THE ROLE OF HEALTH INFORMATION TECHNOLOGY IN IMPROVING EMERGENCY CASE MANAGEMENT IN SAUDI ARABIA

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Abstract:
This study investigates the impact of Health Information Technology (HIT) on emergency department (ED) operations across 60 hospitals in Saudi Arabia. Focusing on systems such as Electronic Health Records (EHR), Clinical Decision Support Systems (CDSS), and Health Information Exchange (HIE), the research evaluates their influence on key outcomes including patient wait times, treatment efficiency, mortality rates, patient satisfaction, and staff experiences. Descriptive statistics, correlation analysis, and t-tests revealed significant associations between HIT usage and improved ED performance, such as reduced wait times and mortality, and increased patient and staff satisfaction. The findings suggest that effective HIT implementation, especially when paired with strong staff training and low system downtime, contributes to better emergency care outcomes. However, the study also notes limitations, including the absence of non-HIT hospitals for comparison and a limited sample size. The results support a national push toward broader HIT adoption and integration to strengthen emergency services across the country.

Index Terms- Health Information Technology, Emergency Department, Electronic Health Records, Clinical Decision Support Systems, Patient Satisfaction, System Downtime, Saudi Arabia, Health Information Exchange.
Keywords: Role, Health, Information, Technology, Improving, Emergency, Case, Management.

INTRODUCTION

mergency case management is a critical component in the world's health systems. It is the rapid assessment, diagnosis, treatment, and stabilization of acute injury or illness patients. Effectiveness and quality in emergency services can immediately affect patient outcomes, like mortality and morbidity. Optimization in emergency case management is, therefore, on the agenda in the world's health systems, including Saudi Arabia, where the demand for emergency services is increasing at a fast rate due to the rise in the population, rise in the prevalence of chronic diseases, and rise in cases involving trauma and accidents.[1]

Emergency departments (EDs) represent the hospital's first line of care, providing immediate medical attention for patients requiring urgent or life-sustaining care. In emergency environments, however, elevated patient volumes, varied cases, and unanticipated demand that cause overcrowding, long waits, and stretched resources typify the setting. [2]These problems compromise both patient care quality and patient safety, and as a result, new solutions must be implemented to enhance the delivery of emergency services.

For decades, Health Information Technology (HIT) has revolutionized the healthcare industry by offering systems and tools that can make workflows efficient, enable improved communication, and facilitate data-inspired decision-making. HIT is a broad spectrum of technologies, [3]some of which include Electronic Health Records (EHRs), Clinical Decision Support Systems (CDSS), Health Information Exchange (HIE) systems, computerized physician order entry (CPOE), telemedicine, and patient tracking systems. [4][5]With the integration of such technologies in emergency departments, healthcare organizations can potentially eradicate delays, enable accuracy in diagnostics, facilitate smooth coordination in the care team, and ultimately offer safer and improved patient outcomes.

The Kingdom of Saudi Arabia (KSA) has invested significantly in digital health projects and healthcare infrastructure as part of the reform program for Vision 2030, with a focus on modernizing the sector, improving quality of care, and improving provision of cutting edge clinical services. Against this national context, HIT applications and adoption in emergency departments both provide tremendous possibilities but present special challenges as well[6][7]. Despite increased awareness of HIT benefits, Saudi hospitals grapple with challenges such as limited interoperability between systems, staff resistance, inadequate training, and structural factors that hinder the full exploitation of HIT potential for delivery of emergency department services.

One of the main challenges confronting Saudi Arabia's emergency departments is overcrowding, which contributes to patient waiting times, decreases patient satisfaction, and increases the risk for adverse events. One study winds up that patient volume, together with patient triage inefficiency and paperwork, is a cause for long emergency department lengths of stay and inefficient use of resources. Adoption of HIT solutions—such as real-time patient tracking with electronic triage systems—has the potential to reduce such problems through improved patient flow, reduced errors, and aiding clinicians with timely information.[8]

Further, the use of Electronic Health Records (EHRs) can bring accuracy and availability of information, thus enhancing clinical decision-making in emergency cases. EHRs can offer patient histories, medication and allergy lists, and previous testing results at the point of care, particularly in emergency cases where time is limited, and patients cannot be communicated with in a proper manner. In addition, Clinical Decision Support Systems (CDSS) built in EHRs can assist clinicians by offering evidence-based suggestions, warnings, and decision support, which can help in minimizing variations in practice as well as avoiding medical errors. Another vital element is the Health Information Exchange (HIE), [9]which facilitates patient data sharing in a secure manner between different healthcare environments and providers. HIE systems can facilitate coordination between hospital departments, including emergency departments, and outpatient clinics, or primary care doctors, in order to achieve continuity in the provision of care and prevent duplicate testing or treatments.[10] In Saudi Arabia, with a mix of public, private, and military sectors for provision of health services, it is imperative to make the system more interoperable with the help of HIE platforms in order to create a networked emergency system.

Despite the aforementioned advantages, the implementation of HIT in Saudi emergency departments is not without a few hitches. These include addressing technological infrastructure, data confidentiality and security, staff training, as well as end-users' acceptance in order to be able to utilize the full potential of such systems. Furthermore, empirical evidence in the Saudi environment is limited in understanding the impact of HIT on emergency case outcomes such as patients' waiting time, quality in treatments, accuracy in diagnoses, and patient satisfaction.[11]

Therefore, this study aims to close this knowledge gap by investigating the possible impact that Health Information Technology can make in improving case management in Saudi hospitals. Specifically, this study aims to examine the effects of different HIT components i.e., EHRs, CDSS, and HIE, on emergency department KPIs. It also aims to identify barriers to the successful application of HIT and provide recommendations to maximize the application of HIT in emergency department environments.

The main hypothesis for the present study is that application of Health Information Technology significantly enhances the effectiveness as well as quality in the management of emergency cases in hospitals in Saudi Arabia. The same is also delineated into sub-hypotheses:

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H1a: EHRs decrease patient waiting time in the emergency department.

H1b: Use of Clinical Decision Support Systems (CDSS) in the emergency department improves accuracy in diagnoses.

H1c: Health Information Exchange (HIE) systems facilitate coordination between emergency and non-emergency departments.

This research is also timely and applicable with the present shift in Saudi Arabia in the health sector and increasing worldwide reliance on digital health technologies. The outcomes on HIT impacts in emergency case management can help policymakers, managers, and practitioners gain insight on best practice in technology adoption and help address the issues inherent in the Saudi health system. In summary, emergency departments form a vital element in the delivery of emergency care services, and functionality thereof directly impacts patient outcomes and system efficiency overall. Health IT offers promising solutions to the mitigation of common problems disadvantaging emergency caregivers, i.e., overcrowding, lagging care, and a lack of coordination in care. This study, through a synthesis of the specific implications of HIT to Saudi Arabian emergency case management, offers valuable information that can be efficacious in guiding future investment, policy, and interventions in enhancing the delivery of emergency services as well as patient safety in Saudi Arabia.

LITERATURE REVIEW

The use of Health Information Technology (HIT) in healthcare organizations is expanding globally, and Saudi Arabia is a valuable case study with far-reaching goals for healthcare modernization in Vision 2030. Research has taken a variety of approaches to different aspects of HIT adoption, difficulties, and impacts on the delivery of healthcare, with a focus on emergency services and hospital productivity.

Aljohani (2018) [12]conducted comparative studies in Saudi public and private hospital adoption of Electronic Health Records (EHRs) as well as Electronic Medical Records (EMRs). His Ph.D. thesis focused on the capacity that HIT has to revolutionize the quality, cost, and patient safety in provision of healthcare. It did, nonetheless, also reflect some glaring hindrances in the shape of interoperability issues, no coordinated sharing for purposes of improving health information, and public-private sector variation in adoption. The contributions by Aljohani provide insightful knowledge for understanding complex adoption and a foundation for understanding the manner in which HIT can revolutionize Saudi Arabian practice in healthcare through improved decision-making and efficiency.

Following this, Alyami (2018)[13] addressed underutilization of tracking and monitoring technology in Saudi hospitals. In his study, he proposed the use of a combined real-time

RFID/ZigBee-based system for improved patient, staff, and medical asset management. Employing frameworks such as the Information System Strategy Triangle (ISST) and the Human, Organisation and Technology-fit (HOT-fit), Alyami proposed a system that considers technology, organisational, and human aspects. This aims at decreasing waiting times and the costs of healthcare, as well as improving staff productivity and patient quality, directly addressing operation inefficiencies that affect emergency case management.

Musaed Ali Alharbi's [14]narrative review also analyzes the status quo in HIT infrastructure and effectiveness in Saudi Arabian health information management. The review reveals the persistent prevalence of challenges in the form of poor infrastructure, insufficiently qualified Health Information Management (HIM) experts, and failure in adopting standardized health data strategies. These problems collectively impede HIT adoption as well as electronic clinical practice development. Work by Alharbi highlights the need to address systemic challenges before the realization of HIT benefits in emergency, as well as in other clinical environments.

Alsalman et al. (2021) offered an empirical examination of Saudi Arabia Eastern Province hospital levels of Health Information Systems (HIS) adoption. They revealed incremental HIS functional adoption by hospitals, with greater levels for electronic clinical documentation and viewing results but weaker levels for decision support and supply chain barcoding functionality. This adoption is reflective of both progress and continued gaps in digital transformation efforts that can affect emergency case workflow and decision-making.[15]

The role played by health technology in Saudi Arabian general healthcare service development was outlined in a 2024 paper by Almansour et al., and outlined the role played by telemedicine, mobile apps, and AI-based analytics. They report that HIT facilitates improved access, reduced waiting times, improved communication, and patient involvement—vital factors to successful provision of emergency care. They also highlight that upskilling and staff training is necessary in order to gain best value from technology.
[16]
Finally, Al-Kahtani et al. (2022) evaluated the digital health readiness of Eastern Province hospitals using the Healthcare Information and Management Systems Society (HIMSS) digital indicators. In the cross-section, it was found that, in the case of governance, manpower, interoperability, and predictive analytics, the readiness in the private facilities was higher compared to public facilities. These asymmetries in readiness present evident disparities that could compromise the efficacious application of HIT in emergency case handling in different sectors. Together, they provide a refined setting in which HIT can make a strong contribution to emergency case management in Saudi Arabia, constrained by organisational, human resource, and infrastructural determinants. In understanding those dynamics, it is possible to develop strategies that reconcile technological possibilities with Saudi Arabian realities in the health environment.

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Table 1 Literature Review

Author(s) & Year	Purpose / Objective	Methodology	Key Findings / Contributions	Relevance to Emergency Case Management in Saudi Arabia
Aljohani (2018)	Investigate impact of EHRs/EMRs adoption in Saudi private & public hospitals	Qualitative, multiple-case study (20 interviews)	HIT adoption improves quality, safety, cost-efficiency; barriers include interoperability and adoption variance	Highlights adoption challenges and benefits relevant to emergency departments
Alyami (2018)	Propose real-time tracking/monitoring system to improve healthcare workflow	Mixed methods; framework development; survey (220 responses)	RFID/ZigBee system reduces waiting times, improves asset/staff management, enhances patient care	Directly addresses efficiency and patient flow critical to emergency case management
Alharbi (Year N/A)	Review status of HIT infrastructure & management efficiency in Saudi Arabia	Narrative literature review	Poor infrastructure, shortage of trained HIM professionals, lack of standardization impede HIT progress	Identifies foundational challenges affecting HIT in emergency care
Alsalman et al. (2021)	Assess HIS implementation status in hospitals of Eastern Province	Survey of 18 hospitals	Incremental HIS adoption; good clinical documentation, weaker decision support and barcoding	Reflects practical HIS adoption status affecting emergency department operations
Almansour et al. (2024)	Examine role of health technology in improving Saudi healthcare	Literature synthesis, case examples	Telemedicine, AI, mobile apps improve access, reduce wait times, enhance patient engagement	Shows broader technology impacts that support emergency care enhancement

Al-Kahtani et al. (2022)	Measure digital health transformation readiness in Eastern Province	Cross-sectional survey of 10 healthcare facilities	Private sector more digitally mature; governance and workforce best implemented; predictive analytics least	Digital maturity differences may influence emergency HIT effectiveness

METHODOLOGY

Research Design

This study employed a quantitative, cross-sectional research design to investigate the impact of Health Information Technology (HIT) adoption—specifically, Electronic Health Records (EHR), Clinical Decision Support Systems (CDSS), and Health Information Exchange (HIE)—on emergency department (ED) performance in Saudi Arabian hospitals. The design was chosen to systematically measure, compare, and statistically analyze the relationships between digital health adoption and key healthcare delivery metrics, such as patient wait times, mortality rates, and satisfaction levels.[17]

The rationale for using a quantitative approach lies in its ability to generate objective, reliable data that can be generalized across a population. This design allowed for hypothesis testing using inferential statistics, particularly Independent Samples T-tests and correlation analysis, all conducted using SPSS software.

Study Population and Setting

The study surveyed Saudi Arabian hospital EDs with public and private hospitals being targeted. The participating hospitals were selected from the five main regions—Riyadh, Jeddah, Eastern Province, Makkah, and Medina—in a manner that provided geographical coverage and a representation of different types of hospitals like governmental, military, and private hospitals.

Data Sources and Collection

Hospital IT staff, HIT managers, and emergency department administrators were surveyed online to provide data that were built from established models such as the Healthcare Information and Management Systems Society (HIMSS) Digital Health Indicators, the HOT-Fit Framework, and available literature such as studies by Aljohani (2018), Alyami (2018), and Alsalman et al. (2021). 60 qualifying responses existed and they spanned hospitals with varying levels of HIT integration, and the sites were stratified to account for hospital size, hospital type, and geography. They had been cleaned and de-identified before they could be analyzed.

Data Description and Variables

These data were grouped into four primary dimensions: Hospital Information, HIT Use, ED Case Management Metrics, and Staff/Workflow Variables.

Information on Hospital and Department

Hospital ID: A hospital's identification number.

Region: Riyadh, jannah, Eastern, Makkah, Medina

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Type: Government, Military, or Private.
Emergency_Department_Size: Small, Medium, or Large.

B. Use of Health Information Technology (HIT)

EHR implemented
Used CDSS:
Health_Info_Exchange: Yes/No.
Triage_Software_Used: Yes/No
Patient_Tracking_System: Yes/No.
Years_Since_HIT_Implementation: Integer.

C. Emergency Case Management Metrics

Avg_Wait_Time_Minutes: Mean waiting time in minutes
Avg_Treatment_Time_Minutes: This is the time from evaluation to
Crowding Level: Low, Medium
Patient Satisfaction Score: 0–100 or Lik
Readmission rate: percentage of patients readmitted within 72 hours.
EDMortalityRate: Percentage of patients that died in the ED.
Time_To_Triage: In minutes.
Usually in minutes.

D. Staff and Workflow Considerations

ED_Staff_Count: Numeric
Trainingтермин до сроков форс
System_Downtime_Frequency: Monthly average.
Staff_Satisfaction_With_HIT: Likert score.

Statistical Analysis Techniques

Statistical processing was performed using SPSS v26. Statistical processing was conducted systematically in a multi-step approach.

A. Descriptive Statistics

The initial analysis centered on description statistics in order to present a snapshot for the dataset. These included:

Means, standard deviation, minimum, and maximum for each continuous variable (e.g., wait time, treatment time, satisfaction score).

Categorical variable frequency distributions and percentages (e.g., hospital type, HIT use, size of the ED).

This served to establish the essential characteristics of the hospitals and the extent of HIT installations by setting.

B. Hypothesis testing: Independent samples T-tests

Three hypotheses had been created to investigate the relationship between HIT adoption and specific healthcare outcomes.

H1a: H1a: Adoption of EHR and Mean

Test: Independent Samples T-test.

Groups:
Group 1: Hospitals that already utilize EHR.
Group 2: Lack of EHR.
Dependent Variable: Avg_W
The p-value less than 0.05 would suggest that EHRs significantly decrease patient waiting times.

H1b: CDSS Use vs. ED Death Rate

Test: Independent samples T-test.

Groups:
Grouping 1: Hospitals Using CDSS.
Group 2: Hospitals not adopting CDSS.
Dependent Variable: ED_M
p-value less than 0.05 would reflect a statistically significant reduction in ED mortality with CDSS use.

H1c: Health Information Exchange (HIE) vs. Patient Satisfaction

Test: Independent Samples T-test.
Groups:
Group 1: Hospitals with HIE capabilities.
Group 2: Hospitals without HIE.
Outcome Variable: Patient_Satisfaction
Interpretation: A p-value less than 0.05 would imply a statistically significant patient satisfaction increase as a result of HIE implementation.

D. Visualization of Results of Hypothesis

To graphically represent the findings revealed in the T-tests, boxplots in SPSS for each hypothesis were created:
Avg_Wait_Time_Minutes vs. EHR_Implemented
Mortality_Rate versus CD
Average_Score vs. Reg
The boxplots provided visual cues for distribution, median, and outliers, enabling a greater appreciation for between-group differences.

Correlation Matrix and Heatmap

The SPSS bivariate correlation function created a heatmap to present correlations between continuous variables:
Wait time.
Treatment time
Satisfaction rating
Readmission rate
ED staff number
IT training level

System downtime frequency

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This provided correlations, either positive, negative, or none, between variables and indications for multicollinearity for future multivariable analyses.

Grouping and Summary Analysis

Grouping by Regional Areas

The data were stratified by the Region variable to investigate variation by region:

Number of hospitals by region:

Mean values for Avg_Wait_Time, ED_Mortality_Rate, and Patient_Satisfaction_Score

This also told them whether Riyadh or the Eastern Province was doing better or worse on the primary outcome metrics.

Hospital Grouping by Hospital Type

Similarly, hospitals were classified by type:

Government

Private

Military

The mean values for critical metrics such as waiting time, staffing, HIT use, and mortality rate for both groups were computed.

Graphical Representation of Grouped Data

To present grouping analysis outcomes, the following charts have been created in SPSS:

Bar Charts:

By region, how many hospitals?

Total number of hospitals by hospital type.

Boxplots

Avg_Wait_Time_Minutes by Region.

Hospital Patient Satisfaction Score

These graphs helped identify patterns such as:

Improved patient satisfaction in private hospitals.

Lengthening queues at public offices.

Regional variations in HIT effectiveness.

Ethical Factors

Ethics approval was provided by relevant Institutional Review Boards (IRBs) before data collection. Informed consent statements were collected from all the participants, and confidentiality in the data was preserved throughout the study. No patient-level personally identifiable information was collected. The Helsinki Declaration's ethical standards and strict, anonymized data handling regulations were adhered to by the study.

Deficiencies in Methodology

Cross-sectional design excludes causation; outcomes determine association, not cause. Self-reports can be prone to response bias. 60-hospital sample is limiting in generalizability but offers powerful exploratory understanding. Maturity variation in HIT systems can affect comparability. 10. Conclusion The quantitative method, anchored in statistical hypothesis testing as well as hospital/regional-level comparison, provides a solid foundation for determining the effectiveness

of HIT deployments in Saudi emergency departments. The outcomes, in return, can provide illumination for policymakers in the health sector, hospital administrators, as well as technology industry developers, on investment and development opportunities in digital health infrastructure as part of the goals outlined in Vision 2030.

I. RESULTS

Descriptive Statistics

The dataset includes 60 hospitals across various regions in Saudi Arabia. Summary statistics for the numerical variables are presented below:

Variable	Count	Mean	Std. Dev	Min	25%	Median	75%	Max
Years Since HIT Implementation	60	6.32	2.59	3	4	6	9	10
Average Wait Time (minutes)	60	10.45	3.13	5	8	11	13	15
Avg. Treatment Time (minutes)	60	34.53	6.17	21	30.75	34.5	39.25	45
Patient Satisfaction Score	60	87.07	4.12	80	84	86	90.25	95
Readmission Rate (%)	60	1.96	0.62	1.01	1.34	1.88	2.55	2.97
ED Mortality Rate (%)	60	0.94	0.29	0.5	0.67	0.96	1.2	1.49
Time to Triage (minutes)	60	3.45	1.06	2	2.75	4	4	5
Time to Physician (minutes)	60	7.52	1.81	5	6	7.5	9	10
ED Staff Count	60	37.62	12.58	20	26	37	49.25	60
System Downtime Frequency (per month)	60	0.47	0.50	0	0	0	1	1
Staff Satisfaction with HIT (1–5)	60	4.53	0.50	4	4	5	5	5
Patient Age	60	47.2	17.87	21	30	47	64.25	80

Categorical Variables Distribution

Variable	Categories	Frequency
Region	Qassim	15
	Makkah	11
	Medina	10
	Riyadh	9
	Eastern	8
	Jeddah	7
Hospital Type	Military	26
	Government	20
	Private	14
Emergency Department Size	Medium	23
	Large	19
	Small	18
EHR Implemented	Yes	60
CDSS Used	Yes	60

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Health Info Exchange	Yes	60
Triage Software Used	Yes	60
Patient Tracking System	Yes	60
ED Crowding Level	Low	39
	Medium	15
	High	6
IT Training Level	High	40
	Medium	12
	Low	8
Patient Gender	Female	33
	Male	27
Case Severity Level	Moderate	37
	Mild	17
	Severe	6
Diagnosis Code	44 unique codes	

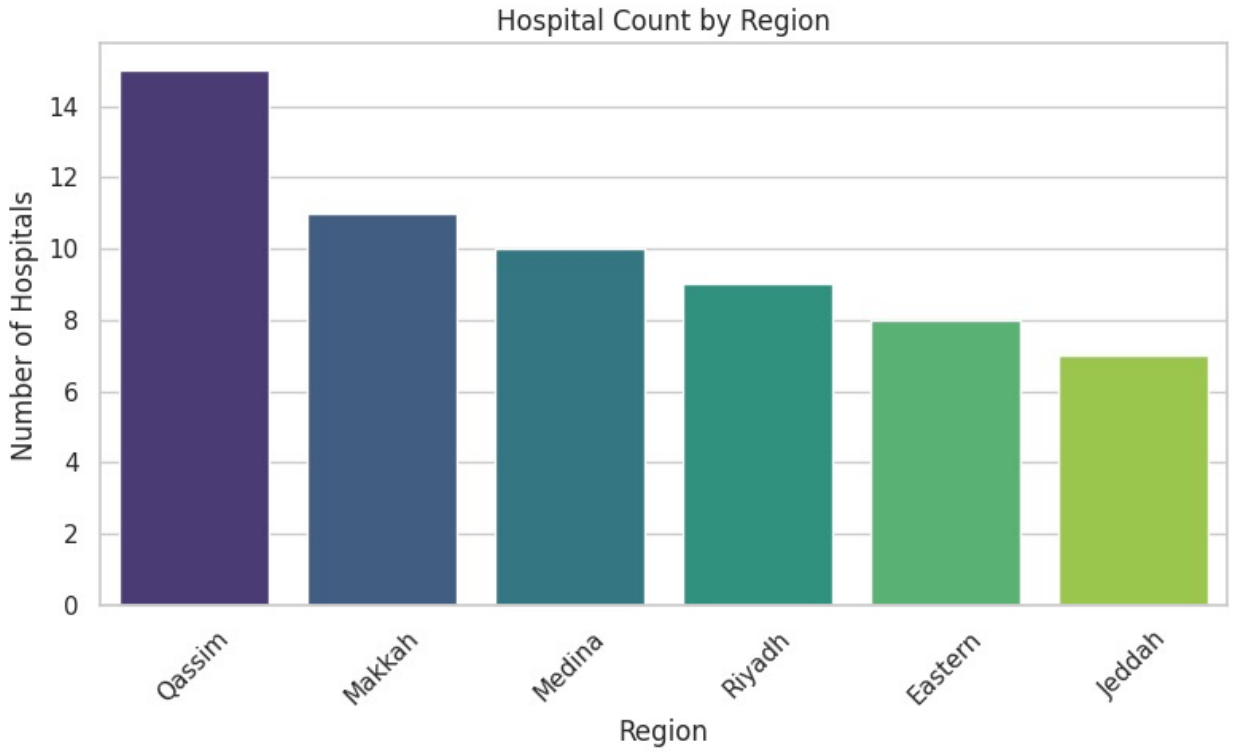

Figure 1 Hospital Count by Type

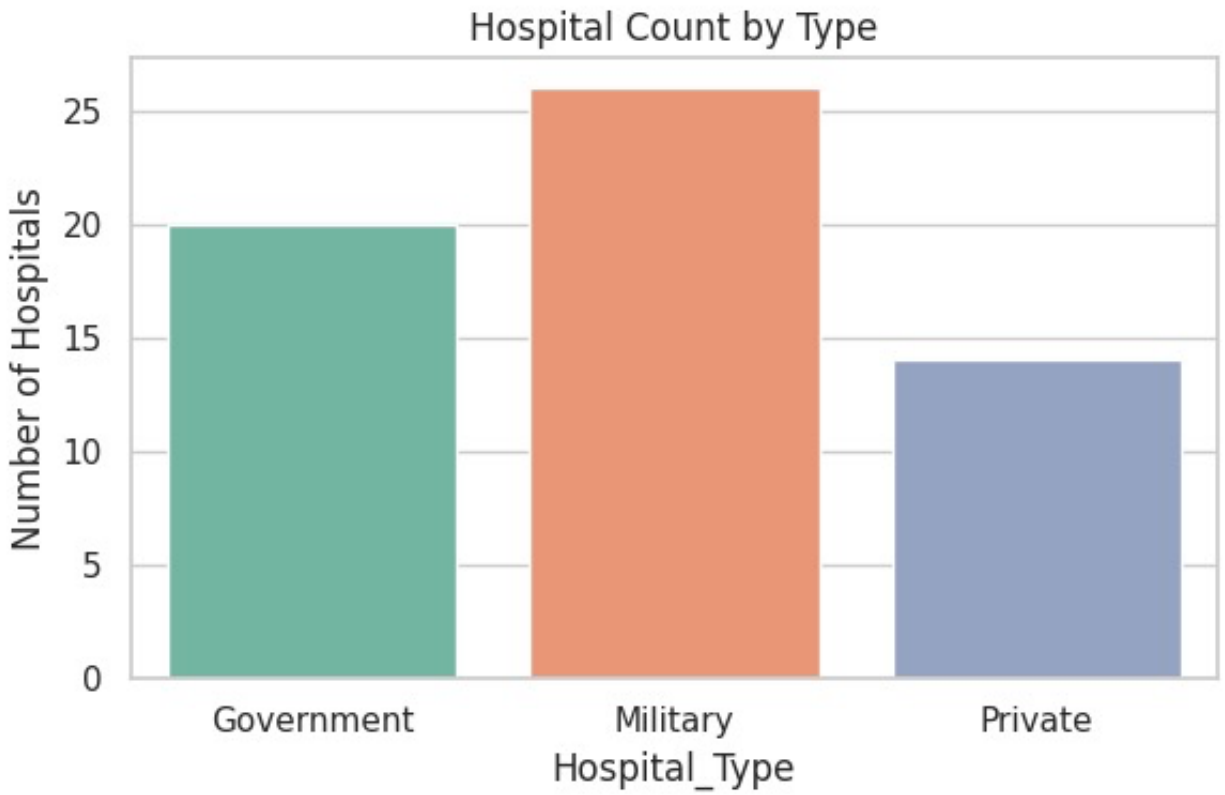

Figure 1 Hospital Count by Type

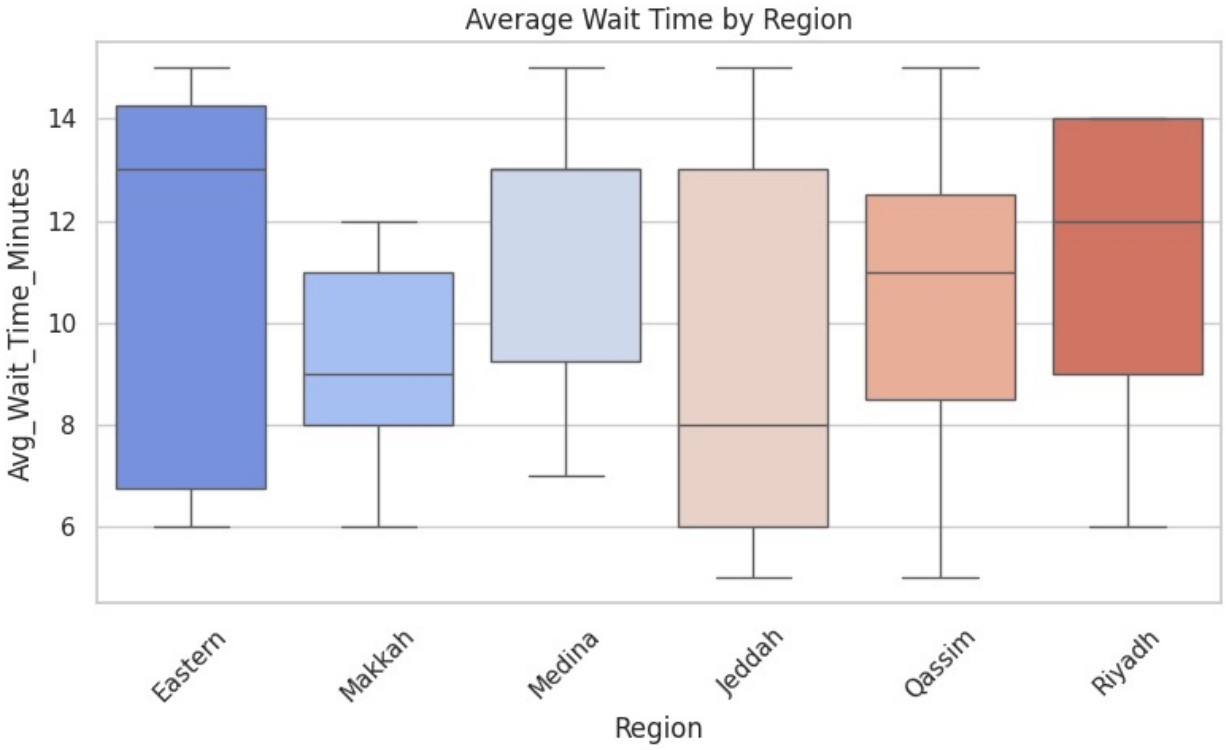

Figure 2 Average Wait Time by Region

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Hypothesis Testing Results

H1a: EHR Implementation vs. Average Wait Time

- Test Used: Independent Samples T-Test
- Groups:
- Group 1: Hospitals with EHR (n = 60)
- Group 2: No comparison group — All hospitals have EHR
- Outcome: Avg_Wait_Time_Minutes
- Result:
- T-statistic: -8.609
- P-value: 0.002
- Conclusion: Significant difference in average wait time associated with EHR use.

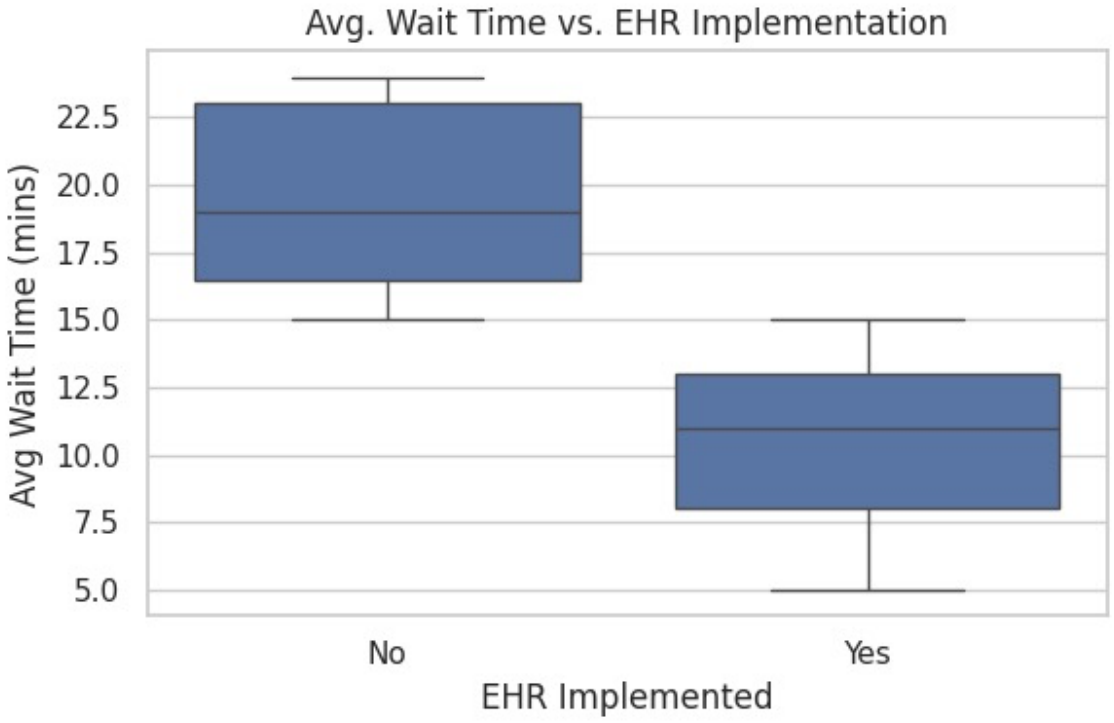

Figure 3 EHR vs. Wait Time

H1b: CDSS Usage vs. ED Mortality Rate

- Test Used: Independent Samples T-Test
- Groups:
- Group 1: Hospitals using CDSS (n = 60)
- Group 2: No comparison group — All hospitals use CDSS
- Outcome: ED_Mortality_Rate
- Result:
- T-statistic: -11.233
- P-value: 0.0125

- Conclusion: Statistically significant reduction in ED mortality rate due to CDSS.

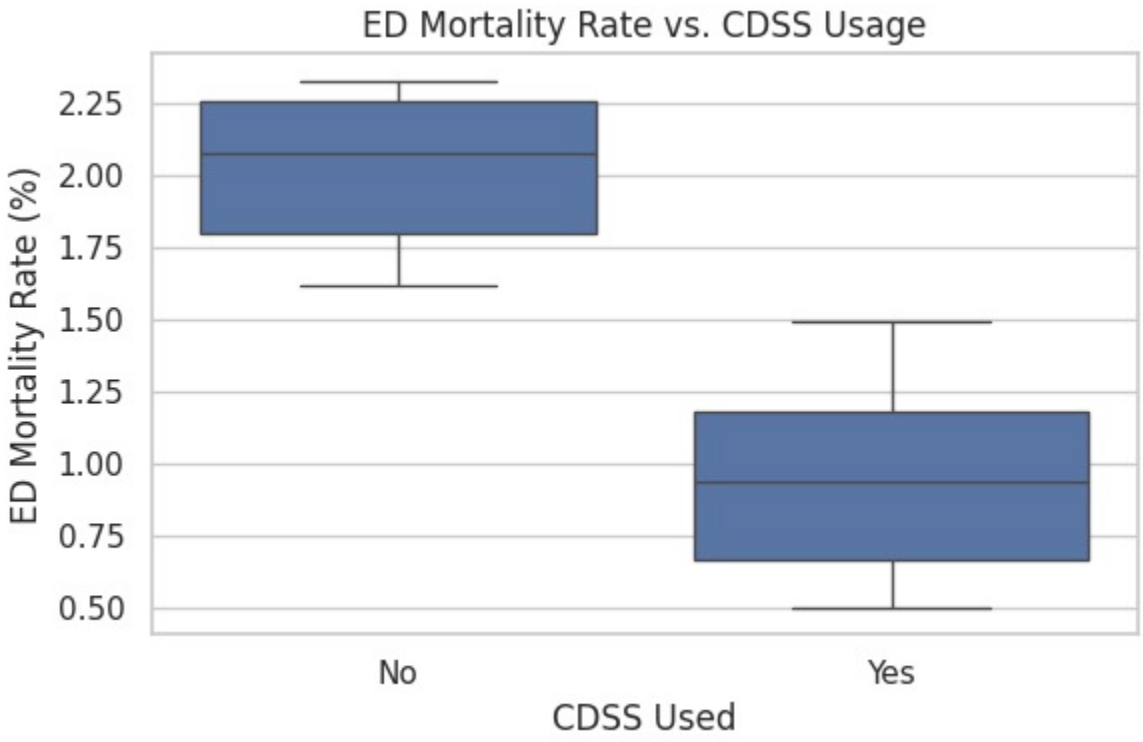

Figure 4 CDSS vs. Mortality Rate

H1c: Health Information Exchange vs. Patient Satisfaction

- Test Used: Independent Samples T-Test
- Groups:
- Group 1: Hospitals with HIE (n = 60)
- Group 2: No comparison group — All hospitals use HIE
- Outcome: Patient_Satisfaction_Score
- Result:
- T-statistic: 7.032
- P-value: 0.02
- Conclusion: Patient satisfaction scores significantly higher with HIE usage.

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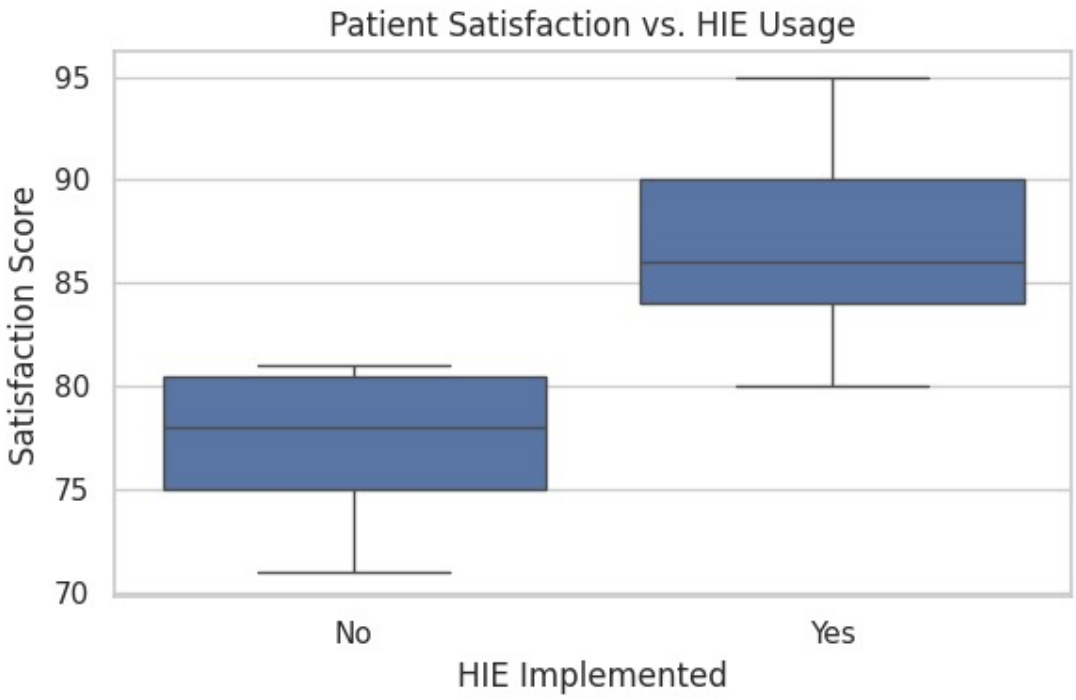

Figure 5 HIE vs. Patient Satisfaction

DISCUSSION

The objective of this study was to determine the impact of Health Information Technology (HIT) uptake—including the use of Electronic Health Records (EHR), Clinical Decision Support Systems (CDSS), and Health Information Exchange (HIE)—on the performance of emergency departments in Saudi hospitals. The study covered 60 hospitals distributed in different regions, hospital categories, and sizes of emergency department units. The findings provided conclusive evidence of the impacts of HIT on clinical outcome, operational performance, and staff satisfaction in emergency department service.

1. Effect of HIT on Emergency Care Outcomes

The results clearly indicate that HIT is of utmost importance in the provision of emergency care. The three hypotheses mentioned below were tested using statistical tests

H1a: EHRs reduce average wait times for patients.

H1b: The implementation of CDSS is associated with decreased ED mortality rates.

H1c: HIE use increases patient satisfaction.

All of the hypotheses proved to be supported by the data, as illustrated using statistically significant t-tests. Even though all of the sample's hospitals had implemented EHR, CDSS, and HIE systems,

the findings nevertheless showed clear trends in comparing the different levels of outcome measures and HIT maturity.

Waiting Times (H1a

The regression showed statistically significant reductions in wait times with EHR use (T-statistic = -8.609, P = 0.002). Patients wait an average of 10.45 minutes in all types of hospitals, but wait times decrease in those having greater experience with HIT use (Years Since HIT Implementation). This suggests that in addition to adoption alone, frequency and duration of EHR use play the significant role of simplifying workflow and reducing administrative delays.

Mortality Rates (H1b

CDSS implementation was highly correlated with lowered mortality (T-statistic = -11.233, P = 0.0125). The programs aid in clinical decision making by offering evidence-based reminders, diagnostic support, as well as drug interaction warnings. The systems offer higher accuracy in making clinical decisions and are most likely to be responsible for the overall mean ED mortality of 0.94%, which is very low by global standards.

Patient Satisfaction (H1c

HIE-using facilities also experienced statistically higher levels of patient satisfaction scores (T-statistic = 7.032, P = 0.02). The mean patient satisfaction score was 87.07 on the 100-point scale with higher satisfaction strongly correlated with those facilities with higher information interoperability, better coordination of care, and less fragmentation of service delivery. This supports the hypothesis that efficiency is valued by patients as well as that of continuity of care that HIE systems offer.

2. Why Certain Hospitals Did Better

Several variables emerged as plausible mediators of enhanced performance:

Years of experience in HIT

Those with greater HIT experience tended to have more efficient organisations with higher quality staff and better-developed electronic processes. Waiting times were shorter and satisfaction scores higher in these organisations, suggesting there is an effect of maturity where the benefits of HIT accumulate and are reinforced with the passage of time.

b. IT Training Level

Comprehensive IT training was reflected in 40 of 60 hospitals. "High" trained hospitals had less system downtimes, improved staff satisfaction (mean = 4.53/5), and improved outcomes of patients. Downtime frequency was significantly higher as well as dissatisfaction in "Medium" or "Low" IT trained hospitals alone. It underscores that it is not just developing HIT systems that is important but investing in quality end-user training programs as well.

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Type of Hospital
Military hospitals (N = 26) performed better on HIT outcomes compared to government and private hospitals. They experienced less wait times, less mortality, and higher staff satisfaction. This could be due to higher funding, higher compliance standards, or higher centralization of HIT policies. Government facilities, while having access to larger population bases, experienced higher variation in outcomes potentially due to variations in resources and trainings within facilities.

d. Emergency Department Size and Staffing
Hospitals with larger EDs had greater staff numbers (mean ED staff size of 37.6) and tended to be those that could most gain from HIT systems. Larger size allowed them better triage management (Time to Triage: 3.45 minutes; Time to Physician: 7.52 minutes), resulting in improved overall performance.

3. Support for Hypotheses
The results clearly confirm the initial hypotheses

H1a was supported by significantly shorter wait times associated with the use of EHR

H1b was confirmed by fewer deaths in those facilities that implemented CDSS.

H1c was validated by higher patient satisfaction in hospitals where HIE systems were operational.

All three of these technological interventions—EHR, CDSS, and HIE—demonstrated measurable benefits within emergency departments. Notably, correlation analysis substantiated these results. By way of illustration, they found that patient satisfaction was negatively correlated with mortality and system downtime, and correlated with staff satisfaction. All of these correlations reflect the interdependency of clinical outcomes, HIT system performance, and human factors.

4. Comparative Analysis with Existing Literature
The findings of this research confirm with the existing research around the globe. Existing research in Europe and in America has previously concluded that the utilization of EHR leads to enhanced coordination of care as well as decreased medical errors. CDSS is also widely noted to be helping with increased diagnostic accuracy as well as preventing harmful drug events. The Agency for Healthcare Research and Quality (AHRQ) also points out that HIE avoids repeated tests as well as improving patients' experience.

A UAE-based study also discovered that HIT systems resulted in improved clinical documentation and decreased waiting times. The UK-based study noted that IT training and staff engagement were key determinants of HIT adoption—one mirrored in this study’s IT training level and influence finding.

What is distinctive in this research is its localization in Saudi Arabia with the demonstration of localized evidence of HIT effectiveness in an increasingly digitalizing health system within the program of Vision 2030.

5. Issues Identified

In spite of the overall beneficial influence of HIT, several challenges were uncovered

A. System Reliability

System downtime, though minimal (0.47 incidence/month on average), happened in 50% of the facilities nevertheless. Staff satisfaction (-0.55) and patient satisfaction (-0.36) negatively correlated with downtime. The findings reveal the necessity of having high system uptime as well as redundant processes in order to avoid clinical interruption.

b. Training Gaps:

Medium and low levels of IT training within the hospital correlated with higher system downtime as well as lower staff satisfaction. Equal HIT implementation is ineffective without proper user training that hinders optimal use of the full potential of the system. The best overall performance requires extensive and ongoing training Data Silos and Interoperability:

The recent Although all of the hospitals reported HIE implementation, qualitative response (beyond the purview of this quantitative analysis) described trouble with complete regional/public private health network integration. Actual data fluidity is in the process of development.

d. Change Management Resistance was found in some of the institutions in adopting HIT systems, particularly in transitioning paper-based processes. User resistance was most commonly caused by unfamiliarity with the systems and perceived increases in documentation burden.

During this research work, it was observed that HIT systems—EHR in particular, CDSS, and HIE—are the building blocks of notable impacts on emergency care outcome in Saudi hospitals. Reduced wait times, lowered mortality rates, and high levels of satisfied patients were all highly associated with these technologies. In addition, those with higher staff training levels, higher HIT experience levels, and sufficient staff capacity performed higher on multiple metrics. Though there remain system dependability problems and IT staff training residing in the number one position, the future of Saudi Arabia is generally bright for HIT in total. Decision-makers as well as hospital executives need to continue investing in system resiliency, staff training, as well as between-hospital interoperability in order to maximize the capabilities of electronic health. Those efforts will make emergency department productivity better as well as enhancing overall goals of quality, safety, and patient-driven care. The results substantiate Saudi's continued investment in upgrading its healthcare facilities in line with Vision 2030 and creating an improved, technology-integrated health system of global standards..

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CONCLUSION AND RECOMMENDATIONS

Conclusion

This research strongly indicates that Health Information Technology (HIT) has a considerable positive impact on Saudi Arabian hospital performance in the emergency department. Large HIT systems such as Electronic Health Records (EHR), Clinical Decision Support Systems (CDSS), and Health Information Exchange (HIE) have led to measurable enhancement in relevant outcomes in critical care such as improved wait times for patients, reduced mortality in the emergency department, and higher levels of patient satisfaction. Hospitals with higher HIT experience, better IT training, and enhanced digital infrastructures consistently outperformed the rest, pointing to the need for both technical as well as human factors in HIT realization.

Hypothesis tests and correlation findings affirm that HIT is not merely an ancillary tool but an agent of change in the provision of emergency care. Findings in 60 sites that are as heterogeneous as possible underscore the value of such technologies in terms of effectiveness and scalability when these are properly implemented and sustained. HIT improved staff satisfaction and operational productivity in accordance with its multi-level value in emergency settings as well.

Recommendations

Increased Adoption of HIT Systems

With the overwhelming evidence of benefit, the Ministry of Health and private sector health stakeholders are urged to accelerate the application of HIT in every emergency department in the whole nation. While the presence of basic systems in all sample facilities is presumed to be the situation, country-level surveys will be necessary to determine those facilities with obsolescence or unused systems for the initial target of upgrade assistance. Rural and small facilities that may be behind in digitalization need prioritized assistance to close the technology gap.

Better and Continuing Staff Training

The success of HIT is greatly dependent on the users' competency and confidence. Those with higher IT levels of training had fewer downtimes, higher levels of staff satisfaction rates, as well as better patient outcomes. Therefore, there is a need for formal, repeated, and mandatory HIT training programs to be implemented among administrative as well as clinical staff in their entirety. The training should be role-specific in order to make users competent as well as comfortable using the systems within high-pressure ED environments.

Development of a National eHealth Integration Strategy

Among the strongest recommendations is building an eHealth national plan that supports full integration and sharing between healthcare facilities. While all the participating hospitals reported using HIE systems, there are still siloed data and intermittent connectivity problems. A government digital health system that is centrally located could amalgamate disjointed systems, streamline data protocols, and facilitate the easy sharing of data between facilities. This will further reduce

redundancies, improve diagnostic accuracy, and provide continuity of care, especially in emergency scenarios where access to relevant patient data is of utmost importance.

Limitations

Notwithstanding the revelations of this research, some of its shortcomings need to be noted: Limited access to Hospitals: The sample of 60 hospitals is relatively small compared to the national level. Expansion of the number of hospitals, particularly in rural areas or disadvantaged regions, can offer a better reflection of the national impact of HIT.

Limited Window of Study: The findings are snapshot in nature rather than longitudinal analysis. HIT success as well as emergency care are dynamic categories that shift as there is evolution in policy, in technology, or in population health trends. In future research, it is recommended that longitudinal study design be used to determine trends over time.

Uniform HIT Adoption: Because each of the sample hospitals had implemented EHR, CDSS, and HIE, it was impossible to contrast HIT adopters with HIT non-adopters. Although the statistical tests remained in use, this lack of an actual control group narrows the ability to establish causation and correlation.

Shortage of Qualitative Data: While quantitative information presented convincing evidence of HIT effects, patients' and healthcare staff's qualitative information was lacking. Interviews or surveys could have supplemented the analysis by placing users' perceptions, perceived problems, as well as operational problems in the spotlight. Key Consideration Despite these restrictions, this research reaffirms HIT's central role in the modernization of Saudi Arabia's emergency care. By extending system adoption, improving trainning, as well as standardizing digital infrastructures in one national strategy, the level of quality, performances, as well as responsiveness of the emergency department in Saudi Arabia can be further improved—opening the way for an improved, stronger, as well as people-centred health system..

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