INFLUENCE OF HEALTH LOGISTICS MANAGEMENT INFORMATION SYSTEM ON AVAILABILITY OF MEDICAL COMMODITIES IN PUBLIC HEALTH FACILITIES IN KAJIADO COUNTY, KENYA

***Julius Habakkuk Bunyali[1*], Kezia Muthoni Njoroge[2], & Fredrick Kimemia[3]**

[1]Postgraduate student, Department of Health Systems Management, Kenya Methodist University, Nairobi, Kenya

[2]Lecturer, Department of Health Systems Management, Kenya Methodist University, Nairobi, Kenya

[3]Lecturer, Department of Health Systems Management, Kenya Methodist University, Nairobi, Kenya

***Email address for the Corresponding Author: jsipoche@gmail.com**

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ABSTRACT

Health logistics management systems is critical to ensure the availability of essential medicines and services. This study aimed to evaluate the influence of health logistics management information system on the availability of medical commodities in level 4 and 5 public health facilities in Kajiado County, Kenya. A descriptive cross-sectional study design was employed. Data were collected using a self-administered 5-point Likert scale structured questionnaire from 108 health care providers (HCPs). Data were coded, processed, and descriptive and inferential statistics were performed. Spearman rank correlation and logistic regression analyses were performed to determine the relationship between variables and the effect of the independent variables on the dependent variable, respectively. Statistical significance was set at <0.05. Health care workers reported varied experience with health logistics management system components. Spearman coefficient and logistic regression analyses reported a positive correlation between inventory management, order process management, and information management systems and the availability of medical commodities ($r = 0.733$, $p=0.000$; $r = -0.397$, $p=0.000$; $r = 0.737$, $p=0.000$, and ($\beta = 2.016$, S.E. = 0.581, $p< 0.05$; $\beta = 1.567$, S.E. = 2.298, $p< 0.05$; $\beta = 0.742$, S.E. = 0.363, $p< 0.05$; and ($\beta = 3.491$, S.E. = 1.312, $p< 0.05$), respectively. In this study, HCPs are not sufficiently proficient in health logistics management system, which negatively impacts the availability of medical commodities. Order process management, inventory management, and information flow management systems have positive relationships and significantly influence the availability of medical commodities in public health facilities in Kajiado County.

Keywords: *Demand Forecasting, Inventory Management System, Health Logistics Management System, Kajiado, Order Process Management*

1.0 INTRODUCTION

According to the World Health Organization (WHO), access is defined as having medicines consistently available and inexpensive at public or private health facilities or medication shops that are within one hour's walk of the population [1]. Approximately two billion people lack access to medications, and with the right care and medication, four million lives may be saved annually in Africa and Southeast Asia [1]. Approximately 80% of medicines should be accessible in all sectors according to WHO medium-term strategic plan. However, the availability of medicines in low- and middle-income nations (LMICs) is severely limited [2]. To ensure the availability of medicines, emphasis is placed on policies, access, quality, and prudent usage. A high-quality health service necessitates the availability of pharmaceuticals that are qualified, safe, and effective in sufficient quantities, always with the proper dosage and dosage forms. However, managing the supply of drugs is a highly difficult task that requires a solid organizational framework and an integrated supply chain [3].

Planning and managing the transportation of commodities and related information is made easier via the use of logistics management information system (LMIS). The LMIS is built on subsystems that are made up of several interconnected components, including demand forecasting, order process management, inventory management, and information flow management systems [4]. The LMIS might be fully computerized, semi-computerized, or paper-based. An efficient LMIS provides relevant, timely, and accurate data to decision-makers across the supply chain. The system performs several tasks, including managing information on how many medications or supplies are required at a particular service delivery point (SDP), reporting on the supply levels at SDPs, and storing and tracking information on how medical supplies are used over time at all levels of the health system [5].

In most countries in Africa, there is a lack of enough health care providers (HCPs), recording and reporting tools for logistics, and information from the SDPs, which have a detrimental effect on logistics management in health care facilities [6,7]. Proper supply of pharmaceutical supplies to health institutions is a problem in many developing nations including Kenya. The Kenya Medical Supplie Authority (KEMSA) is the sole provider of medical supplies in the public sector in Kenya [8]. Several factors including ordering practices by health care facilities, inadequate communications and information flow among stakeholders, and limited use of technology solutions, significantly affect delivery of KEMSA's mandate. In comparison to the national average of 49%, Kajiado County has a 31% mean availability of general tracer medications [9]. More than half of the population of Kajiado County lives in rural areas where they mostly rely on public hospitals. The availability of medical supplies in public hospitals in Kajiado County has not been assessed. Therefore, this study sought to evaluate the influence of a health logistics management information system on the availability of medical commodities in public health facilities in Kajiado County.

2.0 METHODS

Study design and setting

A descriptive cross-sectional study design was employed. The study setting was Kajiado county, Kenya. Kajiado county comprises five subcounties with a population size of 161,862 [(10)]. It has four level 4 and one level 5 public health care facilities served by 397 HCPs.

Study population and sample size

This study targeted health care workers, including pharmacy store managers, pharmacists, pharmacy technologists, procurement officers, laboratory technicians, pharmacy dispensing staff, nurses, and medical doctors in level 4 and 5 public health hospitals. The study was conducted between September 2022 and October 2022 .A sample of 112 of 397 participants was calculated using the Nassiuma formula [11]. Simple random sampling was used to select HCPs from each of the five facilities. The sample size was allocated proportionally depending on the targeted population in the respective subcounties.

Operational definitions of terms

Information flow management system: A set of computer programs that send and exchange data on sales, forecasts, inventory size and location, order status, manufacturing schedules, delivery capability, and firm performance indicators.

Demand forecasting system: A set of computer programs that enable the continuous projection of health commodities that will be purchased, where, when, by whom, and in what amounts.

Information technology: A broad category of increasingly convergent and integrated computer systems that handle both the information that businesses create and utilize as well as their own information.

Inventory management system: A set of computer programs that ensure that the right amount of completed goods and raw materials for transformation are always available, allowing for their quick and efficient delivery to meet a customer's inventory needs.

Order processing system: A set of computer programs that execute group duties to fulfill a customer request for products or services and serves as the foundation for information flow in a logistics system.

Data collection and management

Data were collected using a self-administered 5-point Likert scale structured questionnaire. Each component of the survey concentrated on one or more study objectives. On a 5-point Likert scale, 1, 2, 3, 4, and 5 represented strongly disagree, disagree, neutral, agree, and strongly agree responses to statement-like questions, respectively. Each respondent received a personalized questionnaire. Respondents were given questionnaires to complete in their workplaces using a drop-and-pick strategy.

Bias

The data collection tool was pretested at Embakasi East subcounty hospital, Nairobi for content and face validity tests. The reliability of the instrument was assessed using Cronbach Alpha test technique. The threshold for reliability in this investigation was set at >0.7.

Study variables

Independent variables were demand forecasting, inventory management, order process management, and information management systems, while the dependent variable was the availability of medical commodities.

Data analysis

Data obtained were analyzed using the statistical package for social sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA). Both descriptive and inferential statistics were performed. Data from the 5-point Likert scale were recoded into agree and disagree categories. Descriptive analysis generated measures of central tendency that included frequencies and percentages. Spearman rank analysis was performed to correlate the independent variables and the dependent variables in a combined relationship. The tolerances statistic and variance inflation factor (VIF) were set at <0.1 and >10, respectively. Logistic regression was performed to examine the effect of the independent variables on the dependent variable. The significance level was set at 5% level of significance.

Ethical considerations

Ethical approval for this study was granted by the Kenya Methodist University Ethics Review Committee (registration number Kemu/SERC/HSM/24/2022). Administrative approvals were also obtained from the National Council of Science and Technology (reference numberHSM-3-0539-1/2018) and the Kajiado County Health Department. Study participants were required to consent to participate in the study.

3.0 RESULTS

Demographic characteristics of the study participants

108 of 112 participants responded to the questionnaires. Most respondents 72 (66%) were male, while females were 37 (34%). Forty-two (39%) participants were between 31-40 years, followed by 41 and 50 years 31 (29%). Forty-five (41%) respondents had a bachelor's degree qualification followed by diploma education at 34 (31%). Forty-four (40%) participants had worked for more than 10 years followed by those who had worked for less than five years at 39 (36%) while 16 (15%) had worked for less than one year (**Table 1**).

Demand forecasting system

Most, 71(64.6%) participants agreed that they were always able to determine the quantities of the health commodities needed. A minority, 16 (15.2%) agreed that they were always able to determine the costs of the products required for a specific health program or service. A minority, 41(37.6%) reported that they always can determine the products that should be delivered to ensure uninterrupted supply for the program. Thirty-eight (34.8%) agreed that they were always able to manage demand as a key issue in supply chain operations, whereas 8(63.3%) agreed that they were always able to control the variety of essential goods in their facility. A minority, 12(11.8%) of the respondents reported that they could always guide policy and advocacy efforts shaping future health care portfolios of essential products. Fifteen (14.0%) agreed that they were able to replenish based on their previous records (**Table 2**).

Inventory management system

Fifty-four (49.4%) participants agreed that they were able to deal with the constant and often overwhelming influx of health commodity information. Most 64 (58.9%) agreed that they could consistently follow records management procedures at the facility. A minority, 22 (20.2%) agreed that they could always back up important records to protect the information in the event of a disaster. Eighteen (16.9%) agreed that the system provided them with a central database and point of reference for all inventories. Thirty-seven (33.7%) agreed that the system always helped them ensure there were optimal stock levels to reduce stock out costs. A minority, 13 (11.8%) of the respondents agreed that they were always able to capture and update procurement details to enable them to collate. Fifteen (14.0%) agreed that they could always confirm that physical inventory counts match the inventory records. Thirty-one (28.7%) agreed that they could always document stock levels (**Table 3**).

Information flow management system

A majority, 54 (49.4%) agreed that they always use ICT solutions in the facility operations. Forty-four (40.4%) agreed that the facility has invested in information communication systems. A minority, 22 (20.2%) agreed that they always use the system as it ensures smooth information flow to all logistics functions. Seventeen (15.7%) agreed that the system allows practical internal information sharing (**Table 4**).

Order process management system

A majority, 83 (75.7%) disagreed that the facility uses electronic order processing. Most, 69 (63.2%) disagreed that the system always supported them to make quality orders of products on the first order. Sixty-two (57.3%) disagreed that the system always processes orders on time. Sixty-one (55.6%) agreed that they always have real-time orders data. Forty-eight (43.8%) agreed to have real-time orders data. However, a majority 87 (79.8%) and 91 (82.6%) reported that they used the order tracking system to ensure availability of health commodities and the systems helped them achieve timely deliveries of the commodities (**Table 5**).

Availability of medical commodities

Most, 61 (56.1%) disagreed that commodities and drugs can be accessed at any time by users from the facility's pharmacy or medical/surgical store. Most 64 (58.4%) disagreed that suppliers always delivered supplies in time. Sixty-one (55.6%) disagreed that the facilities did not often experience frequent stock-outs of essential medicines and vaccines. Eighty-seven (79.8%) disagreed that there was access to a regular supply of widely available essential health commodities from KEMSA (**Table 6**).

Correlation analysis results

Spearman's coefficient analysis found a positive correlation between inventory management, order process management, and information management systems and the availability of medical commodities ($r=0.733$, $p=0.000$; $r=-0.397$, $p=0.000$; $r=0.737$, $p=0.000$, respectively (**Table 7**).

Logistic regression for independent and dependent variables

The tolerance and variance inflation factor (VIF) analysis were not statistically significant, hence no multicollinearity between the independent variables. The tolerance and VIF for demand forecasting, quality improvement guidelines, order process management, and information flow management systems were 0.766, 2.152; 0.882, 2.274; 0.750, 1.245; and 0.669, 1.891, respectively. Demand forecasting, inventory management, order process management, and information flow management systems were all significant predictors of the availability of medical commodities ($\beta = 2.016$, S.E. = 0.581, p-value < 0.05; $\beta = 1.567$, S.E. = 2.298, p-value < 0.05; $\beta = 0.742$, S.E. = 0.363, p-value < 0.05; and ($\beta = 3.491$, S.E. = 1.312, p-value < 0.05), respectively (**Table 8**).

Discussion

Demographic characteristics of the study participants

In this study, most respondents were male, 72 (66%), while females were 37(34%), which indicated an uneven gender distribution among HCPs in level 4 and 5 public health care facilities. Forty-two (39%) respondents were between 31-40 years, followed by those between 41 and 50 years 31 (29%). These age groups are considered to have more work experience and would therefore benefit the study by providing information that is based on the systems employed and the availability of medical commodities. Most respondents had attained a bachelor's degree and diploma education level. This indicated that the respondents were qualified, and the responses provided were based on both theoretical and practical knowledge and experience. Approximately, half of the study respondents had worked at their current facilities for more than 5 years. Responses from employees with more than five years' work experience are reliably based on the respondents' experiences rather than general knowledge of the subject matter. The experienced staff will provide relevant information that pertains to what they have experienced in the facilities and seen over the years.

Demand forecasting system

Most respondents were always able to determine the quantities of the health commodities needed. However, only fifteen percent were always able to determine the costs of the products required for a specific health program or service. Demand forecasting systems should facilitate the continuous process of projecting which health commodity will be purchased, where, when, by whom, and in what quantities [12]. Hence, public health hospitals should aim at improving their demand forecasting system to make it possible for the staff to always be able to determine the quantities of the health commodities needed. Respondents reported the ability to determine products to be delivered to ensure uninterrupted supply, manage demand, and control the variety of essential goods in the facility. A few others reported the ability to guide policy and advocacy efforts for future portfolios of essential products and the ability to replenish essential commodities based on previous records. To ensure availability of medical supplies, health facilities should have a team that has significant software database management skills [13]. This is required to structure the quantification databases and then enter the forecasting and supply planning data and assumptions into the database, calculate the final drug quantities and costs, and plan the required shipment quantities and schedules to meet the total program or country requirements. To ensure availability of medical supplies in public hospitals in low-income countries, ICT must be harnessed to improve their demand forecasting systems to ensure uninterrupted supply for the program, manage demand, and have control over the variety of essential medical commodities [14,15].

Inventory management system

Most HCPs in this study reported the ability to deal with the constant and often overwhelming influx of health commodity information and the ability to consistently follow records management procedures at the facility. However, a minority reported the ability to back up important records to protect the information in the event of a disaster. A few others also indicated that the system provided them with a central database and point of reference for all inventory and the system helped them ensure there were optimal stock levels to reduce stock out costs. A majority reported inability to capture and update procurement details to enable them to collate, confirm physical inventory counts match the inventory records, and document stock levels. The inventory management system facilitates ordering of supplies, receiving and storing of stocks, and recording and accounting for stocks is needed in all facilities [16]. The hospital pharmacist should therefore be an expert on

pharmaceuticals since they provide advice on prescribing, administering and monitoring as well as supply management who ensures that medicines are available through procurement, storage, distribution and inventory control and quality assurance [16]. Computerized inventory management systems often deployed in high-income countries allow real-time analysis of drug inventory, providing real-time data on product lot no, expiration of drugs, availability of essential medicine, and stock on hand. Thus, facilitating the easier and faster operation of the pharmacy. Automation in drug inventory management allows the pharmacist and technician to spend less time on drug inventory, efficient in reducing inventory quantity and decreased workload, thus reducing inventory cost using a computerized system [16]. Health care facilities should implement inventory management systems and ensure the HCPs can fully use the systems to ensure proper control of inventory and quantification of drugs.

Information flow management system

Many respondents agreed that they always use ICT solutions in the facility's operations and that the facility has invested in information communication systems. However, a minority agreed that they always use the system as it ensures smooth information flow to all logistics functions and allows practical internal information sharing. Information flow management system usage in the health facility supply chain involves simplicity of adoption, access to the system, management support, user-friendly system and the capability of storing memory of supply chain actors on information and communication technology as tools for attaining effectiveness in the pharmaceutical supply chain [15]. The current study infers that information flow management system application enables actors to fulfill their respective duties and responsibilities accurately, speedily with fewer individuals; hence enabling the health facility to also attain benefits that come along with the ICT execution such as to achieve patient satisfaction and cost reduction in its day-to-day operations [14].

Order process management system

Most respondents disagreed that the facility uses electronic order processing, that the system supported them to make quality orders of products on the first order, and that the system processed orders on time. However, most respondents agreed that they always had real-time orders data. Order processing management system (OPMS), using a range of clear procedures, represents the basis of all logistics systems, which makes it a key factor in logistics operations [17]. OPMS allow a few personnel to make quality orders of products on the first order, process orders on time, and have real-time orders data to ensure there was availability of health commodities at the facility. The implementation of OPMS in health facilities reduces the time needed to provide the end consumer with products or services that enhance better patient satisfaction [18]. Therefore, health facilities should find ways to improve their OPMS to enhance the availability of health supplies. The current study infers that automated order processing enables accuracy the reliability of the processing system.

Availability of medical commodities

Most respondents disagreed that commodities and drugs can be accessed at any time by users from the facility's pharmacy or medical/surgical stores, that suppliers always delivered in time, and that the facilities did not often experience frequent stock-outs of essential medicines and vaccines. Most respondents disagreed that there was access to a regular supply of widely available essential health commodities from KEMSA. The WHO recommended at least 80% availability of medicines across health systems (1). Nevertheless, studies have reported suboptimal availability in LMIC. For instance, a study in 36 LMICs on the availability of 15 medicines in the public and private sectors established that overall generic medicines were not adequately available in both the public and private sector with median availability of 38% and 64%, respectively [19]. Similarly, systematic analysis by the WHO and Health Action International (WHO/HAI) surveys on drug price and availability established differences in the availability of medicines for chronic and acute diseases in the public and private sector of developing countries for originator and generic brands of medicines [20]. In the public sector, the mean availability of generic medicines was low for both baskets (53.5% and 36% for acute conditions and chronic conditions, respectively) [19]. In the private sector, the mean availability of generics in each basket was higher than in the public sector (66.2%) for generics for acute conditions and 54.7% for generics for chronic conditions), but it was still low.

Correlation analysis

The relationship between the demand forecasting system and the availability of medical commodities was insignificant ($r=0.303$, $p=0.000$). This compares unfavorably with other studies, which show a positive change in the demand forecasting system led to increased availability of medical commodities [21]. The inventory management system and the availability of medical commodities were significant and positively correlated ($r = 0.733$, $p=0.000$). Any positive change in the availability of medical commodities led to increased availability of medical commodities. The results agree with studies published elsewhere [22]. The relationship between OPMS and the availability of medical commodities was also significant and positively correlated ($r=-0.397$, $p=0.000$). This means that any positive change in OPMS led to increased availability of medical commodities [23]. The relationship between IFMS and the availability of medical commodities was significant and positively correlated in this study ($r=0.737$, $p=0.000$). Any positive change in IFMS led to increased availability of medical commodities. The results agree with other studies [24].

Logistic regression analysis

Logistic regression analysis reported that DFS and availability of medical commodities in public hospitals in Kajiado county were positively correlated ($r = 0.303$; p-value < 0.05). Logistic regression analysis results indicated that with DFS improved the availability of medical commodities in public hospitals. A one-unit increase in OPMS increased the odds by 7.509 times that the health availability of medical commodities is influenced by DFS. The IMS and the availability of medical commodities in public hospitals were also positively correlated ($r=0.733$; p-value < 0.05). IMS improved the availability of medical commodities in public hospitals. A one-unit increase in the inventory management system increased the odds by 4.794 times that the health availability of medical commodities is influenced by the demand forecasting system. The OPMS and availability of medical commodities in public hospitals, were positively correlated ($r=0.397$; p-value < 0.05). A one-unit increase in the OPMS increased the odds by 0.476 times that the health availability of medical commodities is influenced by the OPMS. The IFMS and availability of medical commodities in public hospitals were also positively correlated ($r=0.737$; P-value < 0.05). This indicated that the IFMS influenced the health availability of medical commodities. A one-unit increase in IFMS increased the odds by 1.030 times that the health availability of medical commodities is influenced by the IFMS.

Limitations of study

This study was not without limitations, since it was dependent on respondents from the study participant and the hospitals' confidentiality policy to reveal their confidential information. The confidentiality policy prevented most of the respondents from answering certain questions. This issue was resolved by assuring the respondents of complete confidentiality and clarifying that the research was for academic purposes only. Other limitations included some respondents not completing the questionnaire, certain areas of the research tools were misunderstood, the respondents gave incomplete responses to some questions, and there were unplanned occurrences such as respondents leaving before completing the questionnaire. The issue was resolved by continuous follow-up to ensure that the respondents filled the questionnaires.

4.0 Conclusion

Health care workers in low-income countries are not sufficiently proficient in health logistics management system, which negatively impacts the availability of medical commodities. Bivariate analysis of order process management, inventory management and information flow management systems reported positive relationships and significantly influenced the availability of medical commodities in public facilities. However, the demand forecasting system was found not to bring any improvement in the availability of medical commodities.

What is already known on this topic

- Essential medical commodities are severely limited in low- and middle-income countries.
- Logistics management systems significantly influence the availability of essential medical commodities.

What this study adds

- Health care providers' proficiency of logistics management systems influences the availability of essential medicines and services.
- Order process management, inventory management, and information flow management systems have a positive relationship and significantly influence the availability of medical commodities in public health facilities.

Conflict of interests

The authors declare no conflicts of interest.

Authors' contributions

Specify the contribution to the work and write-up of the manuscript for each person listed as author.

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Tables and figures

References

1. World Health Organization. Good health adds life to years Global brief for World Health Day 2012 [Internet]. 2012 [cited 2023 Jul 6]. Available from: https://www.who.int/publications/i/item/WHO-DCO-WHD-2012.2

2. Nartey E, Aboagye-Otchere FK, Simpson SNY. Management control and supply chain operational performance of public health emergency to pandemic control. Management Research Review. 2022 Feb 8;45(3):398–435.

3. Shamsuddoha M. Integrated supply chain model for sustainable manufacturing: A system dynamics approach. Advances in Business Marketing and Purchasing. 2015;22B:155–399.

4. Xie Y, Breen L, Cherrett T, Zheng D, Allen CJ. An exploratory study of reverse exchange systems used for medical devices in the UK National Health Service (NHS). Supply Chain Management. 2016 Mar 14;21(2):194–215.

5. Durugbo CM, Almahamid SM, Budalamah LH, Al-Jayyousi OR, BendiMerad B. Managing regional logistics in times of crisis: a COVID-19 case study. Journal of Humanitarian Logistics and Supply Chain Management. 2022 Jan 11;12(1):54–77.

6. Creazza A, Colicchia C, Spiezia S, Dallari F. Who cares? Supply chain managers' perceptions regarding cyber supply chain risk management in the digital transformation era. Supply Chain Management. 2022 Jan 3;27(1):30–53.

7. Velasco N, Moreno JP, Rebolledo C. Logistics practices in healthcare organizations in Bogota. Academia Revista Latinoamericana de Administración. 2018 Nov 30;31(3):519–33.

8. Yadav P. Kenya Medical Supplies Authority (KEMSA) A case study of the ongoing transition from an ungainly bureaucracy to a competitive and customer focused medical logistics organization A study conducted for the World Bank. 2014;

9. Government of Kenya. Kenya Service Availability and Readiness Assessment Mapping (SARAM). Ministry of Health, Nairobi Kenya [Internet]. 2014 [cited 2023 Jul 6]. Available from: https://data-archive.hhfa.online/index.php/catalog/51/related-materials

10. Kenya National Bureau of Statistics. 2019 Kenya Population and Housing Census Reports - Kenya National Bureau of Statistics [Internet]. 2019 [cited 2023 Jul 6]. Available from: https://www.knbs.or.ke/2019-kenya-population-and-housing-census-reports/

11. Nassiuma DK. Survey sampling:Theory and methods. University Press, Nairobi [Internet]. 2001 [cited 2023 Jul 6]; Available from: http://erepository.uonbi.ac.ke/handle/11295/63034

12. Ramani K V., Mavalankar D. Health system in India: opportunities and challenges for improvements. J Health Organ Manag [Internet]. 2006 [cited 2023 Jul 6];20(6):560–72. Available from: https://pubmed.ncbi.nlm.nih.gov/17168107/

13. Khorasani ST, Keshtzari M, Islam MS, Feizi R. Intravenous fluid delivery time improvement: application of cross-docking system. Int J Health Care Qual Assur [Internet]. 2018 Oct 8 [cited 2023 Jul 6];31(8):1070–81. Available from: https://pubmed.ncbi.nlm.nih.gov/30415614/

14. Kneck Å, Flink M, Frykholm O, Kirsebom M, Ekstedt M. The information flow in a healthcare organisation with integrated units. Int J Integr Care [Internet]. 2019 Jul 1 [cited 2023 Jul 6];19(3). Available from: https://ijic.org/articles/10.5334/ijic.4192

15. Charles Okiria J, Mwirumubi R, Mpaata KA. Information Flow Management and the Effectiveness of the Supply Chain of Essential Medicines in the Public Sector. Evidence from Selected Public Hospitals in Uganda: A Downward Perspective. International Journal of Science and Research (IJSR) ISSN [Internet]. 2013 [cited 2023 Jul 6]; Available from: www.ijsr.net

16. Amerine LB, Calvert DR, Pappas AL, Lee SM, Valgus JM, Savage SW. Implementation of an integrated pharmacy supply management strategy. Am J Health Syst Pharm [Internet]. 2017 Dec 15 [cited 2023 Jul 6];74(24):2071–5. Available from: https://pubmed.ncbi.nlm.nih.gov/29222365/

17. Tavakkolimoghaddam S, Hadji Molana SM, Javadi M, Azizi A. System dynamics model for intra-city multimodal transportation considering behavioral indicators and demand under uncertainty conditions. Journal of Advances in Management Research. 2022 Aug 25;19(4):533–59.

18. Barden S, Bick G. Biotronik: bypassing the commodity trap of medical devices in South African healthcare. Emerald Emerging Markets Case Studies. 2021 Feb 26;11(1):1–31.

19. Cameron A, Roubos I, Ewen M, Mantel-Teeuwisse AK, Leufkens HGM, Laing RO. Differences in the availability of medicines for chronic and acute conditions in the public and private sectors of developing countries. Bull World Health Organ [Internet]. 2011 Jun 6 [cited 2023 Jul 6];89(6):412. Available from: /pmc/articles/PMC3099556/

20. Eden T, Burns E, Freccero P, Renner L, Paintsil V, Dolendo M, et al. Are essential medicines available, reliable and affordable in low-middle income countries? J Cancer Policy. 2019 Mar 1;19:100180.

21. Merkuryeva G, Valberga A, Smirnov A. Demand forecasting in pharmaceutical supply chains: A case study. Procedia Comput Sci. 2019 Jan 1;149:3–10.

22. Agarwal S, Glenton C, Henschke N, Tamrat T, Bergman H, Fønhus MS, et al. Tracking health commodity inventory and notifying stock levels via mobile devices: a mixed methods systematic review. Cochrane Database Syst Rev [Internet]. 2020 Oct 28 [cited 2023 Jul 6];2020(10). Available from: /pmc/articles/PMC8094928/

23. Cartmill RS, Walker JM, Blosky MA, Brown RL, Djurkovic S, Dunham DB, et al. Impact of electronic order management on the timeliness of antibiotic administration in critical care patients. Int J Med Inform [Internet]. 2012 Nov [cited 2023 Jul 6];81(11):782–91. Available from: https://pubmed.ncbi.nlm.nih.gov/22947701/

24. Demessie MB, Workneh BD, Mohammed SA, Hailu AD. Availability of Tracer Drugs and Implementation of Their Logistic Management Information System in Public Health Facilities of Dessie, North-East Ethiopia. Integr Pharm Res Pract [Internet]. 2020 Aug [cited 2023 Jul 6];9:83–92. Available from: https://pubmed.ncbi.nlm.nih.gov/32850300/

Tables and figures

Table 1: Sociodemographic characteristics of health care providers in level 4 and 5 public health facilities in Kajiado County

Variable		**Frequency**	**Percent (%)**
Gender	Male	72	66
	Female	37	34
Age (years)	20-30	26	24
	31–40	42	39
	41-50	31	29
	>51	9	8
Education level	Certificate	15	14
	Higher diploma	34	31
	Postgraduate degree	15	14
	Bachelor's degree	45	41
Work experience (years)	<1	16	15
	1-5	39	36
	6 – 10	10	9
	Over 10	44	40

Table 2: Demand forecasting system of health care providers in level 4 and 5 public health facilities in Kajiado County

Statement	**Agree**	**Disagree**
	N (%)	**N (%)**
I am always able to determine the quantities of the health commodities needed.	71(64.6)	38(34.8)
I am always able to determine the costs of the products required for a specific health program or service.	16(15.2)	93(84.9)
I am always able to determine the products that should be delivered to ensure an uninterrupted supply for the program.	41(37.6)	67(61.8)
I am always able to manage demand a key issue in supply chain operations.	38(34.8)	70(64.6)
I am always able to control the variety of essential goods in this facility.	18(16.07)	91(83.7)
I am always able to guide policy and advocacy efforts shaping future healthcare portfolios of essential products.	12(11.8)	97(88.2)
I am able to replenish based on my previous records.	15(14.0)	94(85.9)

Table 3: Inventory management system of health care providers in level 4 and 5 public health facilities in Kajiado County

Statement	Agree N (%)	Disagree N (%)
I am always able to deal with the constant and often overwhelming influx of health commodity information.	54(49.4)	55(50.5)
I am always able to consistently follow records management procedures at the facility.	44(40.4)	64(58.9)
I am always able to back up important records to protect information in the event of a disaster.	22(20.2)	87(79.8)
The system provides me with a central database and point of reference for all inventory.	18(16.9)	91(82.6)
The system always helps me ensure there is optimal stock levels to reduce stock out costs.	37(33.7)	72(66.3)
I am always able to capture and update procurement details to enable me collate.	13(11.8)	96(88.2)
I am always able to confirm physical inventory counts match the inventory records.	15(14.0)	94(85.9)
I am always able to document stock levels.	31(28.7)	78(71.3)

Table 4: Information flow management system of health care providers in level 4 and 5 public health facilities in Kajiado County

Statement	Agree n(%)	Disgree n(%)
I always use ICT solutions in the facility's operations.	54(49.4)	55(50.5)
The facility has invested on information communication systems.	44(40.4)	64(58.9)
I always use the system as it ensures smooth information flow to all logistics functions.	22 (20.2)	87(79.8)
The system allows practical internal information sharing.	17 (15.7)	92 (84.2)

Table 5: Order process management system of health care providers in level 4 and 5 public health facilities in Kajiado County

Statement	Agree n(%)	Disagree n(%)
The facility uses electronic order processing.	83(75.7)	26(24.3)
The system always supports me to make quality orders of products on the first order.	69(63.2)	39(36.1)
The system always processes orders on time.	62(57.3)	47(42.0)
I always have real-time data of orders.	61(55.6)	48(43.8)
I use the order tracking system to ensure there is availability of health commodities at the facility.	87(79.8)	22(20.2)
The systems helps me in achieving timely delivery of health commodities.	91(82.6)	18(16.9)
I am always able to provide a notification to an employee working in a retrieval position and alert them to process the order.	37(33.7)	72(66.3)

Table 6: Availability of medical commodities of health care providers in level 4 and 5 public health facilities in Kajiado County

Statement	Agree n(%)	Disagree n(%)
Commodities and drugs can be accessed at any time by the users from the facility's pharmacy, medical/surgical store.	48(43.3)	61(56.1)
Clients always afford and access health commodities as per need/prescriptions in the facility.	48(45.3)	61(55.7)
Suppliers always deliver supplies in time.	45(41.6)	64(58.4)
The facility does not often experience frequent stock-outs of essential medicines and vaccines.	48(43.8)	61(55.6)
There is access to a regular supply of widely available essential health commodities from KEMSA.	87(79.8)	22 (20.2)

Table 7: Spearman's correlation matrix for independent and dependent variables

			IFMS	IMS	OPMS	DFS	AMC
Spearman's rho	IFMS	Correlation Coefficient	1.000				
		Sig. (2-tailed)	.				
		N	112				
	IMS	Correlation Coefficient	.437**	1.000			
		Sig. (2-tailed)	.000	.			
		N	112	112			
	OPMS	Correlation Coefficient	.579**	.445**	1.000		
		Sig. (2-tailed)	.000	.000	.		
		N	112	112	112		
	DFS	Correlation Coefficient	.227*	.014	.214*	1.000	
		Sig. (2-tailed)	.018	.884	.026	.	
		N	112	112	112	112	
	AMC	Correlation Coefficient	.737**	.733**	.397**	.303	1.000
		Sig. (2-tailed)	.000	.000	.000	.285	.
		N	112	112	112	112	112

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

DFS: demand forecasting system; IM: inventory management system; OPMS: order process management system; IFMS: information flow management system; AMC: availability of medical commodities.

Table 8: Logistic regression for independent variable to dependent variable

Parameters	B	S.E.	Wald	df	Sig.	Exp(B)
Demand forecasting system	2.016	0.581	12.025	1	0.001	7.509
Inventory management system	1.567	2.298	0.465	1	0.005	4.794
Order process management system	0.742	0.363	4.173	1	0.041	0.476
Information flow management system	3.491	1.312	7.086	1	0.008	1.030
Constant	1.057	1.067	.981	1	.322	.348