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Assessment of Factors Influencing IoT Adoption in Jordanian Healthcare Using AHP Technique

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ABSTRACT

The Internet of Things (IoT) has emerged as a transformative technology with vast potential, particularly in the healthcare sector, where it can significantly enhance operational efficiency and improve the quality of care. However, IoT adoption in healthcare, especially within Jordanian public hospitals, remains limited and is still in its early stages, with numerous challenges impeding widespread implementation. The present study seeks to provide deeper insights into the critical factors influencing IoT adoption within this context. Data were collected through a structured survey administered to a panel of experts from Jordanian public hospitals with substantial knowledge and experience in IoT technologies. Utilizing the Analytic Hierarchy Process (AHP), the study calculates the relative importance of factors categorized within four dimensions using an integrated TOE and HOT-Fit framework. The findings highlight Top Management Support (0.238), Relative Advantage (0.223), Compatibility (0.146), and Government Support (0.134) as the most influential criteria for IoT readiness. The study provides enriched theoretical perspectives and practical guidance for policymakers and hospital administrators seeking to enhance institutional readiness and promote IoT adoption in healthcare.

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1. INTRODUCTION

Innovations in healthcare, driven by information and communication technology (ICT), have significantly improved the quality, accessibility, and delivery of healthcare services. Integrating ICTs into healthcare is revolutionising the healthcare sector by introducing innovative methods such as telemedicine, electronic health records, and remote patient monitoring. These innovations have been particularly impactful in developing countries, where they have the potential to reduce costs, improve health information exchange, and enhance healthcare access. Technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Big Data, and Cloud Computing are at the forefront of this transformation, significantly enhancing the effectiveness and accessibility of healthcare services [1]. This shift towards incorporating advanced technologies aims to modernise healthcare and equip it to meet the demands of the 21st century, significantly improving the quality of healthcare and patient outcomes. Among these emerging technologies, IoT has gained significant attention recently for its massive impact on the entire healthcare sector, as it is an innovative way to upgrade healthcare services, making it more efficient and effective [2].

Undoubtedly, the healthcare sector in developing countries faces continuous pressure to keep pace with evolving global healthcare standards. These nations encounter numerous challenges arising from environmental changes, shifting disease patterns, demographic transitions, and other factors that collectively impact the delivery of healthcare services [3]. In the Middle East, these challenges are further increased by ongoing conflicts, political instability, societal disparities, and environmental factors. Over the past two decades, these issues have significantly hindered access to quality healthcare and medical services [4]. Therefore, healthcare organizations in these nations

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are increasingly exploring innovative technological solutions to enhance service quality, accessibility, and efficiency. Among these, adopting IoT technologies has emerged as a promising strategy, offering new opportunities to modernize healthcare delivery and address critical service gaps. While interest in IoT has recently intensified, its potential to transform healthcare has long been acknowledged due to its ability to optimise clinical workflows, support informed decision-making, and improve patient outcomes. In many developing countries, IoT is increasingly viewed as a viable response to pressing health system challenges and is being adopted by governments worldwide [5].

Despite global progress in IoT integration, adoption within Jordan's healthcare sector remains at a nascent stage. Challenges such as limited technological infrastructure, data quality issues, and inconsistent service quality hinder its adoption and implementation [6]. Understanding the adoption of IoT in these contexts requires tailored approaches, as organizations often face unique constraints, including technological, financial, and legal infrastructure challenges [7]. Consequently, there is a growing need for research grounded in robust theoretical frameworks to identify the specific drivers and inhibitors of IoT adoption in developing countries, particularly within the Jordanian healthcare system. According to Alifan *et al.* [8], the current studies on health information technology in the Jordanian context are still insufficient, and there is a need for more comprehensive research to better understand and address the unique challenges and opportunities in this area. Addressing these gaps can help devise strategies to encourage the adoption of IoT-based healthcare solutions, ultimately improving the quality and accessibility of healthcare services in these regions. This highlights the key justification for this research, which is to provide more insight within the context of Jordan to understand the potential factors that are driving or inhibiting the IoT adoption, thereby shedding light on the sector's preparedness for such technological integration. Therefore, this study aims to assess and prioritize the factors influencing IoT adoption in Jordanian public hospitals using the AHP as a Multi-Criteria Decision-Making (MCDM) technique. Critical readiness factors were identified through a comprehensive literature review by integrating the Technology-Organisation-Environment (TOE) Framework and the Human-Organisation-Technology (HOT) Fit Model.

2. LITERATURE REVIEW

2.1 Jordan Healthcare Context

Jordan, a lower-middle-income country with an estimated population of 11.4 million in 2023, has established itself as a regional centre for medical tourism, specialized healthcare services, and biomedical research. The healthcare system in Jordan operates through a mixed model, comprising public, private, university, and military healthcare facilities. Currently, 122 hospitals are offering over 16,000 beds, with public hospitals providing about 51% of this capacity. The Jordanian government allocates approximately 9.3% of its GDP to healthcare, representing one of the highest healthcare expenditures in the region. However, rapid population growth and the influx of around 2.5 million refugees have significantly strained the country's healthcare infrastructure, leading to notable challenges such as disparities in care quality, unequal service access, and overall operational inefficiencies within the health sector [9]. In response to these challenges, Jordan has implemented several key initiatives, most notably the Hakeem Program, launched in 2009 under the auspices of King Abdullah II. Managed by Electronic Health Solutions (EHS), a nonprofit organization, this program aims to digitize health records and deploy integrated electronic health systems across public healthcare institutions. Hakeem embodies Jordan's commitment to digital transformation, aligning with the national healthcare vision and supporting the objective of achieving Universal Health Coverage (UHC) by 2030, ensuring equitable access to essential healthcare services without financial hardship [10].

Despite these advancements, Jordan continues to face ongoing obstacles in its digital health journey. According to Jalghoum *et al.* [6], E-health initiatives, such as Hakeem in Jordan, face significant barriers that hinder their progress. These challenges include a lack of robust regulations and policies to support health information systems (HIS), limited budget allocations, pervasive privacy concerns, and a fragmented healthcare system. While the Hakeem team is aware of these obstacles and is actively working to mitigate them, achieving full adoption will require time, sustained collaboration, and coordinated efforts across sectors. The program's long-term vision is to establish integrated health information systems that improve care quality, reduce medical errors, and position Jordan as a leader in healthcare innovation [11]. In line with this vision, the Jordanian government continues to advance its healthcare system through strategic policies and modernization initiatives. These efforts are guided by frameworks such as Jordan's Vision 2025, the WHO Country Cooperation Strategy (2021–2025), and notably the National Digital Health Strategy (2024–2030). The Digital Health Strategy, grounded in the WHO's Global Strategy on Digital Health, aims to strengthen Jordan's healthcare system by leveraging its Information and Communication Technology (ICT) ecosystem.

In Jordan, the public healthcare sector has historically centred on hospital and clinic-based treatment, leaving home healthcare services less integrated into public health plans. This limited integration reduces accessibility for individuals without sufficient financial means, thereby exacerbating healthcare inequities [12]. The centralized nature of care delivery systems in Jordan highlights their inability to provide equitable and readily accessible care to all segments of society. Moreover, healthcare operations in Jordan are hindered by fragmentation. Many providers rely on disconnected systems that lack scalability and effective data-sharing mechanisms. Consequently, critical patient information often becomes trapped within isolated silos, impairing decision-making, delaying care coordination, and reducing overall efficiency. The COVID-19 pandemic also exposed the inadequacy of real-time monitoring tools. Without continuous patient monitoring, healthcare providers face limitations in predicting and preventing health complications, resulting in a predominantly reactive approach to care [13]. Accordingly, this raises critical questions regarding the integration of advanced technologies and ICT solutions within healthcare environments. Implementing these solutions is likely to improve the healthcare system by creating a more interconnected environment, enhancing communication channels, and optimizing service delivery.

2.2 Theoretical Background

The adoption and diffusion of technology have long been central themes in information systems (IS) research. While adoption and diffusion theories share similar objectives, they differ in practical application. Adoption theories are designed to explain, understand, and predict why, how, and to what extent organizations or individuals are willing to adopt new technologies. In contrast, diffusion theories examine the process through which innovations spread across a population over time. Previous studies have emphasized that no single, comprehensive theory fully explains the adoption of innovation, and it is unlikely that a universal model will ever emerge [14]. According to Wolfe [15], previous studies in the field of information systems (IS) have employed a variety of theories and models to investigate technology adoption and use. These studies differ in their levels of analysis, focusing either on individuals or organizations, as well as in their units of analysis, which may include individuals, specific technologies, or entire organizations. Additionally, the studies vary in their outcome variables, examining either the initial adoption or the continued use of technologies across different contexts.

Since IoT adoption in public hospitals, particularly in developing countries like Jordan, remains an emerging research area, this study adopts a theoretical lens approach to explore the factors influencing Jordanian public hospitals to adopt IoT. As defined by Creswell and Creswell [16], a theoretical lens approach involves applying established theories to investigate relatively new or under-researched topics. Accordingly, several theoretical models were examined to assess their applicability in exploring the factors influencing the readiness for IoT adoption in healthcare organizations. In the information systems (IS) research domain, numerous adoption and diffusion theories have been developed to explain how and why certain technologies are adopted and accepted, generally investigating innovation adoption at two levels: individual and organizational. While most studies focus on the individual level, examining the factors that influence personal decisions to adopt specific technologies, fewer studies concentrate on organizational-level adoption, aiming to understand how organizations decide to adopt new technologies. Given the organizational level focus of this study, two widely used frameworks for examining technology adoption at the organizational level were selected: the TOE framework [17] and the HOT-Fit model [18]. Both models have been widely used in technology adoption and health information systems research and provide a structured foundation for examining technological, organizational, environmental, and human

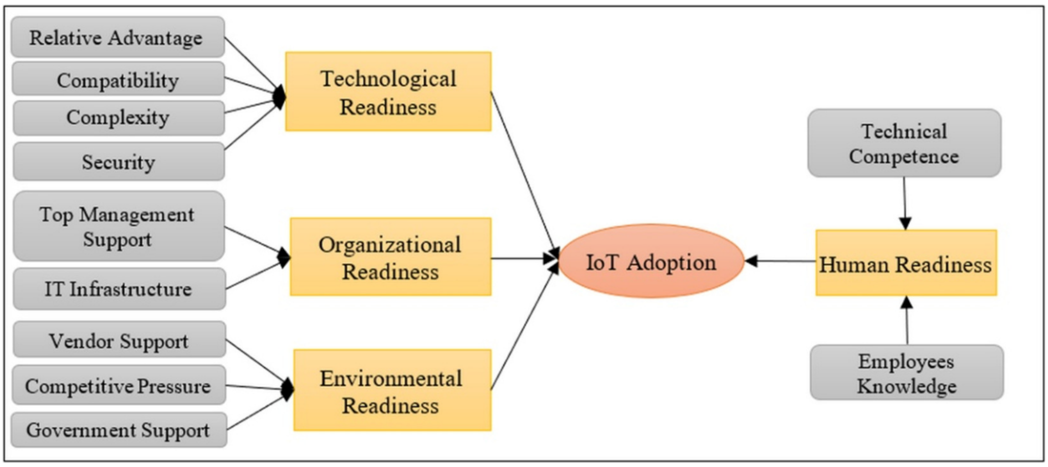

Fig.1: Integrated Theoretical Model of Factors Influencing IoT Adoption in Healthcare.

factors that may shape IoT adoption in healthcare. Employing these theories as guiding lenses ensures that the study remains theoretically grounded while addressing an emerging and complex issue within the healthcare environment.

2.3 Conceptual Research Framework

As shown in Figure 1, this study developed an integrated framework that captures a comprehensive set of determinants for IoT adoption in hospitals. Each dimension encompasses specific factors identified from the literature as influential for innovation adoption (See Table 1).

A. Technological Readiness

Among the technological factors, relative advantage (RA), defined as the perceived benefits of IoT over existing systems, is considered a critical determinant of adoption. IoT offers tangible benefits such as cost reduction, efficiency improvement, and enhanced operational outcomes [19]. Compatibility (COMPA) is another key consideration, referring to the degree to which IoT solutions align with and integrate into current healthcare practices and technological infrastructure [20]. However, the perceived complexity (COPX) of IoT systems can hinder adoption. Organizations' perceptions of innovation complexity vary based on their skills and knowledge. Some may find an innovation complex due to a lack of required expertise, while others possessing the necessary skills may not perceive it as complex [21]. Security and privacy (SP) concerns are also paramount, given the sensitive nature of healthcare data. Institutions must prioritize robust data protection measures to meet legal requirements and safeguard patient information [22].

B. Organizational Readine

Organizational readiness is defined as the extent to which public hospitals can provide and manage all the necessary resources for the successful adoption and integration of IoT technologies into their operations. It emphasizes the institution's internal capacity to support and sustain the implementation process. According to Yang *et al.* [23], the IT Infrastructure (ITI) and Top Management Support (TMS) emerge as two important organizational readiness factors for technology adoption. Top management support is vital, as leadership provides the strategic vision and resources necessary for successful implementation [24]. Moreover, a strong IT infrastructure is essential to facilitate seamless communication, real-time data exchange, and the integration of IoT technologies into existing systems [25].

C. Environmental Readiness

Environmental readiness refers to the organisation's perception of external factors influencing its decision to adopt IoT. It reflects how hospitals respond to the environment in which they operate, including competitive pressure (CP), government support (GS), and the availability of vendor support (VS). These external conditions shape how organizations carry out their activities during the adoption of new technologies [26]. Competitive Pressures, which arise from the threat of losing a competitive advantage in the industry to other competitors, prompt organizations to adopt new technologies to improve their competitiveness and enhance their productivity [27]. Vendor support also plays a critical role, with reliable technical assistance and training ensuring a smooth implementation and maintenance process [28]. Furthermore, government support is a significant enabler, particularly in developing countries. Financial aid, regulatory policies, and training initiatives provided by authorities encourage organizations to embrace IoT innovation [29].

D. Human Readiness

Focusing on the human aspects of IT innovations in healthcare is essential because, ultimately, the success of any new technology depends on its effective use by people within the organization [30]. According to Alharbi *et al.* [31], the human element must be carefully considered before implementing IT projects, as it plays a decisive role in adoption outcomes. In this context, two distinct human-related factors are particularly relevant. The first is technical competence (TC), which refers specifically to the capabilities of IS/IT staff to understand, adapt, and manage technological innovations within their domain [32]. As highlighted by Lian *et al.* [33], organizations with well-trained and knowledgeable IT professionals are more confident and effective in implementing new technologies within hospital settings. The second factor is employee knowledge (EK), which focuses on the broader workforce and their understanding of IoT-related practices and workflows. Empowering this wider group with sufficient knowledge is essential to facilitate the smooth integration of IoT technologies into daily operations and to support long-term success [34]. IT-proficient employees have been shown to play a key role in technology adoption, especially in healthcare settings [35].

Given the scarcity of studies applying both models specifically to IoT adoption in healthcare settings, the review also includes research on technological readiness and adoption in broader contexts to provide a more comprehensive understanding of organizational preparedness. The findings underscore that each dimension plays a significant role in shaping readiness for adopting innovations, while also highlighting a gap in studies directly addressing IoT adoption readiness in healthcare, particularly in Jordan.

3. METHODOLOGY

3.1 Analytic Hierarchy Process (AHP)

In many real-world problems, decision makers must evaluate multiple, often conflicting, criteria to reach an informed choice. Multi-Criteria Decision-Making (MCDM) is a group of methods developed

Table 1: *Prior Studies Related to IoT Adoption.*

Author(s)	Innovation/ Technology Studied	Theories / Models	(TOE) Framework & (HOT) fit Model										
			RA	COMPA	CMPX	SP	TMS	ITI	CP	VS	GS	EK	TC
[38]	Mobile health adoption	TOE		√	√	√	√	√	√	√			
[33]	Cloud Computing adoption in healthcare	TOE + HOT	√	√	√	√	√					√	
[39]	IoT adoption in healthcare	TOE		√		√	√			√	√		
[30]	Cloud Computing adoption in healthcare	TOE + HOT		√	√		√	√		√			√
[40]	AI adoption in healthcare	TOE			√		√		√	√	√		
[41]	Hospital information system adoption	TOE + HOT	√	√	√		√	√	√	√	√	√	
[42]	RFID adoption in healthcare	TOE		√		√	√		√	√	√	√	
[43]	Telehealth adoption	TOE		√	√			√					√
[44]	IS security adoption	TOE + HOT	√	√	√	√	√	√	√		√	√	√
[45]	AI-integrated CRM in healthcare	TOE + HOT	√	√	√	√		√			√	√	
[46]	Big Data adoption in healthcare	TOE		√	√		√			√			
[47]	RFID adoption in healthcare	TOE	√					√				√	
[48]	IoT adoption in the oil and gas industry	TOE			√		√					√	
[49]	IoT adoption in construction companies	TOE	√	√	√		√		√				
[50]	IoT adoption in manufacturing	TOE			√		√	√		√			√
[51]	IoT adoption in the logistics Industry	TOE	√	√		√	√	√	√	√		√	
[52]	IoT adoption in manufacturing	TOE		√	√		√			√	√		√
[53]	IoT adoption in the supply chain	TOE	√	√	√		√		√	√			√
[54]	IoT adoption in manufacturing	TOE	√	√		√	√		√	√			
[55]	IoT adoption in agribusiness	TOE+HOT	√	√		√	√	√	√		√		√
[56]	IoT adoption in manufacturing	TOE	√	√	√		√		√	√			
[57]	IoT adoption in the oil and gas sector	TOE					√	√	√	√			
[58]	Industry 4.0 readiness adoption	TOE	√	√	√		√			√	√		
[59]	AI Readiness adoption	TOE+HOT	√	√			√		√	√	√		
[60]	Big Data adoption readiness	TOE	√	√	√	√	√	√				√	
[61]	ICT adoption readiness	TOE+HOT				√		√		√			√
[62]	Blockchain readiness model	TOE+HOT			√				√			√	√
[23]	SaaS adoption readiness	TOE	√	√	√		√	√	√	√			

to support such complex decision-making situations. MCDM techniques help structure problems, incorporate qualitative and quantitative factors, and derive rational and transparent solutions. Standard MCDM methods include the Analytic Hierarchy Process (AHP), Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), and Weighted Sum Method (WSM), among others [36].

The AHP involves three key processes: (1) constructing the hierarchical structure, (2) establishing priorities by making pairwise comparisons of criteria and alternatives using Saaty's scale, and (3) ensuring logical consistency by assessing the consistency of measures and alternatives to minimize bias in decision-making [37]. As illustrated in Figure 2, the AHP methodology is carried out through the following steps.

In this study, AHP was selected due to its broad applicability and ability to solve complex decision-making problems. The AHP is a structured decision-making method developed by Thomas L. Saaty in the 1970s [63]. It emerged from decision theory and mathematical psychology to derive ratio-scale priorities through pairwise comparisons. AHP decomposes a complex decision problem into a hierarchy of goals, criteria (and sub-criteria), and alternatives. Experts then provide pairwise comparisons of the elements at each level of the hierarchy, which are used to derive ratio-scale priority weights. AHP allows both qualitative and quantitative criteria to be evaluated in a structured manner. It is widely used to transform expert judgments into a coherent set of numerical priorities.

3.2 Expert Panel and Data Collection

To gather the necessary input for the AHP analysis, we conducted an expert survey targeting individuals with substantial knowledge and experience in healthcare technology adoption. The relatively small number of experts aligns with established AHP practice, where analytical consistency and expert judgment quality are prioritized over large sample sizes. Prior literature emphasizes that AHP does not require a statistically significant sample to yield valid results, and panels ranging from 4 to 9 experts are common in applied AHP studies [64-67]. Furthermore, small expert panels are recommended to ensure reliable and coherent pairwise comparisons, as larger panels may compromise consistency due to variability in responses [68]. Our panel was composed to ensure role diversity and provide comprehensive in-

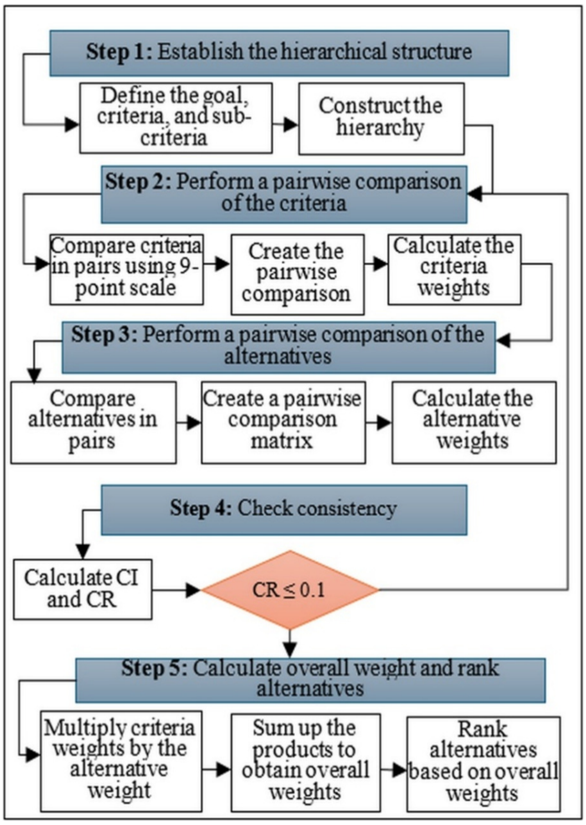

Fig.2: *Steps in the AHP method.*

sights into IoT adoption decisions in the Jordanian healthcare sector.

To ensure credible and well-informed evaluations of IoT readiness factors, this study employed a purposive sampling strategy guided by predefined selection criteria. The expert panel consisted of individuals with substantial experience and institutional knowledge relevant to the adoption of IoT in healthcare. Specifically, experts were required to hold senior positions, such as hospital administrators, chief information officers (CIOs), IT managers, or department heads, within public hospitals [69]. All participants had between 10 and over 20 years of professional experience and demonstrated decision-making authority in digital health initiatives, including health information systems (HIS) and IoT-related projects. In addition, selected experts held academic or professional qualifications in relevant domains such as medicine, health informatics, information systems, or healthcare management. The panel included both clinical and administrative perspectives and represented gender diversity.

Similar approaches have been adopted in prior AHP-based studies in the healthcare domain. For example, a study on telehealth system design for Parkinson's disease recruited a panel of 16 experts, including clinicians and technical specialists, based on their direct involvement in system design and clinical care, ensuring a balance of user-centred and technical perspectives [70]. Another study examining the adoption of surgical innovations included clinicians, health technology assessment professionals, and hospital administrators, selected for their experience in evaluating new technologies within institutional and policy contexts [71]. These examples reinforce the importance of assembling multidisciplinary expert panels with deep domain knowledge and practical involvement, as was done in the current study. These inclusion criteria were designed to ensure that the pairwise comparisons conducted through the AHP methodology were grounded in practical expertise and context-specific insight, in line with recommendations from previous studies that emphasize the role of senior healthcare professionals in technology-related decision-making.

Table 2: *Preference Scale for Pairwise Comparisons.*

Importance	Definition	Explanation
1	Equal importance	Elements *a* and *b* are equally important.
3	Moderate importance	*a* is moderately more important than *b*.
5	Strong importance	*a* is strongly more important than *b*.
7	Extreme importance	*a* is very strongly more important than *b*.
9	Absolute importance	*a* is extremely more important than *b*.
2,4,6,8	Intermediate values	When compromise is needed, for example, six can be used for the intermediate value between 5 and 7.

Experts initially rated the four main dimensions and 11 sub-factors on a three-point scale to assess their importance. As all factors achieved an average score above 2, the complete set was retained, ensuring a comprehensive and focused AHP model. The AHP questionnaire and follow-up interviews were then conducted. The questionnaire presented the experts with the hierarchical Model of IoT adoption factors: at the top level, the goal ("Assess IoT adoption"), followed by the four main criteria (the dimensions), each with its sub-factors. The experts were asked to perform pairwise comparisons at two levels: (1) comparing the four main dimensions relative to the goal, and (2) comparing the sub-factors within each dimension relative to their parent dimension. For each pair of factors, experts assessed which factor is more critical for IoT adoption and the degree of its importance, using Saaty's 1–9 scale (see Table 2). We provided definitions and examples for each factor to ensure a common understanding. Experts completed the pairwise comparisons independently. In a few cases, we conducted short interviews (in person or via teleconference) to clarify any questions the experts had about the factors or the AHP process and to ensure consistency in the evaluation process.

3.3 Pairwise Comparison

The hierarchy typically consists of three levels, as shown in Figure 3: The overall goal at the top, the criteria (and possibly sub-criteria) in the middle, and the alternatives at the bottom (if applicable). Since multiple experts provided input, we aggregated their pairwise comparison matrices into a single group comparison matrix for each level of the hierarchy.

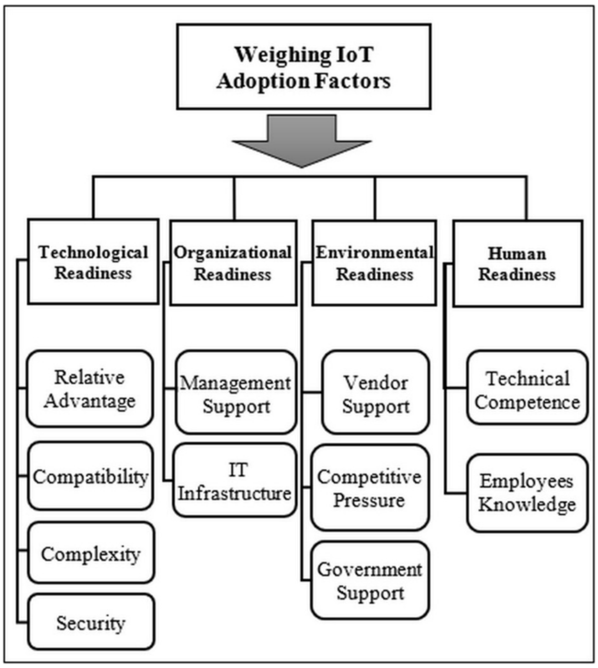

Fig.3: *AHP model to determine important factors for IoT adoption.*

The geometric mean method was employed to combine the experts' judgments, as it is appropriate for ratio-scale data and maintains the reciprocal properties of the AHP pairwise comparisons eigenvector [72]. The geometric mean for n individual judgments $(x1, x2, \ldots, xn)$ is calculated using the following formula:

$$\mathrm{GM} = \sqrt[n]{\prod_{i-1}^{n} xi} \tag{1}$$

The pairwise comparisons are then organized into a matrix A, where each element a_{ij} represents the relative importance of the element i compared to the element j. The matrix has the following properties: the diagonal elements satisfy $a_{ii} = 1$, reflecting that each element is equally important to itself. The matrix is reciprocal, meaning that for every comparison, $a_{ji} = 1/a_{ij}$. The pairwise comparison matrix A is represented as follows:

$$A = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ \frac{1}{a_{12}} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{a}{a_{1n}} & \frac{1}{a_{2n}} & \cdots & 1 \end{bmatrix} \tag{2}$$

After constructing the pairwise comparison matrix A, the next step involves deriving the relative weights of the elements under evaluation. These weights, collectively referred to as the priority vector $W = [w1, w2, w3]$, represent the relative importance of the criteria $(C1, C2, C3, \ldots, Cn)$ in achieving the overall goal. The priority vector is determined by solving for the eigenvector associated with the maximum eigenvalue $\lambda_{\max}$ of the comparison matrix A. The following equation expresses this relationship:

$$Aw = \lambda_{\max} w \tag{3}$$

Where A is the pairwise comparison matrix, W is the priority vector, and $\lambda_{\max}$ is the largest eigenvalue. By solving this equation, the pairwise judgments are translated into a consistent set of numerical priorities, which form the basis for subsequent decision analysis.

Since human judgments may sometimes be inconsistent, it is essential to check the consistency of the pairwise comparisons to ensure reliable results. For each pairwise matrix, the Consistency Index (CI) was computed, and the Consistency Ratio (CR) was obtained by comparing the CI with the Random Index (RI) for the matrix size. The CI is calculated using the formula:

$$CI = \frac{\lambda_{\max} - n}{n - 1} \tag{4}$$

Where n is the number of elements, the Consistency Ratio (CR) is then obtained by:

$$CR = \frac{CI}{RI} \tag{5}$$

Where RI is the Random Index based on the size of the matrix. A CR value below 0.10 is generally deemed acceptable, indicating that the comparisons are reasonably consistent. If a matrix had an unacceptably high CR, we would have asked the experts to revisit their judgments or applied consistency improvement techniques as follows:

$$(a_{ij})^{\lambda} \left(\frac{wi}{wj}\right)^{1-\lambda} \tag{6}$$

However, in our study, all aggregated pairwise comparison matrices achieved $CR < 0.1$, confirming an acceptable level of consistency. This meant that no revision of the expert judgments was required. The outcome of the AHP was a set of priority weights for all dimensions and sub-factors, reflecting their relative importance in influencing IoT adoption readiness. These weights were calculated by synthesizing the priorities through the hierarchy. The results are presented and discussed in the next section. In this study, all AHP calculations and analysis, including pairwise comparison matrices, priority weights (local and global), eigenvalue estimation ($\lambda_{\max}$), and consistency ratio (CR) assessment, were performed using Expert Choice v.11 and Microsoft Excel 365.

4. RESULTS AND DISCUSSION

4.1 Priority Weights of Main Dimensions

After synthesizing the expert evaluations using the AHP method, we derived priority weights for each main dimension and its associated sub-factors. Table 3 below summarizes the priority weights of the four primary dimensions (Technological, Organizational, Environmental, Human) with respect to the overall goal of IoT adoption.

Table 3: *Priorities for the Goal.*

	Local Weight	Rank
Technological	0.458	1
Organizational	0.295	2
Environment	0.201	3
Human	0.046	4
C.R = 0.03		

In this ranking, the Technological dimension clearly emerges as the most influential (local weight 0.458). This suggests that technology-related factors are perceived as the top priority for IoT readiness in our context. The Organizational dimension is the second highest (0.295), indicating that internal organizational factors, most notably leadership and infrastructure, are also critical. Environmental readiness ranks third (0.201), indicating that external factors, such as government policy, are less emphasized compared to technological and organizational considerations. Finally, the Human dimension has the lowest weight (0.046), implying that human-related factors (such as staff skills and knowledge) are seen as a lower immediate priority relative to the other dimensions.

This pattern implies that, overall, experts believe ensuring the technological and organizational preparedness of hospitals will have the most significant impact on IoT adoption readiness. The reason is that developing countries often emphasize concrete technological benefits first, such as improved efficiency or cost savings, when adopting new systems [73]. For instance, among the sub-factors, "Relative Advantage", which refers to the perceived usefulness of IoT, was ranked highest, indicating that decision-makers anticipate clear benefits from implementing IoT technologies. Such emphasis is likely because countries like Jordan, which face limited healthcare resources, view technology as a means to enhance efficiency and improve service delivery rapidly. According to Oliveira and Martins [74], the technological context often drives initial adoption decisions, which aligns with our finding that hospitals first evaluate IoT's functionality and compatibility with existing systems.

The comparatively low weighting of human factors does not mean they are unimportant; instead, it may indicate an assumption that once robust technology and organizational backing are in place, human adoption challenges can be managed. Nonetheless, as other studies note, inadequate human skills can become a bottleneck for successful innovation in the long run, underscoring that sustained IoT success will ultimately require addressing the human element through training and user engagement [61, 75]. In addition, prior studies have highlighted technological, organizational, and environmental factors as more important than the human factors in early adoption stages [28]. In sum, these weights suggest that Jordanian hospitals view IoT readiness primarily as a matter of having the right technology and managerial support, rather than individual user capabilities.

4.2 Sub-Factor Results

Within the technological dimension (Table 4), Relative Advantage (RA) and Compatibility (COMP) were the highest-ranked sub-factors (local weights 0.482 and 0.316, respectively), whereas Complexity (COMX) (0.144) and Security & Privacy (SP) (0.049) were given significantly lower weights. Based on the experts' inputs, the likelihood of successful IoT adoption in Jordanian public hospitals hinges primarily on IoT's ability to deliver clear advantages over current practices and to integrate effectively with existing workflows. This finding is consistent with classic innovation adoption theory: innovations that demonstrate a compelling relative advantage and fit well with current systems tend to be adopted more readily [76]. Compatibility's high ranking reinforces the importance of new IoT solutions aligning with existing work processes and IT setups. Meanwhile, complexity received a moderate emphasis (weight = 0.144), suggesting that while respondents are wary of IoT systems being overly complex, they may be willing to tolerate some complexity if the expected benefits are sufficiently high.

The relatively low emphasis on security/privacy is notable, which had the lowest weight (0.049) among technological subfactors. This finding contrasts with previous studies that identified security concerns as a primary barrier to IoT adoption in healthcare [77]. This result may indicate that experts perceive security risks as secondary at the readiness stage, focusing instead on more immediate priorities such as system usefulness (relative advantage) and Compatibility with existing infrastructure. Nonetheless, security should not be underestimated, as weak protection mechanisms in IoT systems can expose sensitive patient data and disrupt service delivery [78]. Therefore, proactive security planning must accompany IoT implementation, even if it is not ranked as an immediate concern.

Table 4: *Priorities for the Technological dimension.*

	RA	COMP	COMX	SP	Local Weight
RA	1	2.328	3.212	6.959	0.488
COMP	0.429	1	3.510	6.12	0.316
COMX	0.311	0.285	1	4.378	0.144
SP	0.144	0.163	0.228	1	0.049
C.R = 0.04					

Organizational factors (Table 5) indicate that Top Management Support (TMS) is rated far more critical (local weight 0.806) than IT Infrastructure (ITI) (0.194) as an organizational determinant. This finding suggests that executive commitment and leadership are viewed as the linchpin of organizational IoT readiness. This is because, without strong leadership and sponsorship, IoT projects may fail to secure funding and policy backing [79]. In practical terms, public hospitals in Jordan often rely on top-down decision-making; thus, when senior leadership actively champions an IoT initiative, that initiative is much more likely to be approved and adequately resourced. However, the lower weight assigned to IT Infrastructure does not imply that infrastructure is unimportant. Prior studies note that both management support and a robust infrastructure are essential components of readiness [23]. Both IT infrastructure and management support are important for readiness. Organizations must assess and, if needed, upgrade their technological infrastructure (networks, hardware, data systems) before implementing IoT [55, 80]. Hence, even though leadership support dominates in priority, ensuring a sufficient IT infrastructure and technical expertise remains a critical prerequisite for successful IoT adoption.

Table 5: *Priorities for Organizational dimension.*

	TMS	ITI	Local Weight
TMS	1	4.166	0.806
ITI	0.240	1	0.194
C.R = 0.0			

For the Environmental dimension (Table 6), Government Support (GS) is by far the most significant external factor (local weight 0.667), with Vendor Support (VS) (0.241) a distant second and Competitive Pressure (CP) (0.092) last. This implies that national-level policies, funding, and regulatory support are seen as the primary external enablers of IoT readiness for Jordan's hospitals. In Jordan's public healthcare system, significant resources and standards typically originate from government initiatives; accordingly, strong government backing – through clear strategies, sufficient budgets, and supportive regulations – can significantly accelerate IoT adoption [81, 82]. Consistent with this finding, prior research has observed that the absence of clear IoT regulations is a barrier to adoption, indicating that governments need to establish supportive policies and legal frameworks to facilitate the use of IoT in healthcare [83, 84]. Vendor support, while ranked second, still carries a notable weight. This suggests that collaboration with technology vendors (for training, technical assistance, and maintenance) is important; insufficient support from IoT suppliers can impede implementation progress [39]. By contrast, competitive pressure was deemed least influential in this context. This is unsurprising, as public hospitals in Jordan face little market competition; they are generally driven by institutional mandates and public service goals rather than by rivalry with peer hospitals. Thus, for Jordan's public healthcare sector, the findings suggest that creating supportive government policies and cultivating strong vendor partnerships should be prioritized to foster IoT readiness. In contrast, competitive market forces can be regarded as a minor concern.

Table 6: *Priorities for the Environmental dimension.*

	GS	VS	CP	Local Weight
GS	1	3.266	6.154	0.667
VS	0.306	1	3.105	0.241
CP	0.162	0.322	1	0.092
C.R = 0.02				

Within the Human dimension (Table 7), Technical Competence (TC) of staff is weighted much more heavily (0.772) than employees' general IoT Knowledge (EK) (0.228). This indicates that having a highly skilled IT workforce is seen as the key human factor for IoT readiness. IoT systems are complex and require capable IT professionals to install, configure, and manage devices and data. In effect, technical expertise is viewed as indispensable; without sufficiently trained specialists, even a well-designed IoT initiative could falter. This finding aligns with broader literature showing that inadequate technical know-how among staff can constrain IoT adoption [32, 33, 61]. Consequently, Jordanian hospitals should prioritize building and retaining IT capacity as they pursue IoT projects. This could include investing in specialized training for current staff or hiring personnel with strong skills in IoT and networking. At the same time, improving general IoT awareness among non-IT employees (although a lower priority in the AHP results) would help create a more supportive organizational culture for the rollout of the new technology.

4.3 Overall Priority of Dimensions

Table 8 presents the AHP results for all factors when synthesized to the overall goal level. In this global prioritization, Top Management Support

Table 7: *Priorities for the Environmental dimension.*

	EK	TC	Local Weight
EK	1	3.379	0.228
TC	0.296	1	0.772
C.R = 0.0			

emerges as the most critical factor overall (global weight ≈0.238, rank 1), followed closely by the Relative Advantage of IoT (≈0.224, rank 2). The following highest factors are Compatibility (≈0.147, rank 3) and Government Support (≈0.134, rank 4). These four factors come from three of the four dimensions (two technological factors, one organizational, and one environmental) and collectively dominate the priority structure.

In practical terms, this outcome suggests that to achieve IoT adoption, Jordanian public hospitals must have: (1) committed executive leadership to champion the effort (top management support), (2) demonstrated benefits of IoT applications over current practices (relative advantage), (3) seamless integration of IoT solutions into existing workflows (Compatibility), and (4) a supportive external policy environment (government support). This overall ranking is consistent with findings from prior studies on technology adoption. For example, Ahmetoglu [28] found that relative advantage, top management support, and government support were all significant positive predictors of IoT adoption in organizations. Similarly, Al-Rawashdeh [76] reported that perceived usefulness (akin to relative advantage) and leadership commitment were primary drivers of IoT uptake in Middle Eastern hospitals. The alignment of our results with such studies adds credence to the importance of these factors and suggests that our experts' perspectives reflect broader trends in technology adoption literature.

On the other hand, the lower-ranked factors in our study, such as Complexity, IT Infrastructure, Vendor Support, security and privacy, and staff IT Competence, each carry much smaller global weights (all below 0.07). While these factors are perceived as less influential relative to the top-tier drivers, they should not be entirely neglected. Ignoring them could create vulnerabilities that undermine the overall success of IoT implementation. For instance, cybersecurity issues, though low-ranked here, pose well-documented risks in healthcare IoT deployments and could severely impede adoption if left unaddressed [85]. Likewise, even if factors like Vendor Support or core IT Infrastructure scored modestly in the priority list, a lack of reliable technical partnerships or a weak infrastructure can hinder IoT projects at critical moments. A case in point is provided by Malik and Khan [86], who describe a public hospital in Pakistan where limited in-house technical expertise made a health information system rollout challenging; however, strong support from the system vendor helped the hospital overcome those challenges and successfully implement the technology. This example illustrates that even lower-priority factors can become pivotal if they are weak. In short, improvement efforts should focus on the major drivers identified, but a holistic adoption strategy must also address these secondary factors to prevent them from becoming bottlenecks.

Table 8: *The local and global weights.*

Dimension	Priority Weight	Factor	Local		Global	
			Weight	Rank	Weight	Rank
Technological	0.458	RA	0.488	1	0.223	2
		COM	0.320	2	0.146	3
		COMX	0.144	3	0.065	5
		SP	0.049	4	0.022	9
Organizational	0.295	TMS	0.806	1	0.238	1
		ITI	0.194	2	0.057	6
Environmental	0.201	GS	0.667	1	0.134	4
		VS	0.241	2	0.048	7
		CP	0.092	3	0.018	10
Human	0.046	TC	0.772	1	0.036	8
		EK	0.228	2	0.011	11

The prioritization of factors such as top management support, relative advantage, Compatibility, and government support as the top IoT readiness drivers provides a clear roadmap for policy implications in Jordan's healthcare sector.

At the national level, policymakers should align IoT adoption initiatives with Jordan's overarching digital health agenda (e.g., the National Digital Health Strategy 2024–2030) to ensure coherence with broader health system goals. It is also critical to strengthen the regulatory and legal framework by enacting robust policies on health data security, patient privacy, and interoperability – these will create an environment conducive to IoT integration. This need is underscored by past experiences in Jordan's e-health programs, where insufficient regulations and limited funding hindered progress. Addressing such gaps through targeted public investments and incentives could significantly facilitate IoT adoption. For example, the government might establish dedicated funds to support IoT pilot projects in hospitals or offer tax incentives to public hospitals that upgrade their infrastructure with IoT capabilities. Such measures would demonstrate strong government commitment and help showcase IoT's relative advantages through successful real-world trials.

At the organizational level, it is essential to ensure support within hospitals. This includes empowering hospital leadership and upgrading technical infrastructure. Hospital executives should be encouraged (and trained) to become champions of IoT and digital innovation, as their buy-in and vision are crucial for driving projects forward. In parallel, hospitals must invest in improving their ICT infrastructure (networks, hardware, software systems) so that new IoT solutions can be smoothly integrated into existing clinical workflows without disrupting services. These measures echo our study's findings that an enabling environment and committed leadership are pivotal enablers of IoT readiness. By taking initiative at both the policy and institutional levels, stakeholders can create synergy: national strategies and regulations provide the mandate and resources, while hospital leaders and robust infrastructure ensure effective implementation on the ground.

In summary, by embedding IoT goals into strategic health plans, enacting supportive policies and legal frameworks, providing adequate funding and incentives, and empowering top management to lead the change, Jordan can more effectively translate IoT readiness into actual IoT adoption. This coordinated, policy-driven approach would create the necessary conditions for IoT solutions to yield tangible improvements in healthcare delivery.

5. CONCLUSION AND FUTURE WORK

This study applied the Analytic Hierarchy Process (AHP) to examine the critical factors influencing IoT adoption in Jordanian public hospitals, using an integrated framework that combines the TOE and HOT-fit models. Four dimensions (T-O-E-H) were evaluated to understand their relative impact on the adoption decision. Findings based on expert input revealed that Technological readiness, particularly Relative Advantage and Compatibility, holds the most decisive influence, followed by Organizational readiness, with Top Management Support playing a central role. Government Support, under the Environmental dimension, also showed a notable effect, highlighting the importance of external policy and regulatory environments. While Human readiness was given lower priority, it remains a necessary consideration for sustained use and successful integration of IoT solutions, primarily through continued investment in staff capabilities.

Drawing on these insights, the study proposes a phased and practical roadmap that can assist hospital managers and policymakers in planning for IoT implementation. The suggested approach emphasizes initiating with executive sponsorship, assessing and upgrading IT infrastructure, piloting IoT applications in high-impact areas, and providing targeted training. Though preliminary, this sequence reflects the factor priorities identified and may serve as a valuable reference for healthcare institutions exploring IoT adoption.

Ultimately, the study highlights the significance of national-level strategies and supportive policies in promoting IoT readiness. Future research should explore the post-adoption stage, investigating how IoT is integrated into clinical workflows and supported over time. Expanding the sample to include a broader range of stakeholders, such as participants from private hospitals, academic institutions, and international organizations, and adopting a mixed-methods approach, such as combining AHP with interviews or focus groups, may also yield more profound insights into the complex dynamics surrounding IoT adoption in healthcare.

AUTHOR CONTRIBUTIONS

Conceptualization, M.Z. and O.I.; methodology, M.Z. and O.I.; formal analysis, M.Z.; investigation, M.Z. and O.I.; data collection, M.Z.; writing original draft preparation, M.Z. and O.I.; writing review and editing, M.Z. and O.I.; supervision, O.I. All authors have read and agreed to the published version of the manuscript.

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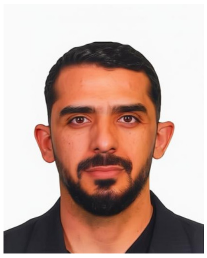

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