Human Resources Factors and Management of Health Products and Technologies: A Multi-County Study on Access to Quality, Affordable Health Products and Technologies

Shadrack Mururu Meme[1*], Carol Kawila[1], Kezia Njoroge[2]

[1]Kenya Methodist University, PO Box 267-60200, Meru, Kenya
[2]Liverpool John Moores University, UK, 10 Copperas Hill Liverpool L3 5AH

**Corresponding Email: shadrackmeme@gmail.com*

Abstract

Health Products and Technologies (HPTs) are fundamental to realizing Kenya's Universal Health Coverage (UHC) goals, which emphasize high-quality medical services and minimized financial barriers. Despite efforts to improve HPT management, several counties face inefficiencies that hinder the consistent availability of affordable essential HPTs, undermining equitable access. This study investigated the impact of human resource for health (HRM) factors on the management of HPTs in selected Kenyan counties. Guided by management theory and the pragmatism paradigm, the research employed a mixed-methods design, using a descriptive survey for quantitative data and an exploratory approach for qualitative data. A census sampling technique encompassed 141 personnel responsible for HPT management at level 4 and 5 public health facilities, supplemented by key informant interviews with County Health Management Teams. Quantitative data were analyzed using descriptive and inferential statistics, while qualitative data underwent thematic analysis. The research revealed a correlation between human resource factors and HPT management of r = .509 (n = 106, P = .000). Human resource factors stood out as the most impactful predictor of HPT management (\beta = 0.251; t = 3.213; P = .002). Improving human resources for health enhances the availability of quality, affordable HPTs, advancing UHC. The study recommends a multidisciplinary Health Products and Technologies management Units (HPTUs) approach to foster collaboration among pharmacy, nursing, and clinical laboratory professionals for integrated, comprehensive HPT management.

Keywords: *Human resources for health, Affordability, Availability, Health Products and Technologies*

IJPP 14(2); 28-39

1.0 Introduction

Health Products and Technologies (HPTs), including medications, vaccines, and medical devices, are core to healthcare delivery, supporting prevention, diagnosis, treatment, and rehabilitation (Wang et al., 2020). Human resources also play a critical role in HPT management. Limitations such as inadequate staffing, absenteeism, low productivity, and weak supervision are well-documented globally. For example, Canadian studies on staffing and productivity found that remote health centers experienced inadequate staffing and oversight, leading to service delivery inefficiencies. Similarly, Snell and Morris (2018) identify human resource factors as key limitations in the management of HPTs. In Kenya, the MOH is responsible for recruiting and developing human resources to ensure effective commodity management and supply chain oversight, yet gaps persist (Ministry of Health [MOH], 2029).

Effective management of HPTs ensures their consistent availability at service delivery points, with the right quality, quantity, price, and timing, to support Universal Health Coverage (UHC) goals (Feyisa et al., 2021). Despite efforts to improve HPT management, challenges such as limited human resources, inconsistent funding, and frequent stockouts of essential medicines and diagnostics persist, undermining sustainable access to healthcare.

In Kenya's devolved health system, disparities in HPT management across counties lead to inconsistent availability, affordability, and quality, thereby negatively affecting the effectiveness of healthcare. While the Ministry of Health aims to support human resources and supply chain capacity, including the establishment of multidisciplinary HPT units, systemic challenges remain, limiting access to quality HPTs in public facilities. This study investigates how human resource factors influence access to quality health services by promoting the availability of quality and affordable health products and technologies. The objective of the study was to establish the influence of human resource factors on the management of Health Products and Technologies in selected Counties in Kenya, to inform policies that improve equitable access to essential health products and technologies, which are vital for Universal Health Coverage.

Literature Review

The management of Health Products and Technologies (HPTs) critically depends on adequate staffing. Sufficient healthcare workers ensure the timely availability, administration, and management of HPTs, which are key to achieving Universal Health Coverage (UHC). The World Health Organization notes that inadequate staffing leads to shortages and delays, especially in diagnostics and essential medicines (Tashobya et al., 2016). In many low- and middle-income countries, healthcare providers are predominantly urban-based, constraining access to essential HPTs in rural regions and resulting in poorer health outcomes (Machanga, 2024). The disparity in healthcare workforce distribution correlates with levels of economic development, illustrating systemic obstacles to delivering equitable health services.

Training is essential for the competent management of HPTs. Healthcare workers must be trained in supply chain management, demand forecasting, safe use of medical devices, and waste management to ensure efficient operations and avoid stockouts (Tesfaye et al., 2019). Studies across Ethiopia, Malawi, and Rwanda show high training rates in Malawi and Rwanda but significant gaps in Ethiopia, leading to uneven HPT management

(Chandani et al., 2012). In Tanzania, the shortage of trained personnel is recognized as a bottleneck to HPT accessibility (Kagwanja et al., 2020). Moreover, task-shifting, in which trained non-specialist cadres perform crucial logistics functions, is a promising approach to mitigation, despite risks of neglecting core responsibilities.

Uneven distribution of the healthcare workforce exacerbates HPT management problems. Urban centers typically attract the majority of skilled professionals, leaving rural and marginalized areas underserved (Karanja et al., 2018). Research in Zambia underscores the need for tailored training and supervision to improve performance across diverse settings (Kanyepe, 2022). Strategic workforce planning and mentoring are imperative to meeting future healthcare needs and improving the geographic distribution of competent staff for HPT management.

Compensation influences the motivation and retention of healthcare workers involved in HPT management. Studies in sub-Saharan Africa and India emphasize that equitable, competitive remuneration aligns workforce interests with UHC goals, improving performance (Kairu et al., 2021; Kwesiga et al., 2020). Ethiopian healthcare professionals report that job satisfaction is strongly linked to compensation fairness, underscoring its role in sustaining the skilled personnel needed for effective commodity management (Fatima et al., 2018).

"The research revealed human resource factors made a substantial unique contribution to explaining the variance in HPT management and stood out as the most impactful predictor of HPT management"

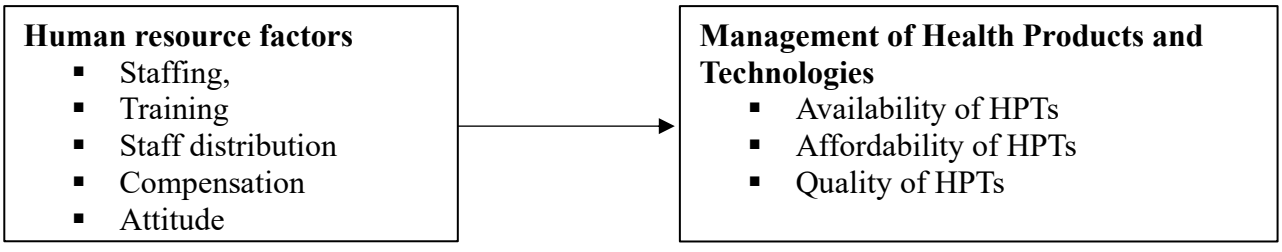
Healthcare workers' attitudes markedly affect the effectiveness of HPT management. Continuous professional development fosters skills that keep pace with evolving medical technologies (Dye, 2020). Challenges in retaining skilled workers in underserved areas underscore the need for incentives and supportive management (Tamene, 2016). Globally, promoting a positive work environment with fair remuneration, effective communication, and transformational leadership enhances motivation to adopt innovations fundamental to UHC (Sweed, 2016; Sansone et al., 2019).

Theoretical Framework

Utilization management theory was used in the study. It emphasizes the importance of efficiency, medical necessity, and appropriateness in the application and management of health products and technologies in the delivery of medical services.

Figure 1

Conceptual framework



2.0 Material and Methods

The study was conducted in Kisumu, Kiambu, Machakos, Nyeri, and Isiolo counties in Kenya to evaluate human resource factors influencing HPT management. It adopted a pragmatist paradigm that embraces both objective and socially constructed realities. A cross-sectional survey design collected quantitative data, complemented by qualitative interviews. The census method was used to select 141 staff managing HPTs at level 4 and 5 public health facilities, with purposively selected County Health Management Team members serving as key informants.

Data collection used pretested questionnaires administered via Google Forms and structured key informant interview guides. Ethical approvals were obtained from the relevant county authorities and the Institutional Scientific Ethical Review Committee at Kenya Methodist University (KeMU/ISERC/HSM/26/2023), and a National Commission permit (NACOSTI/P/23/31850) was secured. Data quality was ensured through piloting in Kajiado County and subsequent refinements.

Quantitative data were processed in SPSS v. 25 for cleaning and validation. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were calculated. Diagnostic tests for normality, autocorrelation, and multicollinearity were conducted to assess violations of assumptions. Inferential statistics included Pearson Chi-square for independence, Kruskal-Wallis H tests, one-way ANOVA, Pearson product-moment correlation, and multiple hierarchical regression analysis, with results presented in frequency tables. Qualitative interviews underwent thematic content analysis. Informed consent and strict confidentiality underpinned ethical compliance throughout the study.

3.0 Results and Discussion

A total of 141 structured questionnaires were distributed via Google Forms. Of these, 106 were completed, yielding a 75.2% response rate. The study aimed to identify the key human factors, including staffing, training, staff distribution, compensation, and attitude, that influence the management of HPTs in public hospitals in Kenya, as shown in Table 1 below.

Table 1

Human Resource Factors Affecting HPTs

County	Staffing	Training	Staff distribution	Compensation	Attitude	N	Chi-Square (χ^2)	P Value
Kiambu	6(46.2%)	5(38.5%)	0(0.0%)	2(15.4%)	0(0.0%)	13	18.705	.284
Isiolo	6(42.9%)	6(42.9%)	0(0.0%)	1(7.1%)	1(7.1%)	14		
Machakos	20(54.1%)	12(32.4%)	5(13.5%)	0(0.0%)	0(0.0%)	37		
Kisumu	12(52.2%)	5(21.7%)	4(17.4%)	1(4.3%)	1(4.3%)	23		
Nyeri	11(57.9%)	4(21.1%)	2(10.5%)	0(0.0%)	2(10.5%)	19		
	55(51.9%)	32(30.2%)	11(10.4%)	4(3.8%)	4(3.8%)	106		

The study identified staffing as the most significant factor influencing the management of HPT across all counties, with 55(51.9%). This indicates a consensus that adequate staffing is crucial for effective HPT management. In addition, training was the second most influential factor in HPT management at the county level, accounting for 32% (30.2%). Staff distribution was reported by 11(10.4%), indicating that the distribution of staff across departments or facilities is less of a concern than staffing and training. Conversely, compensation and attitude were the least cited factors, with only 4(3.8%). In Nyeri County,

staffing was reported as highly important, with 11 (57.9%) respondents, while compensation was not perceived as a concern for the management of HPTs. Also, there was a strong emphasis on staffing in Machakos County (20, 54.1%) and Kisumu County (12, 52.2%). Although in Isiolo County, staffing and training were considered important, each with 42.9% of responses, the county showed a balanced concern for both factors. The statistical analysis showed that these perceptions were relatively consistent across counties, with no significant variation in how these factors were prioritized (Chi-Square Value = 18.705; P-value = 0.284).

The research findings mirrored those of Njogo (2022) in Makueni County and Chelangat et al. (2021) in Kericho County, indicating that staffing and training are critical to healthcare management, with staffing the most significant factor. However, Ewing (2023) in Kajiado County reported a different view, finding that compensation, rather than staffing, was the most important factor, highlighting the role of financial incentives in healthcare management.

Effectiveness of Health Workers' In-Service Training on Management of HPT

The study examined the effectiveness of in-service training for health workers on the management of Health Products and Technologies, with ratings collected across five counties: Kiambu, Isiolo, Machakos, Kisumu, and Nyeri. The results were based on a Kruskal-Wallis H test, a nonparametric method for comparing the mean ranks across more than two independent groups, as shown in Table 2.

Table 2

Effectiveness of Health Workers' In-Service Training on Management of HPT

County	N	Mean Rank	Kruskal-Wallis H	Asymp. Sig.
Kiambu	13	51.65		
Isiolo	14	50.29		
Machakos	37	54.12		
Kisumu	23	58.91		
Nyeri	19	49.37		
Total	106		1.449	0.836

The study found that Kisumu County had the highest mean rank (58.91), indicating that respondents in this county perceived in-service training as the most effective in improving the management of HPTs compared with the other counties. Machakos County had a mean rank of 54.12, with Kiambu and Isiolo Counties having mean ranks of 51.65 and 50.29, respectively. Nyeri County had the lowest mean rank (49.37). Perceptions of the effectiveness of in-service training in managing HPTs were similar across the five counties, with no significant differences in ratings (Kruskal-Wallis H statistic = 1.449, P-value = 0.836).

Evidence from the Kenyan public sector suggests that in-service training is perceived as highly effective by professionals, emphasizing its critical role in enhancing management competencies and professional development across various institutional levels. Similarly, Mwanakarama et al. (2022) reported similar perceptions in Mombasa County, where respondents highlighted the positive impact of regular training on professional competencies. However, a study by Odhiambo and Wabala (2023) in Nakuru County found that in-service training was perceived as less effective due to logistical challenges and insufficient follow-up, resulting in minimal improvements in management practices.

Frequency of Staff Training on HPT Management

The study investigated how frequently training was provided to staff to keep them up to date on advancements in the management of Health Products and Technologies across five counties: Kiambu, Isiolo, Machakos, Kisumu, and Nyeri. The Kruskal-Wallis H test was used to compare mean ranks across these counties, as shown in Table 3 below.

Table 3

Frequency of Staff Training on HPT Management

County	N	Mean Rank	Kruskal-Wallis H	P value
Kiambu	13	46.69		
Isiolo	14	57.75		
Machakos	37	56.89		
Kisumu	23	39.57		
Nyeri	19	65.29		
Total	106		9.952	.041

The study revealed that Nyeri County provided staff training more frequently than other counties (mean = 65.29). Nevertheless, Isiolo County (mean = 57.75) and Machakos County (mean = 56.89) had relatively high mean ranks. Kisumu County had the lowest mean rank (39.57), suggesting that training is provided least frequently in this county. The asymptotic significance of 0.041 (P-value < 0.05) indicated a statistically significant difference in training frequency across counties (Kruskal-Wallis H statistic = 9.952).

Wambugu (2021) conducted a study in Nakuru County that supports these findings, noting that frequent staff training was associated with improved healthcare outcomes. Similarly, Rashid (2021) observed in Mombasa County that higher training frequency was linked to better service delivery in public institutions. However, Wamunga & Wakhu (2021) present a contrasting view from research in Kakamega County, arguing that training frequency had less impact on performance than the quality and relevance of the training provided.

Satisfaction with the Current Compensation Structure for Staff in HPT

The study examined satisfaction with the current compensation structure for staff involved in the management of Health Products and Technologies (HPT) across five counties: Kiambu, Isiolo, Machakos, Kisumu, and Nyeri. The Kruskal-Wallis H test was used to compare the mean ranks of satisfaction across these counties, as shown in Table 4 below.

Table 24

Satisfaction with the Current Compensation Structure for Staff in HPT

County	N	Mean Rank	Kruskal-Wallis H	Asymp. Sig.
Kiambu	13	43.58		
Isiolo	14	55.21		
Machakos	37	51.11		
Kisumu	23	60.15		
Nyeri	19	55.63		
Total	106		3.056	.549

The study found that Kisumu County (mean=63.24) had a compensation structure that was more satisfactory to staff than those in other counties. Nyeri County (mean=55.63) and Isiolo (mean=55.21) also showed relatively high levels of satisfaction. Kiambu County had the lowest mean rank (43.58), indicating lower staff satisfaction with the compensation structure in this county. While Kisumu, Nyeri, and Isiolo counties showed higher mean ranks, indicating somewhat higher satisfaction with the compensation structure, these differences were not statistically significant. The lack of significance implied that, across all five counties, staff satisfaction with the current compensation structure for HPT management was relatively uniform (Kruskal-Wallis H statistic = 3.056; P-value = 0.549).

The findings agreed with those of Patta (2021) in Kakamega County, showing no statistically significant differences in compensation satisfaction among health personnel. However, a study by Mirera et al. (2020) in Machakos County contradicted these results, revealing significant disparities in compensation

satisfaction across healthcare facilities, suggesting that local factors may play a more substantial role in some regions.

Effectiveness of addressing human resources strategy challenges

The respondents rated the effectiveness of addressing challenges in aligning human resources strategies with HPT management goals, as shown in Table 5 below.

Table 3*Effectiveness of addressing human resources strategies challenges*

County	N	Mean Rank	Kruskal-Wallis H	Asymp. Sig.
Kiambu	13	50.54	8.204	0.084
Isiolo	14	37.75		
Machakos	37	56.62		
Kisumu	23	63.24		
Nyeri	19	49.26		
Total	106			

The study found that Kisumu County addresses challenges related to aligning human resources strategies with HPT management goals more favourably than other counties (mean rank = 63.24), followed by Machakos County (mean rank = 56.62). Kiambu and Nyeri Counties addressed these challenges to a moderate extent (mean ranks = 50.54 and 49.26, respectively). Conversely, Isiolo County addressed these challenges less favourably than the other counties. Although Kisumu and Machakos Counties appear to have higher ratings for the effectiveness of addressing these challenges, the differences across counties were not statistically significant (Kruskal-Wallis H value = 8.204; p-value = 0.084).

Further, the key interviewees reported that the hospitals experienced human resources challenges.

"...Some of the challenges faced regarding human resources in the management of health products and technologies include a shortage of personnel, high staff turnover, inadequate training in forecasting and quantification at both the management and facility levels, a limited number of technical staff; capacity challenges in HPT management, cases of lack of integrity, theft, resistance to the use of inventory management tools (manual & electronic), and brain drain due to human resource resignations..." (KII, Male, 004, 24th June, 2024)

In line with these findings, counties that implement more sophisticated human resource strategies generally achieve better alignment with their health product and technology management goals, resulting in superior health outcomes. Similarly, Khatoon (2020) found that effective human resource management is crucial for achieving organizational goals, supporting the idea that certain countries may perform better in this regard. However, Yaqoob et al. (2022) argue that the perceived effectiveness of human resources strategies may vary significantly by regional economic conditions, suggesting that differences across counties could still be impactful, even if not statistically significant.

Health workers' attitude and ability to manage HPT

The study examined the influence of health workers' attitudes on the ability to manage Health Products and Technologies (HPT) across counties. The Kruskal-Wallis H test was used to compare responses across counties, as shown in Table 6 below.

Table 6

Health workers' attitude and ability to manage HPT

County	N	Mean Rank	Kruskal-Wallis H	Asymp. Sig.
Kiambu	13	62.23	1.974	0.741
Isiolo	14	54.86		
Machakos	37	52.65		
Kisumu	23	48.54		
Nyeri	19	54.18		
Total	106			

Kiambu County has the highest mean rank (62.23), suggesting that respondents in this county perceive health workers' attitudes as having a stronger impact on the ability to manage HPT than in other counties. Isiolo and Nyeri counties had similar mean ranks (54.86 and 54.18, respectively), indicating moderate perceptions of the impact of health workers' attitudes on HPT management. In contrast, Kisumu County had the lowest mean rank (48.54). Although Kiambu appears to have the highest mean rank, suggesting a stronger perceived impact of health workers' attitudes on HPT management, the differences among the counties are not statistically significant (Kruskal-Wallis H = 1.974, p = 0.741). Overall, perceptions across the counties were relatively similar, and no county stood out as having a significantly different view on the impact of health workers' attitudes on HPT management.

Wamunga and Wakhu (2021) found in Nakuru County that health workers' attitudes significantly influenced patients' management of hypertension (HPT), supporting the idea that positive perceptions can enhance treatment outcomes. Similarly, Njoroge (2020) in Murang'a County reported that healthcare providers' attitudes played a crucial role in patients' adherence to HPT management plans. However, Kiarie and Mbugua (2022) in Nairobi County disagreed, concluding that health workers' attitudes had a minimal impact on HPT management, with access to healthcare facilities and medication availability being more critical factors.

The study found that human resource factors are pivotal to facilitating access to high-quality Health Products and Technologies (HPTs), as reflected in a mean score of 4.15. Respondents emphasized that effective human resource management—including training, recruitment, and equitable staff distribution—is fundamental to achieving excellence in HPT management. Strategic investment in HR practices directly influences the success of HPT programs. Respondents also strongly agreed that health workers' attitudes significantly impact HPT management, with a mean score of 4.30 highlighting the importance of maintaining a positive, proactive workforce. This elevated score also reflected staff concerns about the unavailability of essential HPTs, underscoring their dedication to patient care and resource provision. Therefore, addressing staff concerns and ensuring the consistent availability of critical HPTs are essential for upholding both quality patient care and workforce morale.

Respondents largely disagreed that the number of staff involved in managing Health Products and Technologies (HPTs) has no impact, indicating that adequate staffing is viewed as critical for effective HPT management (Mean: 1.93). Additionally, there was disagreement about the appreciation and compensation of health workers engaged in HPT management (Mean: 2.65), reflecting concerns about insufficient recognition and remuneration. The findings underscore the importance of addressing compensation and recognition to sustain motivation and job satisfaction. Overall, the analysis identified the vital role of human resources and leadership in promoting quality HPT management, while highlighting the need to improve staff distribution, compensation, and feedback systems.

4.0 Conclusion

The research revealed a correlation of 0.509 (r = .509 **, n = 106, P = 0.000) between human

resource factors and the management of health products and technologies. Human resource factors made a substantial unique contribution to explaining the variance in HPT management and stood out as the most impactful predictor of HPT management (Beta=0.251; t=3.213; P=0.002). The findings highlighted the importance of human resource factors in improving the management of health products and technologies. The study found that human resources for health significantly affect the management of Health Products and Technologies (HPTs) in public hospitals in Kenya. Consequently, the null hypothesis (H03) was rejected, while the alternative hypothesis (Ha3) was supported.

5.0 Recommendations

The study recommends that Kenyan county governments ensure adequate staffing and sufficient healthcare personnel in public hospitals. The study also recommends the multidisciplinary Health Products and Technologies management Units (HPTUs) approach to foster collaboration among pharmacy, nursing, and clinical laboratory professionals for integrated, comprehensive HPT management. The study further recommends ongoing training to develop and maintain competency-building programs in health commodity management, keeping staff up to date on best practices for managing health products and emerging technologies.

County Government to consider workforce optimization by strategically deploying specialized personnel aligned with local needs, with an emphasis on equal distribution to underserved areas.

The study recommends reviewing the compensation system to reassess salary and incentive structures, thereby improving staff motivation, reducing turnover, and recognizing contributions to HPT management. The study also recommends establishing a positive work environment to encourage initiatives that improve workplace culture and foster a professional, proactive attitude toward ensuring the availability of quality and affordable Health Products and Technologies.

Implications for Practice

Investments in human resource recruitment, training, task shifting, and the establishment of multidisciplinary teams are essential to effective and sustainable HPT management.

Policy Implications

Policy frameworks should prioritize human resource development, encompassing continuous training, task shifting, and comprehensive performance management to improve healthcare outcomes.

Recommendations for Further Research

Future studies should examine the impact of multidisciplinary teams on improving access to quality, affordable HPTs in level 4 and 5 referral hospitals.

References

Chandani, Y., Noel, M., Pomeroy, A., Andersson, S., Pahl, M. K., & Williams, T. (2012). Factors affecting availability of essential medicines among community health workers in Ethiopia, Malawi, and Rwanda: Solving the last mile puzzle. *The American Journal of Tropical Medicine and Hygiene*, *87*(5), 120–126. https://doi.org/10.4269/ajtmh.2012.11-0781

Chelangat, C., Kipmerewo, M., & Mukabana, B. (2021). Factors influencing women's Preferred Mode of Delivery in Kericho County Hospitals, Kenya. *Global Journal of Health Science*, *13*(11), 1–11. https://pdfs.semanticscholar.org/361e/031f8bce6ddd9168638fd04d56939619d102.pdf

Dorsey, D. (2020). *A Case Study Exploring the Impact of Human Resource Management Practices on Voluntary Turnover in Nonprofit Organizations. Northcentral University*. [Doctoral dissertation, Northcentral University]. Northcentral University. https://www.proquest.com/openview/8277eb4def0ee8b53b75dab8f44e454a/1?pq-origsite=gscholar&cbl=18750&diss=y

Dye, C. F. (2020). *Leadership in healthcare: Essential virtues and core competencies* (4th Ed.). Health Administration Press

Ewing, A. (2023). *Health care for all: A qualitative exploration of health, space, and accessibility in Kajiado, Kenya* [Master's thesis, Uppsala University]. DiVA. https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1741434&dswid=-8013

Fatima, T., Malik, S. A., & Shabbir, A. (2018). Hospital healthcare service quality, patient satisfaction, and loyalty: An investigation in the context of private healthcare systems. *International journal of quality & Reliability Management*, *35*(6), 1195–1214. https://doi.org/10.1108/IJQRM-02-2017-0031

Feyisa, D., Jemal, A., Aferu, T., Ejeta, E., Fikadu, A., & Alem, E. (2021). Evaluation of cold chain management performance for temperature-sensitive pharmaceuticals at public health facilities supplied by the Jimma Pharmaceuticals Supply Agency Hub, Southwest Ethiopia: Pharmaceuticals logistic management perspective using a multicentered, mixed-method approach. *Advances in Pharmacological and Pharmaceutical Sciences*, *2021*, Article 5167858. https://doi.org/10.1155/2021/5167858

Freeman, J., & Jacobs, S. (2021). Structural Deregulation. *Harvard. Law. Review*, *1*(1) 135, 585. https://heinonline.org/HOL/LandingPage?handle=hein.journals/hlr135&div=29&id=&page=

Kagwanja, N., Waithaka, D., Nzinga, J., Tsofa, B., Boga, M., Leli, H., ... & Barasa, E. (2020). Shocks, stress, and everyday health system resilience: experiences from the Kenyan coast. *Health policy and planning*, *35*(5), 522–535. https://academic.oup.com/heapol/article-abstract/35/5/522/5760350

Kairu, A., Were, V., Isaaka, L., Agweyu, A., Aketch, S., & Barasa, E. (2021). Modelling the cost-effectiveness of essential and advanced critical care for COVID-19 patients in Kenya. *BMJ Global Health*, *6*(12), Article e007168. https://gh.bmj.com/content/6/12/e007168

Kanyepe, J. (2022). Inventory management strategies and healthcare delivery in hospitals in the Mashonaland region of Zimbabwe. Transport and Logistics: *The International Journal*, *22*(52), 2406–1069. https://www.researchgate.net/profile/James-Kanyepe/publication

Khatoon, A. (2020). A blockchain-based smart contract system for healthcare management. *Electronics*, *9*(1), 94. https://doi.org/10.3390/electronics9010094

Kiarie, M. W., & Mbugua, D. (2022). Determinants of Quality of Service offered by Doctors of District Hospitals in Murang'a County, Kenya. *Journal of Strategic Management*, *2*(2), 1-15. https://edinburgjournals.org/journals/index.php/journal-of-strategic-management/article/view/112

Kwesiga, B., Aliti, T., Nabukhonzo, P., Najuko, S., Byawaka, P., Hsu, J., ... & Kabaniha, G. (2020). What has been the progress in addressing financial risk in Uganda? Analysis of catastrophe and impoverishment due to health payments. *BMC Health Services Research*, *20*(1), 741. https://link.springer.com/article/10.1186/s12913-020-05500-2

Lubega, M., Tumwesigye, N. M., Kadobera, D., Marrone, G., Wabwire-Mangen, F., Peterson, S., ... & Ekström, A. M. (2015). Effect of community support agents on retention of people living with HIV in pre-antiretroviral care: a randomized controlled trial in eastern Uganda. *Journal of Acquired Immune Deficiency*

Syndromes, *70*(2), e36-e43. https://10.1097/QAI.0000000000000723

Machanga, A. M. (2024). *Determinants of Health Products and Technologies Management in Level Four and Five Hospitals in Nyeri County* [Master's Thesis, KeMU], Kenya. http://41.89.31.5:8080/bitstream/handle/123456789/1936/FINAL%20ALICE%20MUTHONI%20MACHANGA.pdf?sequence=1&isAllowed=y

Ministry of Health. (2029). *Kenya health sector strategic plan 2024–2029: Accelerating the attainment of universal health coverage*. Government Printer

Mirera, D. O., Kimathi, A., Ngarari, M. M., Magondu, E. W., Wainaina, M., & Ototo, A. (2020). Societal and environmental impacts of seaweed farming in relation to rural development: The case of Kibuyuni village, south coast, Kenya. *Ocean & coastal management*, *194*(1), 105253. https://doi.org/10.1016/j.ocecoaman.2020.105253

Mwanakarama, A. M., Wanja, T., & Musyoki, F. (2022). Factors influencing the Delivery of Quality Maternity Healthcare in Public Primary Healthcare Facilities in Mombasa County, Kenya. *Journal of African Interdisciplinary Studies*, *6*(1), 64-76. https://kenyasocialscienceforum.wordpress.com/wp-content/uploads/2022/02/pdf-mwanakarama-et-al-factors-influencing-the-delivery-of-quality-healthcare-in-kenya.pdf

Njogo, C. (2022). *Efficacy of Health-care Under Devolved Governance in Kenya: The Case of Makueni County* [Master's Thesis, University of Nairobi]. Kenya https://erepository.uonbi.ac.ke/handle/11295/163474

Njoroge, G., & Moi, E. (2020). Effect of devolution on healthcare administration in Murang'a County, Kenya. *International Academic Journal of Arts and Humanities*, *1*(2), 141-156. http://www.iajournals.org/articles/iajah_v1_i2_141_156.pdf

Odhiambo, D. O. O., & Wabala, S. (2023). Data management practices and performance of the HIV program in health facilities in Mombasa County, Kenya. *International Journal of Social Sciences Management and Entrepreneurship* (IJSSME), *7*(2), 246–261. https://sagepublishers.com/index.php/ijssme/article/view/319

Ponnusamy, P., & Sankar, S. (2022). In-Service Training Programmes Related to Inclusive Education: Perspectives of Elementary School Teachers. *Voices of Teachers and Teacher Educators, 11*(2), 49–56. ttp://ejournals.ncert.gov.in/index.php/vtte/article/view/1908

Rashid, N. (2021). *Technical Efficiency of Public Primary Health Care Facilities in Mombasa County* [Master's Thesis, University of Nairobi]. Kenya. https://erepository.uonbi.ac.ke/handle/11295/161048

Sansone, D. (2019). Beyond early warning indicators: high school dropout and machine learning. *Oxford bulletin of economics and statistics*, *81*(2), 456–485. https://doi.org/10.1111/obes.12277

Snell, S. A., & Morris, S. S. (2018). *Managing human resources* (18th Ed.). Cengage Learning.

Sweed, H. S. (2016). Population ageing-Egypt report. *Middle East Journal of Age and Ageing*, *13*(2), 10–17. http://www.me-jaa.com/dec2016/Egypt.pdf

Tamene, E. H. (2016). Theorizing a conceptual framework. *Asian Journal of Educational Research* *4*(2), 50–56. https://ju.edu.et/education-and-behavioral-science/wp-content/uploads/sites/5/2023/01/theorizing-conceptual-framework.pdf

Tashobya, C. K., Dubourg, D., Ssengooba, F., Speybroeck, N., Macq, J., & Criel, B. (2016). A comparison of hierarchical cluster analysis and league table rankings as methods for analysis and presentation of district health system performance data in Uganda. *Health policy and planning*, *31*(2), 217–228. https://doi.org/10.1093/heapol/czv045

Tesfaye, S., Taye, G., Birhane, E., & van der Zee, S. E. (2019). Observed and model-simulated twenty-first-century hydro-climatic change of Northern Ethiopia. *Journal of Hydrology: Regional Studies*, *22*(1), 100595. https://doi.org/10.1016/j.ejrh.2019.100595

Wambugu, P. (2021). *Drama Participation as a Strategy in the Management of Discipline among Students in Secondary Schools in Central Region, Kenya* [Master's Thesis, KeMU]. Kenya. http://41.89.31.5/bitstream/handle/123456789/1187/PACHOMIUS%20FINAL%20SUBMISSION%20PDF.pdf?sequence=1&isAllowed=y

Wamunga, F. M., & Wakhu, D. O. (2021). Enhancing Health-Seeking Behavior: A Case of Khwisero Sub-County, Kakamega County, Kenya. *Africa Environmental Review Journal*, *4*(2), 148–158. http://41.89.164.28/index.php/aerj/article/view/191

Wang, X., Zhang, X., & He, J. (2020). Challenges to the system of reserve medical supplies for public health emergencies: reflections on the outbreak of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) epidemic in China. *Bioscience Trends*, *14*(1), 3–8. https://www.jstage.jst.go.jp/article/bst/14/1/14_2020.01043/_article/-char/ja/

Yaqoob, I., Salah, K., Jayaraman, R., & Al-Hammadi, Y. (2022). Blockchain for healthcare data management: opportunities, challenges, and future recommendations. *Neural Computing and Applications*, *34*(14), 11475–11490. https://link.springer.com/article/10.1007/s00521-020-05519-w