

The Digital Paradox: Assessing the Impact of Health Information Systems (HIS) on Cognitive Load, Patient Interaction, and Work-Life Integration Among Kirinyaga's Medical Practitioners

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ABSTRACT

The effect of Health Information System (HIS) adoption strategies on the performance of medical practitioners in Level 4 and Level 5 public hospitals of Kirinyaga County, Kenya, was investigated. Based on the Job Demands-Resources (JD-R) model, four dimensions of HIS were used: system usability, administrative screen-time demands, IT infrastructure stability, and digital work-life boundaries. The cross-sectional approach was used, and a stratified random sampling of 272 practitioners was made from a target population of 990. The data collected from 166 valid responses were analyzed descriptively and with multiple regression analysis (SPSS v26). The four dimensions explained 77.6% of the variance in practitioner performance in the results. The most consistent individual predictor was IT infrastructure stability, followed by system usability, administrative screen-time demands, and digital work-life boundaries. The significance of all the null hypotheses was taken as < 0.001 . It was found that the adoption of HIS is a “digital paradox” in Kirinyaga County: technologies that were meant to enhance performance can hinder performance when not implemented correctly. The need for emphasis on priority investment in IT infrastructure, systematic usability audits, documentation redesign, and formal digital disconnection policies.

Keywords: Health Information Systems, HIS, Cognitive Load, Patient Interaction, Work-Life Integration, Medical Practitioners, Kirinyaga County, System Usability, IT Infrastructure, Job Demands-Resources Model.

INTRODUCTION

Health Information Systems (HIS) include Electronic Health Records (EHR), Laboratory Information Systems (LIS), Telemedicine Systems, and the Integrated Hospital Management Systems and are a key pillar of healthcare delivery reform in today's world. The adoption of HIS in public health facilities is a strategic initiative in Kenya as it is confronted with a combination of resource constraints, staff shortages, and an increasing number of patients. Kirinyaga County is a textbook example of this situation: Despite at least four sector strikes between 2018 and 2022, the county allocated KES 1.962 billion (43.31% of its total budget) to health in 2021/2022, which is still a very low doctor-to-population ratio, at 1:36,339, compared to the WHO recommended ratio of 1:230.

This study centers on an intriguing paradox: the digital paradox. HIS are adopted specifically because they have the potential to make healthcare delivery faster, safer, and more efficient. In reality, however, these systems can have the opposite impact: a nurse that spends 40% of her shift filling out data in a poorly designed interface has less time on hands to spend with patients. With the loss of data, a clinical officer whose EHR system crashes in the middle of their consultation is losing clinical momentum and trust from their patients. A doctor who receives an after-hours alert notification on a shared mobile platform will never

get the day back, regardless of what happens the next morning. In both, the device intended to assist turns into a source of aggravation.

The study analyzed four identifiable aspects of this paradox: (i) system usability, which focuses on whether the design of the HIS interface makes the system easy to use for practitioners and thus less burdensome cognitively; (ii) administrative screen-time demands, which centers on whether documentation requirements are more likely to interfere with or enhance direct patient care; (iii) stability of IT infrastructure, which looks at the stability of the technology that underpins the HIS and whether this is adequate for practitioners to rely on; and (iv) digital work-life boundaries, whether the introduction of digital systems leads to a reduction or an increase in direct patient care. The study was guided by the Job Demands-Resources (JD-R) Model, which was used to develop the theoretical framework for comprehending when a digital tool becomes a performance resource or a performance-depleting demand.

The study aimed at establishing: (i) the relationship between system usability and practitioner performance; (ii) the relationship between administrative screen-time demands and the practitioner's performance; (iii) the relationship between IT infrastructure stability and practitioner performance; and (iv) the relationship between digital work-life boundaries and practitioner performance in Level 4 and Level 5 hospitals in Kirinyaga County.

METHODOLOGY

A descriptive cross-sectional research design was used. The target population was 990 medical practitioners from all the public health facilities in Kirinyaga County at levels 4 and 5. A sample of 272 respondents was selected using stratified random sampling in the five practitioner cadres based on Yamane's (1967) formula at a 95% confidence level and 5% error. Data was gathered using a structured questionnaire that included the System Usability Scale, along with scales for the other variables. A reliability study of the sub-scales was conducted on a pilot study of 28 participants at a similar facility in Murang'a County with Cronbach's Alpha coefficients all above 0.70 (Table 2), which confirmed reliability. The data were analyzed using descriptive statistics, Pearson correlation, simple regression, and multiple regression in SPSS v26. Descriptive statistics were performed on the data obtained from 166 valid questionnaires returned (response rate: 61.0%).

Table 1: Sampling Distribution by Practitioner Cadre

Stratum	Categories	Population	Sample
Physicians	Medical Officers, Clinical Officers, Dental Officers	180	49
Nurses	Registered and Enrolled Nurses	480	132
Technicians	Lab, Radiography, Pharmacy, Dental	170	47
Specialists	Nutritionists, Physiotherapists, Surgeons, Radiologists	60	17
Others	Public Health, Social Work, Entomology	100	27
Total		990	272

Table 2: Instrument Reliability (Cronbach's Alpha)

Variable	No. of Items	Cronbach's Alpha
System Usability (SUS)	10	0.831
Administrative Screen-Time Demands	8	0.756

Variable	No. of Items	Cronbach's Alpha
IT Infrastructure Stability	9	0.802
Digital Work-Life Boundaries	8	0.721
Performance	12	0.850
Overall Instrument	47	0.818

RESULTS

Descriptive Profile of Respondents

The majority of respondents (105 out of 166, 63.3%) were female, reflecting the gender distribution of the healthcare workforce in Kenya, where the majority of nurses are female. 86 (51.8%) of those who responded were aged 30–40 years, and 121 (72.9%) had the most advanced education level of a bachelor's degree and/or postgraduate education. Nurses were the largest cadre with 65 (39.2%) of the respondents as sampled, a higher proportion than was reported in the population of nurses. This mid-career group was well-educated, and so was their sensitivity to the HIS demands.

Descriptive Statistics on HIS Variables

Results were found to be high on the composite mean for all four HIS dimensions (range 4.56–4.62 on a 5-point scale) with good agreement from practitioners regarding the relevance of the HIS dimensions to their experience. The integration of the HIS system was poor, with a mean score of 4.57 (161/166 participants). The IT infrastructure stability was also high ($M = 4.59$), but there was more variation in the answers (SD up to 0.712) across the facilities, thus again highlighting the issue of infrastructure inequality. Respondents concurred that the greatest concern with digital work-life boundaries was that they posed a negative impact on productivity ($M = 4.55$, $SD = 0.706$), with 159 of 166 (95.8%) respondents agreeing that work-life integration challenges negatively affected productivity. Performance indicators were rated consistently high ($M = 4.62$), with the highest scores for goal achievement ($M = 4.68$) and team promotion ($M = 4.68$), and the most variable scores for delivery of efficient patient services ($M = 4.42$, $SD = 0.805$), suggesting a genuine degree of heterogeneity between facilities.

Correlation Analysis

Table 3 shows significant positive relationships between all HIS dimensions and practitioners' performance by using Pearson correlation analysis. The strongest bivariate correlation was found for system usability ($r = 0.845$, $p < 0.01$), IT infrastructure stability ($r = 0.800$), administrative screen-time demands ($r = 0.784$), and digital work-life boundaries ($r = 0.773$). Multiple regression analysis was supported by the meaningful but non-collinear relationships among the predictors, as determined by the correlation coefficient ranging from 0.682 to 0.804.

Table 3: Pearson Correlation Matrix

Variable	Performance	Sys. Usability	Screen-Time	IT Stability	Work-Life
Performance	1				
System Usability	.845**	1			
Screen-Time Demands	.784**	.747**	1		
IT Stability	.800**	.697**	.769**	1	

Variable	Performance	Sys. Usability	Screen-Time	IT Stability	Work-Life
Work-Life Boundaries	.773**	.682**	.692**	.804**	1

Simple Regression Results by HIS Dimension

Numbers of the digital paradox. All four HIS dimensions below carry the same story in each dimension, so good-quality implementation enhances performance, but poor-quality implementation has a negative impact on performance. These relationships are summarized in Table 4. The results of the four null hypotheses (H01–H04) were all rejected at $p < 0.001$.

Table 4: Summary of Simple Regression Results

HIS Dimension	R	Adj. R ²	F-value	p-value
System Usability	0.845	0.712	419.345	< 0.001
Administrative Screen-Time Demands	0.784	0.612	274.032	< 0.001
IT Infrastructure Stability	0.804	0.644	310.044	< 0.001
Digital Work-Life Boundaries	0.773	0.568	247.814	< 0.001

IT Infrastructure Stability (Adj. $R^2 = 0.644$). The simplest paradox: a system that does not work cannot help anybody. Most of the individual predictors were significant, with infrastructure stability being the most significant ($F = 310.044$, $p < 0.001$; $B = 0.834$), indicating that for each unit increase in infrastructure reliability, there is an increase in performance of 0.834 units. The paradox comes when the facilities invest in the HIS but in the absence of the supporting infrastructure necessary for use by practitioners to achieve the desired results. Downtime in resource-limited public facilities is a problem necessitating either restoration (loss of clinical time) or the use of paper despite all the efficiency gains. This aspect of the paradox can be resolved with reliable infrastructure; otherwise, it can be worsened.

System Usability (Adj. $R^2 = 0.712$ bivariate; Beta = 0.377 combined). The cognitive paradox here is that the use of HIS can be adopted to lessen mental strain during patient record management, but with a poorly designed interface, the mental strain can be enhanced. Usability is also the most significant switch in the combined model, having the highest standardized beta and the strongest bivariate correlation ($r = 0.845$). Intuitive and cognitively compatible navigation frees mental bandwidth for patient care when HIS is integrated into clinical workflows. If it is not, then practitioners have to handle two cognitive loads at once: the clinical and the navigational, and both are not given sufficient focus. Good systems address this aspect of the paradox; bad usability perpetuates the paradox.

Administrative Screen-Time Demands (Adj. $R^2 = 0.612$). This dimension is most poignantly captured by the paradox that was evident from the beginning: that HIS documentation was designed to be used in the patient record, but unmanaged, it takes the practitioner away from the patient. Documentation requirements that are structured and supported, with a positive regression coefficient ($B = 0.848$), explain 61.2% of variance among individuals. The conundrum is when they're not—when a nurse finishes patient rounds in a lower time than the EHR could fill out and when a clinical officer sits at a screen longer than at the bedside. This dimension is addressed by structured documentation design and proper clinical support staff.

Electronic Work-Life Balance (Adj. $R^2 = 0.568$). The final dimension of the paradox is outside the walls of the facility. With HIS connectivity, practitioners don't have to stay on duty all the time, a design goal that helps deliver responsive and flexible healthcare. Of the 166 who responded, 159 (95.8%) said this connectivity hampers their productivity. The practitioner who receives a system notification at 10 pm is

already exhausted the next morning when he or she returns to work. The paradox is that the technology that makes care possible at all hours of the day also takes its toll on the human resources that make care possible. This dimension is addressed by formal digital disconnection processes and organizational norms for boundaries; if these are missing, the cycle continues.

Multiple Regression Analysis

The overall model, including all four HIS dimensions, was highly significant [$F(4,161) = 150.233$, $p < 0.001$] and explained 77.6% of the variance in practitioner performance (Adjusted R^2). There was no evidence of autocorrelation (Durbin-Watson statistic = 1.599); H_0 s was rejected.

$$Y = -0.241 + 0.362X_1 + 0.231X_2 + 0.328X_3 + 0.198X_4$$

Table 5: Multiple Regression Coefficients

Predictor	B	Std. Error	Beta	t	Sig.
(Constant)	-0.241	0.187	—	-1.288	.200
System Usability (X1)	0.362	0.054	0.377	6.692	.000**
Screen-Time Demands (X2)	0.231	0.061	0.214	3.786	.000**
IT Infrastructure Stability (X3)	0.328	0.052	0.398	6.297	.000**
Digital Work-Life Boundaries (X4)	0.198	0.063	0.172	3.143	.002**

$p < 0.01$. Model: Adjusted $R^2 = 0.776$; $F(4, 161) = 150.233$; Durbin-Watson = 1.599

IT infrastructure stability was co-dominant in the combined model with system usability (Beta = 0.398 and 0.377, respectively); subordinate factors included administrative screen-time demands (Beta = 0.214) and digital work-life boundaries (Beta = 0.172), which also contributed significantly. The individual coefficient reduction from simple regression to multiple regression models illustrates how the dimensions of HIS are interrelated; infrastructure reliability adds to usability benefits, the cognitive cost of the demands of screen time is influenced by usability, and the boundary is defined by organizational digital policies that are dependent on infrastructure capabilities. No single dimension works on its own; a holistic approach is needed.

CONCLUSION

The aim of this study was to explore one of Kirinyaga County's public healthcare system's basic paradoxes: the use of the same digital technologies that are supposed to enhance practitioner performance is, under some circumstances, causing practitioners' performance to decline. It is found empirically in the findings, which also reveal the exact location of the breach in the paradox and its reasons.

The paradox is based on a disconnect between what you want and how you do it. The aim of HIS is to simplify clinical workflow, enhance data quality, and facilitate evidence-based decision-making. However, in reality each of the four dimensions examined can become a performance facilitator or a performance saboteur. A system that fails to run three times a day is not streamlining; it just forces practitioners to go back to paper, duplicate work, and waste time. If it takes two hours to document a shift, it is not saving time; it is taking the time needed to sustain performance the next day. These are not hypothetical but actual risks evident in the data, which together account for 77.6% of the variance in performance in Level 4 and Level 5 facilities.

The first and most obvious driver of the digital paradox is the instability of IT infrastructure. Infrastructure reliability was the top individual predictor of performance with an adjusted R^2 of 0.644. For any other benefit of HIS to come true, the system itself must function — reliably, consistently, and readily with a quick response from technical support if it breaks. Every minute of downtime costs someone something in a county with more than 36,000 people served by one doctor. Infrastructure investment is thus not a luxury from a technical point of view but rather a condition for the solution of the paradox.

Secondly, usability is the most important way by which HIS changes from demand to resource. A well-designed interface will minimize the cognitive load and leave clinical decision-making at the center of focus. A poorly designed one becomes a second job — a job with technology — and it takes away from the first job of caring for patients. The paradox deepens when usability is poor and lessens when usability is high.

Third, administrative screen-time demands present the most visible side of the digital paradox in most practices. Structured documentation, proper allocation, and clinical staff support make HIS documentation a performance resource with better records accuracy and follow-up care. If those requirements aren't managed and focused, they work against the very patient-to-practitioner interaction that makes the healthcare experience good.

Fourth, work-life boundary erosion is real: 95.8% of respondents said these boundary violations hamper their productivity when they leave the facility. The very technology that allows for flexible, connected healthcare delivery also makes practitioners unable to recover. When there are no formal organizational arrangements for digital disconnection, this connectivity is a constant demand without a buffer.

Therefore, it can be concluded that the digital paradox in Kirinyaga County exists and is measurable and solvable. It is real because the data show that HIS adoption both enables and hinders performance. It is measurable because the four dimensions together account for 77.6% of the variance in performance. It is solvable — not by giving up on digital health systems, but by taking a multi-faceted approach addressing infrastructure, system usability, documentation design, and boundary management as a single policy agenda rather than separate technical decisions.

RECOMMENDATIONS

Policymakers and County Health Administrators

- (i) Create IT infrastructure quality criteria for all the Level 4/5 facilities, including minimum uptime and dedicated clinical-grade network bandwidth. All decisions for the expansion of HIS should follow or be based on investment in infrastructure.
- (ii) Conduct biennial HIS usability audits based on validated tools like the SUS, with findings feeding into procurement decisions. No HIS platform should be deployed below a minimum agreed usability threshold.
- (iii) Establish and implement formal protocols for digital disconnection (after hours, when to and when not to use digital communication, and explicitly protecting time for practitioners to recover).
- (iv) Match HIS documentation workload to staffing models — implementing clinical support officers to enter information into the HIS to free practitioner time for clinical functions.

HIS Implementation Teams

- (i) Implement co-design strategies as a meaningful way of engaging frontline practitioners in the development of interfaces and workflow mapping before deployment. Clinical workflow compatibility needs to be shown prior to rollout.
- (ii) Design and conduct cadre-specific training programs, incorporating a continuous component of refresher training where necessary, specifically targeting cadres most likely to be involved in documentation (such as nurses and clinical officers).
- (iii) Embed automated documentation tools such as voice recognition, smart templates, and clinical decision support to minimize manual data entry loads and enhance documentation quality and completeness.

Healthcare Institutions

- (i) Develop digital wellness monitoring systems to measure practitioner screen time and documentation allocation and provide evidence to guide workload management.
- (ii) Develop structured peer mentoring programs to pair HIS users who experienced successful adoption with those who are struggling, thus minimizing the performance cost of the adoption learning curve.
- (iii) Establish systematic feedback loops and clear escalation procedures for practitioners to share information on infrastructure failures, usability barriers, or documentation burden issues with management and IT teams.

Areas for Further Research

Future studies should (i) use longitudinal study designs to capture dynamic HIS-performance relationships as systems and practitioner experience change; (ii) include patient-level outcome variables to provide insight on context-specific performance; (iii) incorporate the moderating effect of leadership style and organizational culture; and (iv) explore the impact of emerging clinical decision support (CDS) using artificial intelligence (AI) and telemedicine on practitioner performance in the Kenyan public health context.

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