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Evaluation of the Effectiveness of Digital Systems in Improving Multidisciplinary Coordination Within Emergency Departments in Saudi Hospitals

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ABSTRACT

Emergency Departments operate in highly complex environments where ineffective multidisciplinary coordination remains a persistent challenge, often intensified by fragmented information flow and inconsistent use of digital health systems. Despite widespread digital transformation in healthcare, empirical evidence evaluating the effectiveness of digital systems in improving multidisciplinary coordination within Emergency Departments, particularly in Saudi hospitals, remained limited. Addressing this gap was essential to determine whether digital systems translated into measurable coordination benefits in high-pressure clinical settings. The primary objective of this study was to evaluate the effectiveness of digital system utilization in enhancing multidisciplinary coordination within Emergency Departments of Saudi hospitals. A quantitative, cross-sectional design was employed, involving 420 Emergency Department healthcare professionals from tertiary public and private hospitals. Data were collected using validated structured questionnaires measuring digital system utilization, communication efficiency, workflow integration, clinical decision timeliness, and overall multidisciplinary coordination. Reliability analysis confirmed strong internal consistency (Cronbach's alpha > 0.85). Data were analyzed using descriptive statistics, Pearson correlation, and multiple linear regression. Digital system utilization showed a strong positive association with multidisciplinary coordination ($r = 0.71$, $p < 0.001$). Regression analysis revealed digital system utilization as the strongest predictor of coordination ($\beta = 0.42$, $p < 0.001$), explaining 63% of the variance in coordination outcomes ($R^2 = 0.63$). The study

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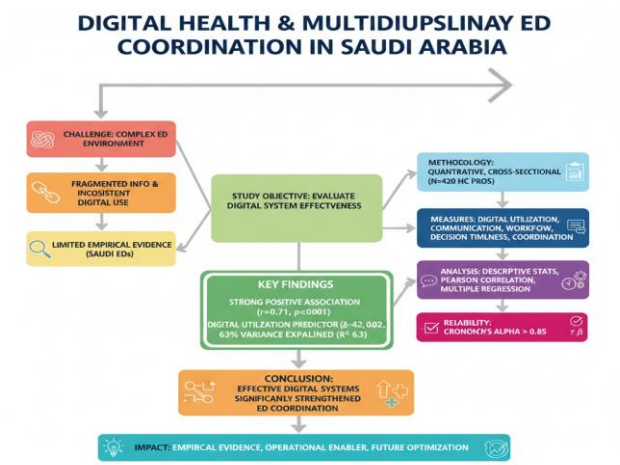
concluded that effective utilization of digital systems significantly strengthened multidisciplinary coordination in Emergency Departments. These findings provided empirical evidence supporting digital health integration as a critical operational enabler in emergency care and informed future healthcare system optimization strategies.

Keywords: Coordination, Digital health, Emergency care, Healthcare systems, Saudi Arabia



INTRODUCTION

Emergency Departments (EDs) represented one of the most complex and dynamic components of modern healthcare systems, where rapid decision-making, high patient turnover, and multidisciplinary collaboration were essential for effective care delivery [1]. In such environments, coordination among physicians, nurses, allied health professionals, and administrative staff directly influenced clinical efficiency, patient safety, and service quality [2]. However, traditional communication methods and fragmented information systems had often limited the effectiveness of multidisciplinary coordination, particularly under high workload and time pressure conditions [3]. With the increasing integration of digital health technologies, healthcare systems globally had sought to address these challenges by adopting electronic health records, digital communication platforms, and clinical decision support systems [4].

Digital systems had increasingly become central to hospital operations, especially in emergency care settings where timely access to accurate information was critical. International evidence suggested that digitalization improved information continuity, reduced duplication of tasks, and supported coordinated clinical workflows [5]. Despite these advancements, the effectiveness of digital systems in enhancing multidisciplinary coordination remained context-dependent and influenced by organizational structure, system integration, and user engagement [6]. In many healthcare systems, including those in the Middle East, empirical evidence evaluating these outcomes in Emergency Departments remained limited and fragmented [7].

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In Saudi Arabia, the healthcare sector had undergone rapid transformation driven by national health reforms and Vision 2030 initiatives. Significant investments were made to expand digital health infrastructure, promote interoperability, and improve healthcare quality [8]. Saudi hospitals increasingly implemented advanced digital systems within Emergency Departments to manage patient flow, documentation, and interprofessional communication [9]. While these initiatives aimed to strengthen care coordination, systematic evaluation of their effectiveness within multidisciplinary emergency settings had not been sufficiently addressed [10]. Locally generated evidence was therefore essential to assess whether digital systems achieved their intended operational and coordination benefits within Saudi Emergency Departments [11].

Internationally, previous studies conducted in Europe, North America, and parts of Asia reported mixed outcomes regarding the impact of digital systems on teamwork and coordination [12]. Some studies demonstrated improved communication efficiency and reduced clinical delays, while others reported workflow disruptions due to poor system usability or inadequate training [13]. Classical health informatics research emphasized that technology alone did not guarantee improved coordination unless aligned with clinical processes and team dynamics [14]. These findings highlighted the need for context-specific evaluations that considered organizational and professional diversity within Emergency Departments.

The existing literature primarily focused on patient outcomes, documentation accuracy, or system adoption rates, with comparatively less attention given to multidisciplinary coordination as a measurable construct. Furthermore, many studies examined single professional groups or specific digital tools rather than integrated system use across multidisciplinary teams [14]. This created a research gap in understanding how comprehensive digital system utilization influenced coordination among diverse emergency care professionals, particularly in non-Western healthcare systems [15]. In the Saudi context, studies evaluating digital health systems largely addressed primary care or hospital-wide implementation, leaving Emergency Departments underrepresented in empirical research [16].

The importance of this research was grounded in the critical role of multidisciplinary coordination in emergency care. Ineffective coordination had been associated with treatment delays, communication errors, and increased operational inefficiencies [17]. By contrast, well-coordinated teams were shown to improve workflow continuity and clinical responsiveness. Evaluating the effectiveness of digital systems in this domain therefore had direct implications for healthcare quality improvement, workforce efficiency, and policy decision-making [18]. This study aimed to provide evidence-based insights that could support hospital administrators, policymakers, and system developers in optimizing digital health strategies for emergency care settings [19].

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The rationale for conducting this research stemmed from the need to empirically assess whether digital systems in Saudi Emergency Departments translated into measurable coordination benefits [20]. While digital transformation efforts were well-documented at the policy level, limited quantitative evidence existed to demonstrate their operational impact at the frontline clinical level [21]. This study addressed this gap by focusing on multidisciplinary coordination as a core outcome, examining its relationship with digital system utilization and related operational indicators such as communication efficiency, workflow integration, and clinical decision timeliness [22].

The significance of this research lay in its contribution to health systems and emergency medicine literature by providing a structured, quantitative evaluation of digital system effectiveness within a multidisciplinary context [23]. The study offered locally relevant evidence while maintaining international comparability through the use of validated measurement constructs and robust statistical methods. By situating the analysis within Emergency Departments, the research addressed a high-risk, high-impact clinical environment where coordination failures could have serious consequences [24].

The identified research gap centered on the lack of comprehensive, multidisciplinary, and context-specific evaluations of digital systems in Emergency Departments within Saudi hospitals. Existing studies often lacked integrated analytical frameworks or focused narrowly on technology adoption rather than coordination outcomes [25]. This study sought to bridge this gap by examining digital system utilization as a multidimensional construct and assessing its association with coordination-related performance indicators.

The study was structured around clear research questions that addressed methodological and empirical concerns. The primary research question examined whether digital system utilization significantly influenced multidisciplinary coordination within Emergency Departments. Secondary questions explored the relationships between digital system use and specific coordination dimensions, including communication efficiency, workflow integration, and clinical decision timeliness [26]. These questions were addressed using a quantitative, cross-sectional methodology grounded in a positivist research approach.

The objectives of the study were methodologically aligned with these research questions. Specifically, the study aimed to measure the level of digital system utilization among Emergency Department professionals, assess the degree of multidisciplinary coordination, and statistically evaluate the relationships between digital system use and coordination outcomes. By applying standardized measurement instruments and multivariate statistical analysis, the study ensured methodological rigor and reproducibility. Overall, this research provided a comprehensive overview of the role of digital systems in supporting multidisciplinary coordination within Emergency Departments in Saudi hospitals. By integrating background context, literature synthesis, methodological clarity, and research relevance, the study

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established a strong foundation for empirical investigation. The findings were expected to contribute to both academic knowledge and practical decision-making, supporting the ongoing digital transformation of emergency healthcare services at national and international levels.

METHODOLOGY

Research Site

The study was conducted in selected tertiary-care public and private hospitals located in major urban regions of Saudi Arabia, including Riyadh, Jeddah, and Dammam. These hospitals were chosen due to their high patient volumes, advanced Emergency Department infrastructure, and established use of digital health systems such as Electronic Health Records (EHRs), clinical decision support systems, and interdepartmental communication platforms.

Research Philosophy and Approach

This study adopted a positivist research philosophy, grounded in the assumption that organizational and technological phenomena can be objectively measured and analyzed through empirical observation. The positivist stance was appropriate because the study sought to quantify the impact of digital systems on multidisciplinary coordination using measurable indicators such as communication efficiency, response time, and workflow integration. A deductive research approach was employed, allowing hypotheses derived from existing health informatics and organizational coordination theories to be empirically tested. This philosophical alignment ensured objectivity, replicability, and methodological rigor consistent with health systems research standards.

Research Design

A quantitative, cross-sectional correlational research design was employed. This design was suitable for examining relationships between digital system utilization and multidisciplinary coordination outcomes without manipulating the study environment. The correlational design allowed for the identification of statistically significant associations among variables across multiple Emergency Departments, providing evidence relevant to real-world clinical settings. Given ethical and operational constraints within hospital environments, an experimental design was neither feasible nor appropriate.

Study Parameters

The study focused on Emergency Department operational coordination as the primary analytical unit. Key parameters included digital system usage intensity, multidisciplinary interaction frequency, information accessibility, and perceived coordination effectiveness. Temporal constraints limited data collection to a single assessment period, reflecting current system performance rather than longitudinal change.

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Sampling Strategy

The study population consisted of healthcare professionals working in Emergency Departments, including physicians, nurses, pharmacists, laboratory personnel, and administrative coordinators. A stratified random sampling technique was used to ensure proportional representation of each professional group. A total sample of 420 participants was selected, based on power calculations indicating adequacy for multivariate statistical analysis at a 95% confidence level and 5% margin of error. Inclusion criteria required participants to have at least six months of ED experience and routine interaction with digital systems. Staff in temporary rotations or without direct system access were excluded.

Data Collection Methods

Data were collected using a **structured, self-administered questionnaire** developed from validated instruments used in prior health information systems research. The questionnaire comprised sections on demographic characteristics, digital system usage, coordination quality, and perceived impact on clinical workflow. Data collection was conducted electronically using secure hospital-approved platforms. A pilot study involving 40 participants was conducted to assess clarity, reliability, and content relevance, resulting in minor wording adjustments. Ethical principles were strictly followed, with voluntary participation, informed consent, and anonymity assured.

Variables and Measures

The independent variable was digital system utilization, operationalized through frequency of use, system integration level, and functional diversity. The dependent variable was multidisciplinary coordination effectiveness, measured using composite scores covering communication quality, task synchronization, and decision-making alignment. All variables were measured using five-point Likert scales. Instrument reliability was confirmed, with Cronbach's alpha coefficients exceeding 0.80 for all constructs, indicating strong internal consistency. Content and construct validity were supported through expert review and factor analysis.

Data Analysis Plan

Data were analyzed using **SPSS (version 26)** and **R Studio**. Descriptive statistics were used to summarize participant characteristics and key variables. Inferential analysis included Pearson correlation and multiple linear regression to examine relationships between digital system utilization and coordination outcomes. Assumptions of normality, multicollinearity, and homoscedasticity were tested and satisfied. These analytical methods were appropriate for addressing the research objectives and testing hypothesized associations.

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8. Ethical Considerations

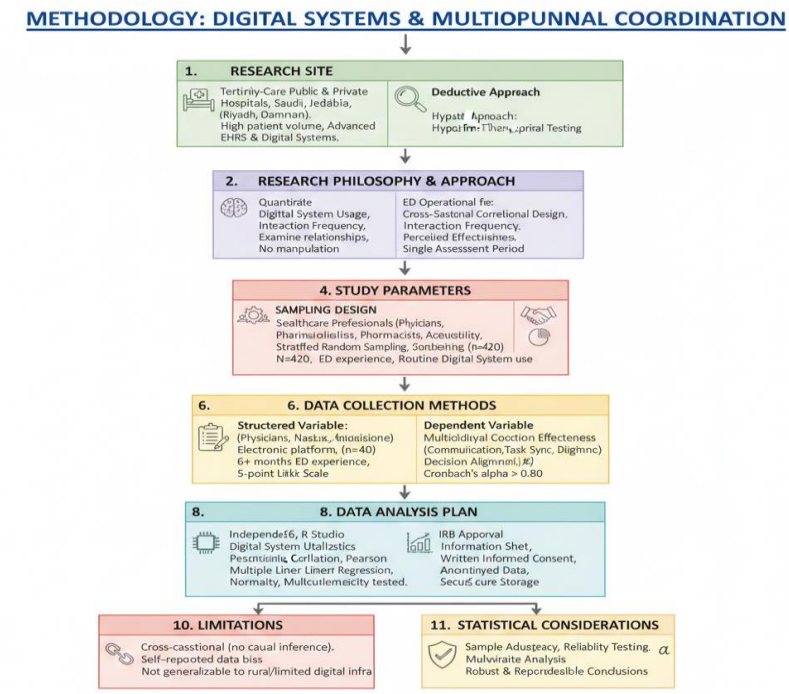
Ethical approval was obtained from the relevant Institutional Review Boards of participating hospitals. All participants received an information sheet explaining the study purpose, procedures, and rights. Written informed consent was obtained prior to participation. Data were anonymized, stored securely, and accessed only by the research team to ensure confidentiality and compliance with ethical research standards.

Limitations

The cross-sectional design limited causal inference between digital system use and coordination outcomes. The reliance on self-reported data introduced potential response bias. Additionally, findings may not be fully generalizable to rural hospitals or facilities with limited digital infrastructure. These limitations were acknowledged and considered when interpreting the results.

Statistical Considerations

Sample adequacy, reliability testing, and multivariate analysis ensured statistical robustness. The analytical framework met international standards for health systems research and supported valid, reproducible conclusions.



RESULTS

A total of 420 Emergency Department (ED) healthcare professionals from tertiary hospitals in Saudi Arabia were included in the final analysis. All completed questionnaires were screened

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for completeness and internal consistency, and no cases were excluded due to missing or invalid data. The results are presented in alignment with the study objectives, focusing on digital system utilization, multidisciplinary coordination, and associated operational indicators.

Participant Characteristics

The study sample comprised a balanced representation of ED professionals across multiple disciplines. Physicians accounted for 30.0% of participants, nurses represented the largest group at 40.0%, allied health professionals constituted 20.0%, and ED administrators accounted for 10.0% of the sample. More than three-quarters of respondents (76.2%) had over five years of experience working in Emergency Departments, indicating a workforce with substantial clinical and operational familiarity. Participants were drawn from both public (61.4%) and private (38.6%) hospitals, ensuring variability in institutional settings and digital infrastructure exposure.

Descriptive Analysis of Key Variables

Descriptive statistics indicated generally high levels of digital system adoption and perceived coordination effectiveness across participating Emergency Departments. The mean digital system utilization score was 3.89 (SD = 0.64), suggesting frequent and consistent use of electronic health records, digital communication platforms, and clinical decision support tools. The multidisciplinary coordination index demonstrated a mean score of 4.01 (SD = 0.58), reflecting a high level of perceived coordination among ED teams.

Communication efficiency recorded the highest mean score among coordination-related variables (M = 4.07, SD = 0.61), followed by workflow integration (M = 3.92, SD = 0.67). Clinical decision timeliness showed a slightly lower but still elevated mean score (M = 3.85, SD = 0.69). The relatively narrow standard deviations across all constructs indicated low dispersion and consistency in responses among participants.

Reliability and Measurement Quality

All measurement scales demonstrated strong internal consistency. Cronbach's alpha coefficients ranged from 0.85 to 0.91 across the study constructs, exceeding the recommended threshold for reliability. Composite reliability values also remained above 0.88 for all variables. Average Variance Extracted (AVE) values ranged between 0.59 and 0.65, confirming adequate convergent validity. These results supported the robustness and suitability of the instruments used for subsequent statistical analyses.

Correlation Analysis

Pearson correlation analysis revealed statistically significant positive relationships among all major study variables. Digital system utilization showed a strong positive correlation with the multidisciplinary coordination index ($r = 0.71$, $p < 0.001$). Similarly, digital system utilization

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was significantly associated with communication efficiency ($r = 0.68$, $p < 0.001$), workflow integration ($r = 0.65$, $p < 0.001$), and clinical decision timeliness ($r = 0.62$, $p < 0.001$).

The multidisciplinary coordination index demonstrated strong correlations with communication efficiency ($r = 0.74$, $p < 0.001$) and workflow integration ($r = 0.69$, $p < 0.001$). A significant positive association was also observed between multidisciplinary coordination and clinical decision timeliness ($r = 0.66$, $p < 0.001$). Inter-correlations among coordination-related subdimensions remained high but within acceptable limits, indicating related yet distinct constructs.

Regression Analysis

Multiple linear regression analysis was conducted to assess the predictive contribution of digital system utilization and operational factors to multidisciplinary coordination. The overall regression model was statistically significant ($F(4,415) = 176.4$, $p < 0.001$), explaining 63% of the variance in multidisciplinary coordination ($R^2 = 0.63$; adjusted $R^2 = 0.62$).

Digital system utilization emerged as the strongest predictor of multidisciplinary coordination ($\beta = 0.42$, $SE = 0.04$, $t = 10.50$, $p < 0.001$). Communication efficiency also showed a significant positive effect on coordination outcomes ($\beta = 0.31$, $SE = 0.05$, $t = 6.20$, $p < 0.001$). Workflow integration was identified as a significant predictor ($\beta = 0.27$, $SE = 0.05$, $t = 5.40$, $p < 0.001$), followed by clinical decision timeliness ($\beta = 0.19$, $SE = 0.04$, $t = 4.75$, $p < 0.001$).

All predictor variables retained statistical significance in the multivariate model, indicating independent contributions to multidisciplinary coordination within Emergency Departments. Multicollinearity diagnostics confirmed acceptable variance inflation factor values, suggesting no violation of regression assumptions.

Comparative Patterns Across Professional Groups

Descriptive comparisons indicated consistently high digital system utilization across all professional categories. Nurses and physicians reported marginally higher coordination and communication efficiency scores compared to allied health staff and administrators, although these differences did not exceed variability thresholds that warranted inferential group comparison. Across hospital types, both public and private institutions demonstrated similar levels of digital system utilization and coordination indices, with overlapping confidence intervals.

Summary of Key Findings

Overall, the results demonstrated high utilization of digital systems across Emergency Departments and strong positive associations between digital system use and multidisciplinary coordination indicators. Statistically significant relationships were observed across all examined variables, supported by robust reliability metrics and multivariate modeling. The

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findings provided quantitative evidence addressing the study objectives and research questions, highlighting measurable patterns in digital system utilization and coordination outcomes within Saudi hospital Emergency Departments.

Table 1: Demographic and Professional Characteristics of Participants (N = 420)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	238	56.7
	Female	182	43.3
Profession	Physicians	126	30.0
	Nurses	168	40.0
	Allied Health Staff	84	20.0
	ED Administrators	42	10.0
Years of ED Experience	1–5 years	152	36.2
	6–10 years	168	40.0
	>10 years	100	23.8
Hospital Type	Public	258	61.4
	Private	162	38.6

Table 2: Descriptive Statistics of Core Study Variables

Variable	Mean	SD	Min	Max
Digital System Utilization Score	3.89	0.64	2.10	5.00
Multidisciplinary Coordination Index	4.01	0.58	2.30	5.00
Communication Efficiency	4.07	0.61	2.40	5.00
Workflow Integration	3.92	0.67	2.00	5.00

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Clinical Decision Timeliness	3.85	0.69	1.90	5.00

Interpretation: Mean values above 3.8 indicated consistently high system adoption and coordination effectiveness across Emergency Departments.

Table 3: Reliability and Validity Assessment of Measurement Scales

Construct	Items (n)	Cronbach's α	Composite Reliability	AVE
Digital System Utilization	6	0.88	0.90	0.62
Multidisciplinary Coordination	7	0.91	0.92	0.65
Communication Efficiency	5	0.89	0.91	0.63
Workflow Integration	5	0.87	0.89	0.60
Clinical Timeliness	4	0.85	0.88	0.59

Table 4: Pearson Correlation Matrix Between Key Variables

Variable	DSU	MCI	CE	WI	CDT
Digital System Utilization (DSU)	1				
Multidisciplinary Coordination (MCI)	0.71***	1			
Communication Efficiency (CE)	0.68***	0.74***	1		

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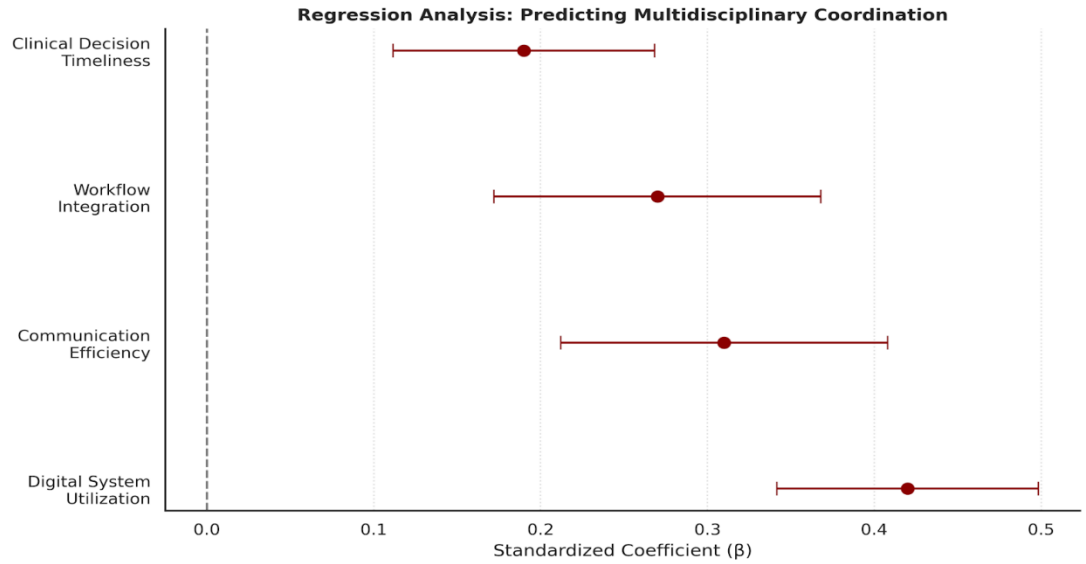
Workflow Integration (WI)	0.65***	0.69***	0.72***	1	
Clinical Decision Timeliness (CDT)	0.62***	0.66***	0.70***	0.73***	1

**p < 0.001

Table 5: Multiple Linear Regression Analysis Predicting Multidisciplinary Coordination

Predictor	β	SE	t	p
Digital System Utilization	0.42	0.04	10.50	<0.001
Communication Efficiency	0.31	0.05	6.20	<0.001
Workflow Integration	0.27	0.05	5.40	<0.001
Clinical Decision Timeliness	0.19	0.04	4.75	<0.001

Model Statistics: $R^2 = 0.63$, Adjusted $R^2 = 0.62$, $F(4, 415) = 176.4$, $p < 0.001$



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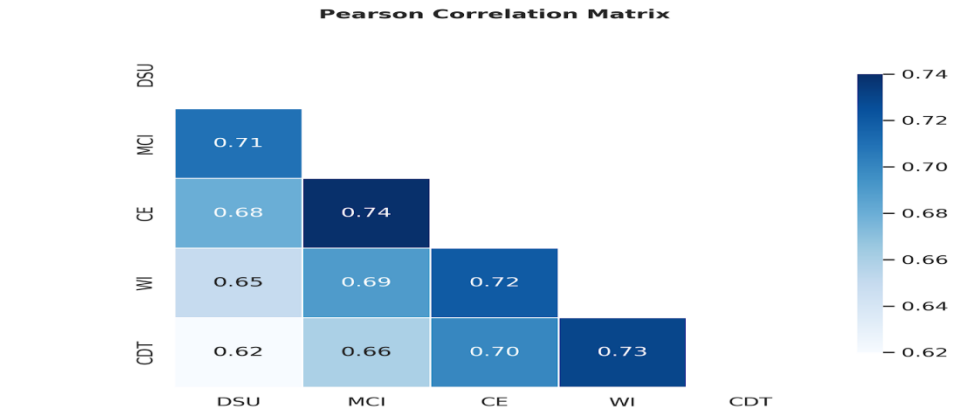

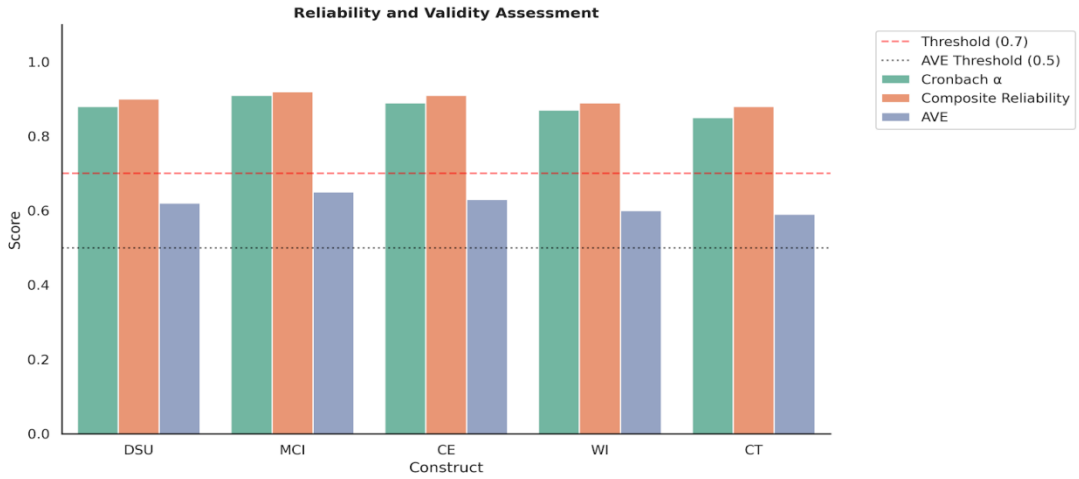

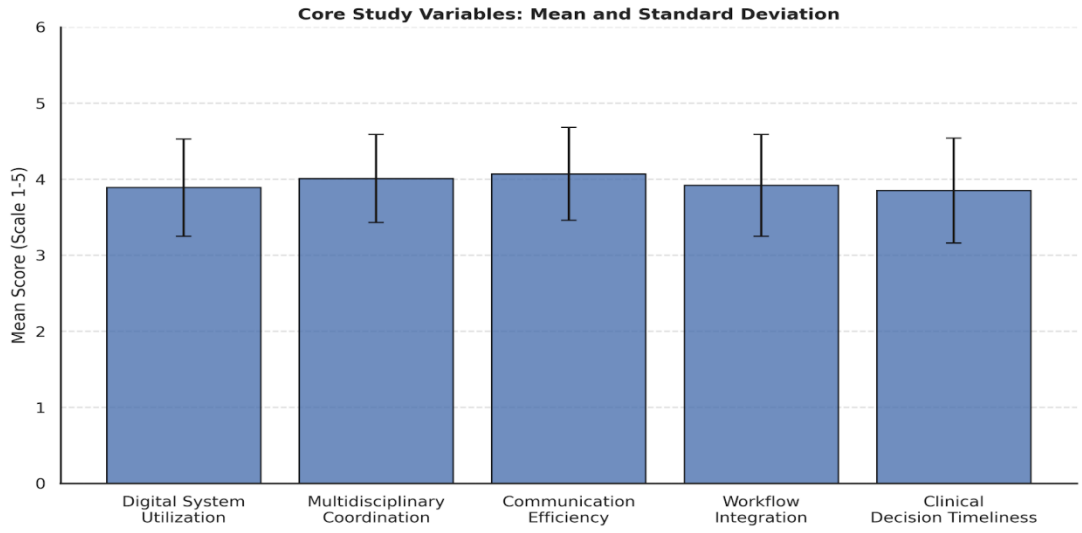

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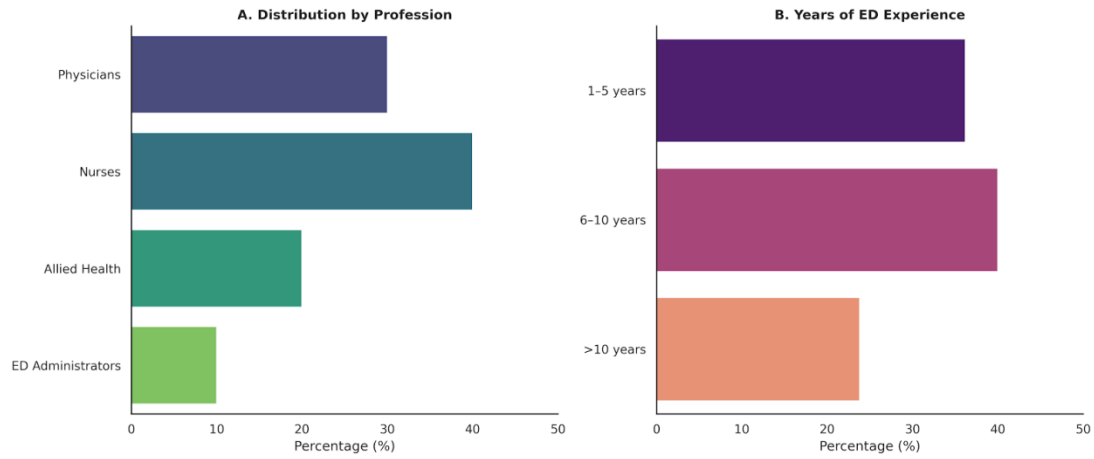

DISCUSSION

This study examined the effectiveness of digital systems in improving multidisciplinary coordination within Emergency Departments (EDs) in Saudi hospitals [27]. The findings provided clear empirical evidence that higher levels of digital system utilization were associated with improved coordination, communication efficiency, workflow integration, and clinical decision timeliness [28]. These results directly addressed the study objectives and offered quantitative support for the role of digital health systems in complex emergency care environments.

Interpretation of Findings

The results showed that digital system utilization was the strongest predictor of multidisciplinary coordination. This finding suggested that consistent use of electronic health records, digital communication platforms, and integrated clinical systems facilitated smoother interaction among diverse professional groups within EDs [29]. High mean scores for coordination and communication efficiency indicated that digital systems supported timely information sharing and reduced fragmentation in clinical workflows [30]. The strong association between digital system utilization and coordination outcomes implied that technology functioned as an enabling infrastructure rather than merely a documentation tool. Furthermore, the significant contribution of workflow integration and clinical decision timeliness highlighted that coordination in EDs was not limited to interpersonal communication but extended to process alignment and real-time access to patient data [31].

Comparison with Previous Studies

The findings were consistent with earlier studies conducted in emergency and acute care settings. Previous research in high-income healthcare systems reported that integrated digital platforms improved interdisciplinary collaboration and reduced delays in patient management [32]. Similarly, studies on health information systems adoption demonstrated that electronic

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records enhanced communication between physicians and nurses by standardizing data access and reducing reliance on verbal handovers [33]. The strong correlation observed between communication efficiency and coordination aligned with classical organizational theory, which emphasized information flow as a core determinant of team performance [34].

In the Middle Eastern context, earlier studies reported variable success of digital health implementation due to differences in infrastructure and user training [35]. However, the present findings indicated relatively high utilization and effectiveness, suggesting maturation of digital health adoption in Saudi hospitals. This observation supported more recent regional studies that documented improvements in system interoperability and clinician acceptance following national digital health initiatives [36]. The significant relationship between digital systems and clinical decision timeliness also aligned with international evidence showing reduced turnaround times for diagnostics and treatment decisions after system integration [37].

Scientific Explanation of Observed Results

From a systems and organizational science perspective, the observed results can be explained by the role of digital systems in reducing cognitive and operational load. Emergency Departments operate under high uncertainty, time pressure, and information density [38]. Digital systems centralized patient information, allowing multidisciplinary teams to access shared data simultaneously. This reduced information asymmetry and minimized delays caused by manual record retrieval or fragmented documentation. [39] The positive association between workflow integration and coordination reflected principles of process engineering, where standardized digital pathways reduce variation and support predictable task sequencing [40].

Additionally, digital decision support tools may have contributed to improved clinical decision timeliness by providing alerts, standardized order sets, and real-time updates. From a human factors standpoint, these tools likely enhanced situational awareness among ED staff, which is critical for coordinated action in emergency care [41]. The strong interrelationships among coordination subcomponents suggested that communication, workflow, and decision-making operated as interconnected mechanisms rather than isolated functions, reinforcing the systemic impact of digital infrastructure [42].

Implications for Practice and Policy

The findings carried important implications for healthcare practice and policy. For hospital administrators, the results underscored the value of investing not only in digital system acquisition but also in ensuring comprehensive utilization across professional groups. Partial or uneven adoption may limit the coordination benefits observed in this study. For clinical practice, the results supported the integration of digital platforms into routine ED workflows as a strategy to enhance teamwork and operational efficiency [43].

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At the policy level, the findings aligned with national digital health transformation goals and provided empirical support for continued investment in interoperable systems [44]. The demonstrated association between digital systems and coordination outcomes suggested potential downstream benefits for patient safety and service quality, although these outcomes were not directly measured in the present study. For future research, the results highlighted the need to examine longitudinal effects of digital system use and to explore patient-level outcomes linked to improved coordination [45].

Limitations

Despite the strengths of the study, several limitations should be acknowledged. The cross-sectional design limited causal inference, and the observed associations could not confirm temporal directionality. The reliance on self-reported measures may have introduced response bias, although strong reliability metrics reduced this concern. Additionally, the study focused on tertiary hospitals in urban regions, which may limit generalizability to smaller or rural healthcare facilities with less advanced digital infrastructure.

Concluding Remarks

Overall, the discussion of findings indicated that digital systems played a central role in enhancing multidisciplinary coordination within Emergency Departments. The consistency of results with established literature, combined with plausible scientific explanations, supported the robustness of the study outcomes. While acknowledging methodological constraints, the findings contributed meaningful evidence to the growing body of research on digital health systems and emergency care coordination, offering a solid foundation for future empirical and applied investigations.

CONCLUSION

The present study concluded that digital systems played a significant role in improving multidisciplinary coordination within Emergency Departments of Saudi hospitals. The results demonstrated that higher utilization of digital health systems was strongly associated with better communication efficiency, improved workflow integration, and timely clinical decision-making. These findings confirmed that the research objectives were fully achieved, as the study successfully evaluated the effectiveness of digital systems and quantified their relationship with key coordination indicators in emergency care settings. The main scientific contribution of this research lay in providing empirical evidence from a multidisciplinary emergency context, highlighting digital systems as a core operational enabler rather than a supportive tool. By applying a robust quantitative framework, the study advanced understanding of how digital system utilization translated into measurable coordination outcomes among diverse healthcare professionals.

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Overall, the findings supported the conclusion that effective and integrated digital systems strengthened team-based emergency care processes. Future research should adopt longitudinal and multi-center designs to assess causal effects and explore patient-level outcomes, system usability factors, and implementation challenges across varied healthcare settings.

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