

The Role of Health Information Systems (HIS) Utilization on Administrative Performance in Conflict-Affected Public Hospitals: The Case of Yemen

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Abstract

Objective: This study aimed to examine the relationship between HIS utilization and administrative performance in major public hospitals in Sana'a, Yemen, and to identify which dimensions of utilization (e.g., data quality, frequency of use, or mere availability) are the strongest predictors of overall administrative performance, integrating the conceptual lenses of Information Use Theory and the PRISM Framework.

Methods: A quantitative cross-sectional study was conducted in three major public referral hospitals in Sana'a: Al-Thawra General Hospital, Al-Jamhuri Teaching Hospital, and Kuwait University Hospital. The sample comprised N=180 administrative staff routinely interacting with HIS, with 60 participants drawn from each hospital. Internal reliability was confirmed using Cronbach's alpha ($\alpha > 0.77$) for all measures. Data were analyzed using Pearson correlation and Multiple Linear Regression to determine the strength and predictive hierarchy of the relationships.

Results: Overall, HIS utilization was moderate (Mean = 3.38, SD = 0.63), with data integration (Mean = 3.14, SD = 0.72) recording the lowest score. A strong, statistically significant positive correlation was found between overall HIS utilization and administrative performance ($r = 0.56$, $p < 0.001$). The regression model explained 39% of the variance in administrative performance ($R^2 = 0.39$, $p < 0.001$). The strongest predictors were Data Quality and Accuracy ($\beta = 0.33$, $p < 0.001$) and Frequency of System Use ($\beta = 0.28$, $p < 0.01$), while the effect of system availability alone was weak.

Conclusion: Improving administrative performance in conflict-affected public hospitals hinges not on the installation or availability of HIS, but on fostering behavioral and operational reliability. The focus must shift from infrastructural inputs to data governance and user support to ensure information is trusted and routinely integrated into decision-making, which is supported by Information Use Theory within a resource-constrained environment.

Keywords: Health Information System. Administrative Performance. Conflict-Affected. Public Hospitals. Yemen.

دور استخدام نظم المعلومات الصحية على الأداء الإداري في المستشفيات العامة المتأثرة بالنزاعات — حالة اليمن

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ملخص: هدفت هذه الدراسة إلى استكشاف العلاقة التبادلية بين استخدام نظم المعلومات الصحية (HIS) ومستوى الأداء الإداري في كبرى المستشفيات الحكومية بمدينة صنعاء، اليمن. وعمل البحث على تمييز أبعاد الاستخدام الأكثر قدرة على التنبؤ بالأداء الإداري، مفاضلاً بين تأثير "جودة البيانات" و"تكرار الاستخدام" مقابل مجرد "توفر النظام"، مستنداً في تأطيره النظري إلى دمج عدسات نظرية استخدام المعلومات وإطار "بريزم (PRISM)" لتقييم أداء النظم الروتينية.

ولتحقيق هذه الأهداف، اعتمد المنهج الكمي عبر دراسة وصفية عرضية شملت ثلاثة مستشفيات مرجعية رئيسية هي: مستشفى الثورة العام، مستشفى الجمهوري التعليمي، ومستشفى الكويت الجامعي. استهدفت الدراسة عينة قوامها $N=180$ من الكوادر الإدارية الذين يتعاملون بانتظام مع النظام، بواقع 60 مشاركاً من كل مستشفى؛ حيث تم التأكد من الثبات الداخلي لأدوات القياس باستخدام معامل "ألفا كرونباخ" (يقم تجاوزت 0.77)، واستخدم معامل ارتباط "بيرسون" والانحدار الخطي المتعدد لتحليل البيانات وتحديد التراتبية التنبؤية للعلاقات المدروسة.

أظهرت نتائج التحليل الإحصائي أن مستوى استخدام نظم المعلومات الصحية جاء بدرجة متوسطة بمتوسط حسابي (3.38)، مع ملاحظة انخفاض في بُعد تكامل البيانات. وقد رصدت الدراسة ارتباطاً إيجابياً قوياً وذا دلالة إحصائية بين الاستخدام الكلي للنظم والأداء الإداري بواقع ($r = 0.56, p < 0.001$)، حيث فسر نموذج الانحدار 39% من التباين في الأداء. ($R^2 = 0.39$). وبرزت "جودة البيانات ودقتها" و"كثافة الاستخدام" كأهم العوامل المؤثرة، في حين ظل تأثير توفر النظام وحده ضعيفاً ومحدوداً.

وتخلص الدراسة إلى أن تحسين الأداء الإداري في المستشفيات العامة الواقعة في مناطق النزاع لا يرتبط بوجود التقنية بحد ذاتها، بل بمدى تعزيز الموثوقية السلوكية والتشغيلية لدى الكوادر. وتوصي الدراسة بضرورة الانتقال من التركيز على المدخلات الإنشائية والتقنية إلى التركيز على حوكمة البيانات ودعم المستخدمين؛ لضمان تحويل المعلومات إلى أداة موثوقة في اتخاذ القرار، تماشياً مع مبادئ نظرية استخدام المعلومات في البيئات التي تعاني من شح الموارد.

الكلمات المفتاحية: نظم المعلومات الصحية، الأداء الإداري، المستشفيات المتأثرة بالنزاعات، المستشفيات العامة، اليمن.

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1. Introduction

1.1. Background: Effective hospital administration, particularly within Fragile and Conflict-Affected Settings (FCAS), fundamentally relies on functional Health Information Systems (HIS) (World Health Organization, 2022; Kruk et al., 2018). However, a persistent challenge is the significant divergence between HIS availability (presence) and its effective, routine utilization (use) in operational decision-making. Yemen exemplifies this, where public referral hospitals function under severe resource constraints, struggling to translate technological investment into measurable administrative gains.

1.2. Global Context and the Imperative for Functional Health Information Systems (HIS)

Health Information Systems (HIS) are globally recognized as critical enablers for data-driven governance, resource optimization, and monitoring progress towards Universal Health Coverage (UHC). Global strategies, including the World Health Organization's (WHO) Global Strategy on Digital Health (2020–2025), support the digitalization of health services (World Health Organization, 2021). However, in Low- and Middle-Income Countries (LMICs), investment in technology frequently fails to yield sustained administrative benefits due to fundamental weaknesses in implementation, user behavior, and operational discipline.

1.3. The Unique Challenge of Fragile and Conflict-Affected Settings (FCAS)

Fragile and Conflict-Affected Settings (FCAS) are defined by chronic instability, resource

scarcity, and severe limitations on infrastructure and human capital (World Health Organization, 2022; World Bank, 2024). Yemen represents a critical case study of a protracted FCAS, where the health sector operates under extreme duress marked by lack of resources, high staff turnover, and continuous infrastructure instability (Kruk et al., 2018). In Sana'a's public hospitals, this pressure leads to dysfunctional information flow, often resulting in decisions based on fragmented or subjective records, even when HIS platforms are present. Poor information systems in FCAS threaten global health security by creating environments where disease outbreaks are difficult to track and resource needs are near impossible to forecast reliably (World Health Organization, 2022; World Health Organization, 2019).

1.4. Statement of the Problem: The Availability-Use Disconnect

While HIS are implemented to standardize processes and provide timely data, the mere availability of a system is not commensurate with its impact on performance. Evidence suggests that HIS that are consistently bypassed, unsupported, or distrusted add minimal value, potentially creating parallel workflows. In the public hospitals studied in Sana'a, the disparity between relatively high system availability scores (Mean = 3.61) and lower scores for data quality and integration (around 3.20) indicates a critical gap. This divergence requires a focused analysis of the behavioral and organizational determinants—framed by the PRISM model—that impede the translation of technical availability into sustained administrative efficiency.

1.5. Research Gap Formulation

Despite the widespread adoption of digital health strategies and the urgent requirement for enhanced administrative resilience in FCAS (World Health Organization, 2022), empirical evidence linking the routine and behavioral components of HIS use directly to

indicators of day-to-day administrative performance remains noticeably sparse, particularly when compared to existing literature that focuses on technical feasibility or system acceptance (Sahay et al., 2018; Alvarez & Kendall, 2023).

However, most available studies concerning HIS in resource-constrained settings primarily focus on input metrics (e.g., system installation or user attitudes), consequently failing to dissect the specific behavioral and organizational mechanisms—the core determinants outlined in the PRISM framework—that transform system presence into sustainable, data-informed administrative action (Aqil et al., 2009; Alvarez & Kendall, 2023).

Therefore, this study addresses this critical gap by rigorously examining the predictive hierarchy of HIS utilization components on administrative performance across three major public hospitals in Sana'a, Yemen, utilizing the prevailing FCAS environment to provide a rigorous test of theoretical models. The research employs the PRISM framework and Information Use Theory to provide context-specific, policy-relevant evidence aimed at enhancing data governance in conflict-affected health systems.

2. Literature Review: A Critical Analytical Review

2.1. Administrative Performance and Data Quality as an Imperative in FCAS

Administrative performance in this study is defined by operational indicators such as reporting efficiency, inter-departmental coordination, and timeliness of managerial decisions. Recent systematic reviews (2020–2024) affirm that effective hospital administration, even under high operational pressure, hinges on integrating quality information into continuous improvement and leadership practices (Sfantou et al., 2017; Kruk et al., 2018). In fragile settings, the

challenge is compounded by low sustainability; failure to maintain data quality quickly converts functional systems into symbolic ones, a factor explaining persistent administrative deficiencies despite technological inputs (World Health Organization, 2022).

2.2. Routine Health Information System (RHIS) Challenges in Limited-Resource Settings (Post-2020)

Literature covering Low- and Middle-Income Countries consistently documents that RHIS implementation often prioritizes installation over sustainable use, leading to frequent problems such as limited ongoing training, weak maintenance, and fundamental infrastructure instability (Lippeveld et al., 2000).

Scoping reviews covering the post-2020 period, focusing on regions like Sub-Saharan Africa (Tannor et al., 2024), demonstrate that health systems, and their underlying information systems, degrade rapidly under external shocks (e.g., conflict or pandemics), causing significant declines in health service utilization (Tannor et al., 2024). This confirms that system fragility stems not just from the conflict environment but also from the lack of established administrative mechanisms to ensure the continuity of quality data collection and utilization.

A major research gap remains: most implementation successes are documented in resource-rich contexts (Alvarez & Kendall,

2023; Arnett, 2000). This deficiency in evidence from FCAS means that implementation strategies often succeed elsewhere but fail in complex environments where the HIS must compete with immediate, high-pressure operational demands and unstable infrastructure (Sahay et al., 2018; World Health Organization, 2022).

2.3. Behavioral and Organizational Determinants of Sustainable Utilization

Recent studies stress that effective HIS use is fundamentally shaped by organizational and behavioral factors (Sahay et al., 2018). Research shows that utilization relies not solely on technology availability, but critically on user data management skills, consistent supportive supervision, and ongoing training (Mekonnen & Deribe, 2019). These personal and institutional variables are what determine whether an administrator will invest the necessary effort to ensure accurate data entry.

Furthermore, contemporary literature emphasizes that the challenge is not only analyzing data but "translating data into action" (Alvarez & Kendall, 2023). This requires integrating the HIS within a broader governance structure that mandates performance evaluation and administrative accountability to guarantee that information leads to changes in practice. When this data-to-action link is absent, data loses relevance, and the system becomes an administrative burden.

Table 1: Critical Comparison of Recent Studies on HIS in Resource-Constrained Settings (2019-2024)

A. Reference	B. Geographic Context (System Type)	C. Methodology & Focus	D. Key Findings	E. Research Gaps/Contradictions Addressed
F. (Alvarez & Kendall, 2023)	G. Tanzania, South Africa (RHIS)	H. Mixed-methods study.	I. The critical determinant of use is "taking action" based on the data, rather than just collection or analysis.	J. Minimal focus on data governance mechanisms required to compel organizational action and effective accountability in hospitals.
K. (Tannor et al., 2024)	L. Sub-Saharan Africa (Multi-	M. Scoping Review	N. Significant median decrease (35.6%) in	O. Highlights the extreme fragility of administrative

	country, HSU)	(N=262 studies).	Health Service Utilization (HSU) during external shocks (e.g., pandemic).	and HIS systems in maintaining continuity during crises.
P. (Mekonnen & Deribe, 2019)	Q. Ethiopia (Health Centers, RHIS)	R. Cross-sectional study (N=250).	S. Overall RHIS utilization was low (38.4%). Computer skills and supportive supervision were key determinants of utilization.	T. Lack of comparative studies across large hospitals in an high-intensity FCAS context to evaluate the impact of data quality on direct administrative outcomes.

3. Theoretical and Conceptual Framework

This study is grounded in a methodical perspective that moves beyond purely technical assumptions to focus on the organizational and behavioral determinants of information system success, guided by the PRISM Framework and Information Use Theory.

3.1. Framing the Study with the PRISM Framework

The PRISM (Performance of Routine Information System Management) framework is a diagnostic model designed to assess and strengthen Routine Health Information Systems by concentrating on three key determinants of performance: technical, organizational, and behavioral (Aqil et al., 2009; Lippeveld et al., 2000). PRISM provides the structure for understanding why technical investment often fails to improve performance.

In this study, variables are mapped to PRISM domains:

- **Technical Determinants:** Represented by system availability and technical support. The analysis showed these are weak performance predictors.
- **Behavioral Determinants:** Represented by system use frequency and data quality. The high predictive

power of these variables confirms that performance deficits in Sana'a's environment stem primarily from behavioral challenges (data culture) rather than purely technical ones.

- **Organizational Determinants:** Represented by inter-departmental integration and supervision. The low data integration score indicates a structural impediment that constrains the system's ability to enhance overall coordination.

3.2. Information Use Theory

Information Use Theory dictates that the value of information is determined by its actual application in achieving organizational goals (Wilson, 1997). In health administration, information is used to meet objectives like increasing reporting efficiency and improving decision timeliness. If information is unreliable or late, it fails to achieve its purpose, leading to a diminished perceived value and eventual system abandonment (Wilson, 1997).

The study's results—particularly the strength of Data Quality as a predictor ($\beta = 0.33$)—provide empirical validation of this theory in high-stress operational settings. When staff lack confidence in data accuracy, they bypass the system as a rational adaptation to its shortcomings, transforming the HIS into a mechanism for compliance reporting rather than for daily decision support.

3.3. Hypothesized Relationships

The following relationships were tested:

- **H1:** A statistically significant positive relationship exists between overall HIS utilization and administrative performance.
- **H2:** Utilization components related to behavioral determinants (Data Quality and Frequency of Use) will be stronger positive predictors of administrative performance compared to the technical determinants (System Availability and Technical Support).
- **H3:** Low data integration across departments (an organizational determinant) will significantly restrict inter-departmental coordination, serving as a structural constraint on performance gains.

4. Methodology

4.1. Design, Setting, and Population

A quantitative cross-sectional study was executed in 2024 to assess the existing relationship between utilization and administrative performance. The setting included three public referral hospitals in Sana'a (Al-Thawra General Hospital, Al-Jumhuri Teaching Hospital, and Kuwait

University Hospital), chosen for their comparable external constraints and critical roles as major referral centers. The study purposefully targeted administrative staff with routine operational experience with HIS, ensuring the collected data reflected sustained practice rather than mere initial attitudes towards the system.

4.2. Sample Justification and Statistical Inference

The sample size was $N=180$, with 60 participants from each hospital, selected using purposive sampling. This sample size was determined to be statistically appropriate for multiple regression analysis, providing a very high statistical power (>0.99) to detect the significant effect size observed ($R^2 = 0.39$ with five predictors, $p < 0.001$), thereby addressing the rigor expected by Q1 journals (Dattalo, 2008; Faul et al., 2007; Cohen, 1988).

4.3. Reliability and Validity

A structured questionnaire utilizing a five-point Likert scale was employed. Content validity was established through expert review. Internal consistency for all dimensions was assessed using Cronbach's alpha (α), with all major dimensions (Utilization and Performance) meeting acceptable reliability thresholds ($\alpha > 0.77$) for applied health research.

Table 2: Reliability Level

U. Dimension/Variable	V. No. of Items	W. Cronbach's Alpha (α)	X. Reliability Level
Y. Administrative Performance (Dependent)	Z. 4	AA. 0.85	BB. Very Good
CC. Reporting Efficiency	DD. --	EE. 0.80	FF. Good
GG. Inter-departmental Coordination	HH. --	II. 0.78	JJ. Acceptable
KK. Timeliness of Administrative Decision	LL. --	MM. 0.81	NN. Good
OO. HIS Utilization (Independent)	PP. 5	QQ. 0.87	RR. Very Good
SS. System Availability and Support	TT. --	UU. 0.77	VV. Acceptable
WW. Frequency of Daily Use	XX. --	YY. 0.83	ZZ. Good
AAA. Data Quality and Accuracy	BBB. --	CCC. 0.86	DDD. Very Good
EEE. Integration between Units	FFF. --	GGG. 0.79	HHH. Acceptable

4.4. Statistical Analysis and Assumptions

Pearson correlation and Multiple Linear Regression were utilized. Statistical

assumptions necessary for regression modeling—including linearity, independence of errors, and the absence of high multicollinearity (via VIF assessment)—were confirmed to ensure the reliability of the beta coefficients (beta). The statistical significance level was set at $p < 0.05$.

5. Results

5.1. Level of HIS Utilization

Overall, HIS utilization was moderate (Mean = 3.38, SD = 0.63). System Availability and basic access recorded the highest mean (Mean = 3.61, SD = 0.58), confirming basic infrastructure presence. In contrast, Inter-unit Data Integration recorded the lowest mean (Mean = 3.14, SD = 0.72), reflecting reliance on parallel reporting channels. Data Quality and Accuracy was also low, scoring Mean = 3.22 (SD = 0.70). Al-Thawra General Hospital reported the highest overall HIS utilization (Mean = 3.52), while Kuwait University Hospital reported the lowest (Mean = 3.25).

5.2. Administrative Performance

Overall administrative performance was moderate (Mean = 3.46, SD = 0.57). Reporting Efficiency was relatively stronger (Mean = 3.58, SD = 0.61), but Coordination between Departments scored lower (Mean = 3.31, SD = 0.65), indicating information flow restrictions across units.

5.3. Predictive Relationship Between Utilization and Performance

Correlation analysis confirmed a strong, statistically significant positive relationship between overall HIS utilization and administrative performance ($r = 0.56$, $p < 0.001$).

Multiple regression analysis established that the utilization components explained 39% of the variance in administrative performance ($R^2 = 0.39$, $p < 0.001$). The analysis confirmed

that the behavioral determinants were the strongest predictors:

- **Data Quality and Accuracy:** (beta = 0.33, $p < 0.001$)
- **Frequency of System Use:** (beta = 0.28, $p < 0.01$)

System Availability alone did not exhibit the same robust predictive strength as the behavioral determinants.

6. Discussion

6.1. Confirmation of Hypotheses and Contextual Interpretation

This study confirmed that administrative performance in Sana'a's hospitals is primarily determined by data quality and the consistent use of HIS, supporting Hypothesis H2. The strong predictive power of Data Quality (beta = 0.33) demonstrates that reliability is the critical constraint on performance. In an FCAS setting, administrators view bypassing a system with unreliable data as a rational coping strategy to maintain operational flow, rather than mere resistance to technology.

These findings shift the interpretation of HIS challenges in Sana'a from being primarily technical to being issues of governance and information discipline.

6.2. Alignment with Theoretical Frameworks

The results offer empirical validation for the guiding theoretical frameworks in conditions of extreme operational constraints.

- **PRISM Validation:** The predictive dominance of behavioral and organizational factors reinforces PRISM's utility in fragile settings (Aqil et al., 2009). The observed variation in outcomes across the three hospitals, despite similar external pressures, suggests that internal organizational

factors, such as supervision and clear procedures, are key in determining sustainable use, aligning perfectly with PRISM's focus on context.

- **Information Use Theory:** The robust association between data quality and user reliance confirms Information Use Theory (Wilson, 1997). The system delivers perceived value only if its output is trustworthy. When reliability fails, the system is abandoned, losing its function as a tool for daily, localized decision support.

6.3. Implications for Administrative Coordination

The observed weakness in inter-departmental coordination and data integration confirms Hypothesis H3, demonstrating that HIS platforms operate within administrative silos. Enhancing coordination requires not just technical links but also governance mechanisms that mandate the HIS as the mandatory, single source of truth for cross-departmental communication (Alvarez & Kendall, 2023). Without addressing this organizational challenge, administrative performance remains constrained by information fragmentation.

6.4. Scientific and Practical Contributions

Scientific Contribution: This study provides unique, rigorous quantitative data linking behavioral utilization components to administrative outcomes within an FCAS (Yemen), a severely underrepresented context in global Q1 health informatics literature (Sahay et al., 2018; World Health Organization, 2022). It offers empirical proof that behavioral determinants are the primary barriers in constrained environments, urging a re-evaluation of standard implementation models.

Practical Contribution: The results provide actionable evidence for health managers and

donors. Resources should be strategically directed toward non-technical interventions, such as supportive supervision and accountability frameworks, which are more cost-effective and sustainable than reliance on purely technical investments.

7. Conclusion and Implications

7.1. Conclusion

The study concludes that HIS can improve administrative performance in conflict-affected public hospitals in Sana'a, but this improvement is strictly conditional on achieving data quality and consistent, routine use. The analysis identified a critical availability-to-use gap, confirming that behavioral and operational reliability (data quality and frequency of use) are the most powerful determinants of performance, overriding the significance of mere technical availability. System success in this constrained environment depends on sustained managerial discipline and behavioral commitment.

7.2. Practical Implications

Hospital administrators must implement strict data governance procedures, clearly assigning responsibility for data timeliness and accuracy at the unit level. The adoption of supportive supervision for task-focused training is essential to enhance digital skills and ensure staff perceive added value in using the system, thereby reducing the reliance on manual workarounds (Mekonnen & Deribe, 2019).

7.3. Policy Implications

The Ministry of Public Health and Population and supporting organizations (e.g., World Bank, UNICEF) must redirect funding to strengthen the **sustainability** and **governance** of HIS (World Bank, 2024; UNICEF, 2025). Policies should mandate the horizontal integration of information across departments to facilitate true administrative coordination, moving beyond reporting requirements focused solely on vertical accountability.

7.4. Research Implications

Future research should conduct longitudinal studies in Sana'a to assess the impact of targeted managerial interventions, based on the PRISM framework, on administrative performance over time. It is also recommended to integrate objective HIS log data (e.g., error rates, entry timeliness) with self-reported metrics to provide a more comprehensive, triangulated measure of actual administrative practice and system function.

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