilities in the counties of Kajiado, Makueni and Mombasa. The choice of these participants was guided by the subject of the study and the role that these cadre of staff play within the health facility in relation to health information and essential medicines supply chain management. The sample frame included 23 (20 levels 4 and 3 level 5) public health facilities. A multistage sampling was applied to sample level 4 and 5 public healthcare facilities. Health facilities were groups into clusters depending on the county where they run and tier/level of operation; To keep homogenous characteristic of the sample public healthcare facilities was classified as level 4 or level 5 and the county of operation. Simple random sampling was applied to choose a sample of 11 level 4 public health facilities from Makueni County (5), Mombasa County (3) and Kajiado county (3) as units of the study. Each of the three counties has 1 level 5 public health facility. The total sampled public healthcare facilities were 14 (11 level 4 and 3 level 5)

The first stage involved sub dividing the health facilities per county (cluster). The second stage involved simple random sampling of the level 4 public healthcare facilities per county to take part in the study. The third step was to show the number of human resources for health (clinical officers, medical officer, pharmacists and health records and information officers) from the sampled public healthcare facilities in the three counties. The final stage involved random choice of the number of health records and information officers, medical officers, pharmacists, and clinical officers to be interviewed. 14 key informants were purposively selected from the sampled 14 public healthcare facilities based on the individual's health information roles, leadership in the public healthcare facility and essential medicine supply chain management at the public healthcare facility level.

Sample size calculation formulae was obtained from Nasiurma, D. K. (2000); in the formulae N is the population, C is the coefficient of variation (0.5), e the level of precision (0.05) and n is the sample size.

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

Based on the above calculations 150 healthcare workers were sampled through simple random sampling and 14 key informants chosen from 14 sampled public healthcare facilities. The 150 healthcare workers respondents were 150 participants were distributed as follows; 20 medical officers (Makueni 8, Kajiado 4 and Mombasa 8), 34 pharmacists (Makueni 06, Kajiado 8 and Mombasa 20), 30 clinical Officers (Makueni 12, Kajiado 6 and Mombasa 12), 16 health records and information officers (Makueni 6, Kajiado 3 and Mombasa 7), 20 procurement officers (Makueni 8, Kajiado 4 and Mombasa 8), 10 nurses (Makueni 4, Kajiado 2 and Mombasa 4), 8 pharmaceutical technologists (Makueni 3, Kajiado 2 and Mombasa 3), and 5 medical stores officers (Makueni 2, Kajiado 1 and Mombasa 2) responded to the semi structured questionnaire. Out of 150 sample population, 143 semi structured interview respondents and 12 key informants participated in the study.

4. Finding and discussions

Respondents were requested to indicate their level of agreement on influence of quality of digitized health information on essential medicine supply chain management in public healthcare facility in Kenya.

Table 1: Quality of Digitized Health Information

Statements	strongly disagree	disagree	Neutral	Agree	strongly agree	Mean	Std. Dev
This health facility has a functional digital HIS that support in the management of essential medicine supply chain	41.20%	57.60%	0%	1.20%	0.00%	1.00	0.00
Information from your digital health information system is reliable for essential medicine supply chain management	38.80%	48.20%	5.90%	7.10%	0.00%	2.76	0.114
Information from your digital health information system is timely for essential medicine supply chain management	37.60%	49.40%	5.90%	5.90%	5.20%	3.15	0.163
Information from your digital health information system is accurate for essential medicine supply chain management	30.00%	25.00%	0.00%	22.90 %	22.10%	1.57	0.054
Information from your digital health information system is complete for essential medicine supply chain management	35.30%	55.30%	5.90%	3.50%	0.00%	2.73	0.108
Information from your digital health information system has improved essential medicine supply chain management	37.60%	50.60%	3.50%	2.40%	5.90%	3.26	0.158
Average						**2.41**	**0.0995**

Results in table 1. show that a cumulative majority disagreed that their health facility had a functional digital HIS that supports the management of essential medicine supply chain. On the contrary, only 1.20% of the respondents agreed that their facilities had a functional digital HIS that supports the management of essential medicine supply chain. The findings, therefore, indicate that a majority of the healthcare facilities in Kenya do not have a functional digital HIS that support in the management of essential medicine supply chain. The findings are in consistent with Kaupa and Naude (2021), who found out that most hospitals in Malawi do not have digital health information systems.

The findings were also corroborated by interview fundings, which showed that most public healthcare facilities in Kenya do not have complete digital health systems. As a key informant stated, "Apart from KHIS/DHIS and the Digital health platform (DPH) which was introduced in 2022 and yet to be installed, the facility has no experience of using health information for managing medical supply chain." Findings from interviews also reveal that most healthcare facilities did not have complete digital health information systems. For those that had, they were mixed, that is, partly digital based and partly paper based. To support this, another respondent stated that "The electronic system used in the facility is MEDBoss, a mixture of paper and electronic system. It is used at the stores level. Not fully integrated." As Faridi and Malik (2020) argue, a mixture of systems can easily result in inaccuracies and inconsistencies, especially when it comes to the management of essential medicine supply chain management. Such systems can promote drug pilferage and loss as they are not able to exhibit accountability. WHO (2008) postulates that digitizing paper-based data is simpler when it is applied in the initial stages of data considering that it is challenging to manually move data from one database to another collection. Concerns have been raised by World Health Organization (2021) that over 40% of health facilities globally cannot provide evidence of analysis on data quality and process.

From the findings, a cumulative majority of the respondents (87%) disagreed that information from their digital health information system was reliable for essential medicine supply chain management. Only 7.10% of the respondents agreed that information from their digital health information system was reliable for essential medicine supply chain management. The findings support WHO (2021), which states that reliability of health facility information is greatly reliant upon the consistency and completeness of reporting generated from facilities. The findings are also in tandem with Ngusie et al (2022) and Kanfe et al (2021), who articulate that effective use of timely, reliable, and accurate information is essential for the delivery of quality healthcare services.

While findings from the interviews revel that the quality of digitized health information influences essential medicine supply chain management in public healthcare facilities in Kenya by ensuring timely orders and reduced errors, this can only be achieved when public healthcare facilities in Kenya can install complete digital health information systems to support essential medicine supply chain management.

When respondents were asked to state to what level they felt that information from their digital health information system was timely for essential medicine supply chain management, most of them (87%) disagreed with the statement. Only 11.10% of the respondents felt that information from their digital health information system was timely for essential medicine supply chain management. The findings are in tandem with Phalange (2017), who remarks that digitalization has most profound impact to increase the ability of the information system to communicate transparent, real-time data that enables ongoing monitoring of essential medicines, efficient medicine inventory and supply chain management at the facility. GSMA Intelligence (2017) further illustrates that timely visibility of essential medicines stock level information facilitates timely replenishment to mitigate against essential medicine stock outs at the facility.

From the findings, most of the respondents (55%) disagreed that information from their digital health information system was accurate for essential medicine supply chain management. On the other hand, 45% of the respondents agreed that information from their digital health information system was accurate for essential medicine supply chain management.

Quality of digitized health information influences essential medicine supply chain management in public healthcare facility in Kenya by ensuring the accuracy of information. The quality of digitized health information influences essential medicine supply chain management in public healthcare facilities in Kenya by ensuring management and monitoring of essential medicines.

Further, most of the respondents (90.60%) also disagreed that information from their digital health information system was complete for essential medicine supply chain management. On the other hand, only 3.5% of the respondents agreed that information from their digital health information system was complete for essential medicine supply chain management. According to Little (2020), despite proven benefits of digitization many hospitals are still slow towards adoption of digitized solutions for management of essential medicine supply chain. A study by Ngusie et al (2022) and Kanfe et al (2021) asserts that incomplete information contributes to low utilization of the information among health professionals for planning and service delivery. They further allude that incomplete, inaccurate, and erratic information affect the confidence in managers to use the information produced from non-digital information systems for planning and service delivery.

Respondents were also asked to state if information from their digital health information system had improved essential medicine supply chain management. From the findings, most of the respondents (88.20%) disagreed with the statement, which means that information from their digital health information system had not improved essential medicine supply chain management. Only 7.30% of the respondents agreed that information from their digital health information system had improved essential medicine supply chain management.

From the interviews, however, a few respondents whose facilities had at least some digital health information systems, even if not complete, reiterated the importance of these systems. As one of them postulated, "It makes it easy to compile data and reports regarding number if patients, conditions, medicines required. This informs procurement of meds. Right now, am dealing with 50 ICU cases. I can only budget fir some drugs. From the records, it's easy to tell and procure their drugs regarding age and other demographics. Data is easily available on short notice, which helps us make infirmed requisition and supply if drugs. Helps in stock monitoring and sharing with other hospitals to minimize expiries. It also minimizes on pilferages." Closely, another respondent stated that "The available DHIS helps us assess trends in diseases and we are able to tell top ten conditions and general outpatient workload. It helps reduce pilferage and theft of medicine within our facility. It ensures timely delivery of both pharmaceuticals and non-pharms. When there are efficient digital health information systems in place, it is obvious that the stockings will be fast and transparent."

Table 2: Management of essential medicines supply chain

Statements	Yes	No	Mean	Std. Dev
Overall, do you agree that the management of essential medicine supply chain is dependent on the quality of information produced by the digital health information?	**97.60%**	**2.40%**	**1.98**	**0.152**
Do you face any challenges working with the existing digital health information systems in managing essential medicine supply chain in your facility.?	**68.20%**	**31.80%**	**1.68**	**0.468**
Average			**1.83**	**0.310**

Table 3: Specific Challenges Faced

Challenge	Frequency	Percent
Reliability	**20**	**23.53%**
Completeness	**31**	**36.47%**

Accuracy	10	11.76%
Accessibility	8	9.40%
Timeliness	6	7.08%
Others	10	11.76%
Total	85	100%

The study also sought to find out if the management of supply chain is dependent on the quality of information produced by digital health. From the findings, 97.60% of the respondents agreed that the management of supply chain was dependent on the quality of information produced by digital health while only 2.40% disagreed to this. This is a clear indication that the quality of information produced by the digital health system is significant in determining the management of supply chain.

The study also sought to find out if respondents faced any challenges working with the existing digital health information systems in managing essential medicine supply chain in their facilities. From the findings, 68.20% of the respondents agreed that they face challenges working with the existing digital health information systems in managing essential medicine supply chain in your facility while only 31.20% disagreed to this. From the findings most of the healthcare workers within the public facilities in Kenya challenges working with the existing digital health information systems in managing essential medicine supply chain in their facilities.

From the findings, most of the respondents cited completeness (36.47%) as the major challenge they faced while working with the existing digital health information systems in managing essential medicine supply chain in their facilities. This means that while most public healthcare facilities in Kenya have some existing digital health information systems, they are not complete to ensure proper management of essential medicine supply chain management. A good number of respondents also cited reliability (23.53%) as another challenge they encountered while working with the existing systems. This is a clear indication that in as much as there exists some digital health information systems in public healthcare facilities, they are not sufficiently reliable in ensuring proper management of essential medicine supply chain management. Accuracy, accessibility and timeliness were also cited as other challenges.

From the findings, 10% of the respondents cited "others" as other challenges encumbering them. They include network issues and consistency leading to delays and user specifications. As one respondent stated, "There are network problems. Without a network, the system cannot work and if there is any technical problem, you cannot do most of the work like processing the orders, thus bringing issues with stock. Besides, all MoH staff are not fully trained." Others included lack of automation of stores due to lack of resources, high workload issues, outdated systems, lack of skilled staff in DHIS, and inadequate ICT facilities.

Correlation Analysis

Correlation analysis was conducted between quality of digitized health information (independent variable) and essential medicine supply chain management (dependent variable). Results are presented in Table 4.

Table 4: Correlation Matrix

		Essential Medicine Supply Chain Management	Quality Of Digitized Health Information
Essential medicine supply chain management	**Pearson Correlation**	1.000	.317**
	Sig. (2-tailed)		0.000
Quality of digitized health information	**Pearson Correlation**	.317**	1.000
	Sig. (2-tailed)	0.000	
** Correlation is significant at the 0.01 level (2-tailed).			

Results in Table 4 indicated that there was a positive and a significant association between quality of digital health information and essential medicine supply chain management (r=0.317, p=0.000). These findings agree with that of Nsaghurwe et al. (2021), who found a positive relationship between the quality of digitized information and pharmaceuticals supply chain management.

Regression Analysis

The results presented in table 5 present the fitness of model used of the regression model in explaining the study phenomena. Quality of digitized health information was found to be satisfactory variable in explaining the essential medicine supply chain management. This is supported by the coefficient of determination also known as the R square of 10.1%. This means that the quality of digitized health information explains 10.1% of the variations in the dependent variable which is essential medicine supply chain management.

Table 5: Model Fitness

Variables	Values
R	0.317
R Square	0.101
Adjusted R Square	0.094
Std. Error of the Estimate	0.513

The results on analysis of variance are represented below.

Table 6: Analysis of Variance

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	4.178	1	4.178	15.906	0.000
Residual	37.299	143	0.263		
Total	41.478	144			

Table 6 provides the results on the analysis of the variance (ANOVA). The results indicate that the overall model was statistically significant. Further, the results imply that the independent variable (quality of digitized health information) is a good predictor of essential medicine supply chain management. This was supported by an F statistic of 15.906 and the reported p value (0.000) which was less than the conventional probability of 0.05 significance level.

Regression of coefficient results is presented in Table 7

Table 7: Regression of Coefficients

	B	Std. Error	T	Sig.
(Constant)	1.597	0.455	3.509	0.001
Quality of digitized health information	0.468	0.117	3.988	0.000

Regression of coefficients showed that quality of digitized health information and essential medicine supply chain management had a positive and significant relationship (r=0.468, p=0.000). These results were consistent with that of Nsaghurwe et al (2021) who found a positive relationship between the quality of digitized health information and medicine supply chain management.

$$Y = 1.597 + 0.468X1$$

From the regression equation when quality of digitized health information changes by 0.468% the essential medicine supply chain management changes by 1%, showing there is a positive relation between the two variables.

5. Conclusion

This study sought to evaluate the influence of quality of digitized health information on essential medicine supply chain management in public healthcare facility in Kenya. The findings exhibited that a majority of the healthcare facilities in Kenya do not have a functional digital HIS that support in the management of essential medicine supply chain. The findings also show that information from their digital health information system in public healthcare facilities in Kenya is not reliable for essential medicine supply chain management. The findings further show that information from the digital health information system is not accurate for essential medicine supply chain management in most of the public healthcare facilities in Kenya. Besides, information from the digital health information system is not complete for essential medicine supply chain management. From the findings, information from the digital health information system has not improved essential medicine supply chain management in public healthcare facilities in Kenya. The findings also demonstrate that the major challenges faced in the use of digital health information systems were reliability, completeness, and accuracy.

The study concludes that quality of digitized health information influence essential medicine supply chain management in public healthcare facilities in Kenya. This is deduced from the fact that quality of digitized health information has positive and significant influence on essential medicine supply chain management in public healthcare facilities in Kenya. The study is significant as it provides evidence for strengthening digital health information systems in public healthcare facilities in Kenya.

References

[1]. Aila M. S. and Kithuka P. (2021). Use of routine health information for decision making among health care workers in Marsabit county, Kenya, International Journal of Community Medicine and Public Health, 2021 Oct;8 (10):4726-4733, pISSN 2394-6032/eISSN 2394-6040, DOI: https:/dx.doi.org/10.18203/2394-6040.ijcmph20213768. http: www.ijcmph.com.

[2]. GSMA Intelligence, Analysis, scaling digital health in development markets, opportunities and recommendations for mobile operators and other stakeholders, June 2017, gsmaintelligence.info@gsmaintelligence.com.

[3]. Jason Jone. (2021). Four Elements that Bridge the Gap Between Using Data and Becoming Data-Driven, Health Catalyst, May 25th, 2021, https://www.healthcatalyst.com/insights/data-driven-healthcare-versus-using-data-4-elements.

[4]. Karijo, E. K., Otieno, G.O., & Mogere, S. (2021). Determinant of data use for decision making in health facilities in Kitui county, Kenya. Quest Journal of Management and Social Sciences, 3(1), 63-75.

[5]. Koumamba, A.P., Bisvigou, U. J., Ngoungou, E. B and Diallo, G. (2021). Health Information Systems in developing counties; Case study of African countries, BMC Medical Informatics and Decision Making, (2021) 21:232. https://doi.org/10.1186/s12911-021-01597-5.

[6]. Lemma S, Janson A, Persson LÅ, Wickremasinghe D, Källestål C. (2020) Improving quality and use of routine health information system data in low- and middle-income countries: A scoping review. PLoS One. 2020 Oct 8;15(10): e0239683. doi: 10.1371/journal.pone.0239683. PMID: 33031406; PMCID: PMC7544093.

[7]. Lugada, E., Komakech, H., Ochola, I. et al. Health supply chain system in Uganda: current issues, structure, performance, and implications for systems strengthening. J of Pharm Policy and Pract 15, 14 (2022). https://doi.org/10.1186/s40545-022-00412-4.

[8]. Management Science for Health (2012). MDS-3: Managing access to medicines and Health technologies; VA: Management Science for Health.

[9]. Ministry of Health (2020). Guidelines on management of health products and technologies in Kenya, October 2020, Ministry of Health, Republic of Kenya.

[10]. Ministry of Health, Kenya (2020). Quantification Handbook for Health Products and Technology, Ministry of Health, Afya House, Cathedral Road, Nairobi, Kenya.

[12]. Ministry of Health. (2014). The Kenya Health Policy, 2014-2030, Ministry of Health (MoH), Nairobi, Republic of Kenya.

[13]. Ministry of Health. (2016). One monitoring and evaluation framework for the health sector in Kenya "towards accelerating the achievement of Universal Health Coverage in Kenya," The Kenya Health Information Collaborative Report, Ministry of Health, Republic of Kenya.

[4]. Nasiurma, D.K. (2000). Survey Sampling: Theory and Methods. University of Nairobi, Nairobi, Kenya

[15]. Ngusie HS, Ahmed MH, Kasaye MD, Kanfe SG.(2022) Utilisation of health management information and its determinant factors among health professionals working at public health facilities in North Wollo Zone, Northeast Ethiopia: a cross-sectional study. BMJ Open. 2022 Apr 5;12(4):e052479. doi: 10.1136/bmjopen-2021-052479. PMID: 35383058; PMCID: PMC8984035.

[16]. Ogollah, H.A., Odaya, C. A., and Baraza, E. (2022). Information Systems Infrastructure used for health commodities management and service delivery: A case of level 4 Public Hospitals in Western Kenya, International Journal of Innovation Research and Advanced Studies (IJIRAS), volume 9 issue 8, August 2022.

[17]. Oreni, K.B., Andre, Y., Otieno, O.G., and Iwaret, O. M., (2021). Data Quality in Health Management Information Systems at Kenyatta National Hospital in Nairobi City County, Kenya: Influence of Technological Factors, IOSR Journal of Nursing and Health Science (IOSR-JNHS), e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 10, Issue 3 Ser. I (May – June 2021), PP 45-51, www.iosrjournals.org.

[18]. Shukar S, Zahoor F, Hayat K, Saeed A, Gillani AH, Omer S, Hu S, Babar Z-U-D, Fang Y and Yang C (2021). Drug shortage: Causes, impact, and mitigation strategies. Front. Pharmacol.12:693426. Doi:103389/fphar.2021.693426.

[19]. Tiye, K and Gudeta, T. (2018). Logistics management information system performance for program drugs in public health facilities of East Wolega Zone, Oramia region state, Ethiopia, BMC Medical Informatics and Decision Making, (2018) 18:133. https://doi.org/10.1186/s12911-018-0720-9.

[20]. WHO (2015). Technical Consultation On Preventing and Managing Global Stock Outs Of Medicines, 8–9 December 2015, WHO Geneva, Switzerland.

[21]. WHO (2017). Access to medicines: making market forces serve the poor, Ten years in public health 2007–2017, www.who.int/publications/10-year-review/en/.

[22]. WHO (2021). Health information systems: How Do Countries Perform? World Health Organization.

[23]. WHO 2021. Global Strategy on Digital Health 2020-2025, Licence:CC BY-NC-SA 3.

[24]. WHO guideline recommendations on digital interventions for health systems strengthening. Geneva: World Health Organization;2019. Licence: CC BY-NC-SA 3.0 IGO.

[25]. WHO. (2017). Health information systems and rehabilitation, Rehabilitation 2030, A call for action.