JRRCCN-Journal of Rapid Response and Critical Care Nursing
Volume 1, Issue 2 | October-2025
e-ISSN: 3068-6415 ISSN Print: 3068-6407

Determinants of Effective Adoption of IoT Technologies in Healthcare: A Qualitative Exploration

Dr. Claire Howard[1], Dr. Graham Douglas[2]
[1]Faculty of Nursing, University of Worcester, Worcester, United Kingdom
[2]Faculty of Nursing, University of Worcester, Worcester, United Kingdom
Received: 27-08-2025; Revised: 10-09-2025; Accepted: 27-09-2025; Published: 22-10-2025

Abstract
The incorporation of the Internet of Things (IoT) into healthcare has attracted a lot of interest because of the fact that it can lead to better patient outcomes, better clinical workflow, and better real-time monitoring. Nevertheless, the process of the successful implementation of the IoT-based solutions in the healthcare sector is still complicated, and various technological, organizational, and human factors influence the process. The current qualitative research examines the factors that affect successful IoT implementation in healthcare contexts such as infrastructure preparedness, data protection, interoperability, stakeholder involvement, regulatory adherence, and healthcare practitioners adoption. Based on an extensive thematic analysis, the paper identifies essential enablers and obstacles that affect the implementation of IoT in health systems. The results offer practical implications to policymakers, healthcare administrators, and technology developers to develop strategies that encourage sustainable and secure integration of IoT as a technologic system, eventually leading to digital transformation of health services.

Keywords: ***IoT in healthcare, digital health, technology adoption, implementation factors, interoperability, data security, healthcare innovation, qualitative study, smart health systems, patient monitoring.***

1.Introduction
The Internet of Things (IoT) has become one of the most disruptive technologies that transform the contemporary healthcare sector, providing chances to enhance patient safety, simplify clinical procedures, and go beyond the hospital boundaries. Wearable devices, sensors, and smart monitoring systems are connected by the IoT, enabling the real-time data collection, remote diagnosis, and personalized interventions, which are especially essential due to growing populations of aging people, increased demand of chronic diseases treatment, and inflated cost of providing health services. In contrast to the classical health technologies, which work in closed conditions, IoT is the connected ecosystem where devices, patients, caregivers and institutional systems can interact with each other dynamically(1). This ongoing stream of information and communication is not only allowing the professionals in the healthcare industry to make more informed decisions but also giving patients greater access to taking an active part in their care management. In spite of these exciting opportunities, the blurring of the theoretical uptake and effective application in reality is not a smooth ride. Most organizations are continuing to struggle with the challenge of transitioning to mass integration once a pilot project has been completed, and one of the primary reasons is sociotechnical issues that go beyond technological innovation per se.

FIGURE 1 Sociotechnical Factors in IoT Implementation in Healthcare

The issue of IoT in healthcare can only be fully understood by being able to differentiate between the concepts of adoption and implementation as they commonly appear to be used interchangeably, but are essentially different in real practice. Adoption is generally the first step to adopt or test an innovation and implementation is the more complex and longer lasting process of integrating that particular innovation into the day-to-day practice within an organizational system. It requires restructuring of working processes, adherence to regulatory guidelines,

retraining of employees, resource acquisition, and orientation to patient requirements. That is to say that adoption may be considered an organizational choice, but implementation is the practice of actual change. The adoption of IoT in the literature has tended to focus more on adoption, usually based on models like the Technology Acceptance Model (TAM) or the Unified Theory of Acceptance and Use of Technology (UTAUT). These models illuminate on psychological and technological influences on decision-making to adopt yet they do not go deep enough to discuss the organizational, legal and infrastructure-level impediments that arise after technologies are implemented(2). This has resulted in medical institutions often facing sudden challenges in going beyond the theoretical zeal to practice.

Past research in related disciplines like telemedicine offers a lot of information on this distinction. The evidence on telehealth implementation has always indicated that success in implementation is not entirely based on technical performance but rather it depends on a mix of financial models, organizational preparedness, staff acceptance and supportive policy frameworks. Such results are familiar to IoT integration, where issues tend to be a stringent procurement, cumbersome data protection regulations, opposition of professional communities, or insufficient infrastructure like Wi-Fi connectivity and secure cloud solutions. To illustrate, even the most advanced IoT offerings can collapse when healthcare professionals do not trust data security measures or when employees believe that technology is weakening their work in the caregiving field. On the same note, regulatory uncertainty as to whether a machine is categorized under the surveillance legislation or under the medical equipment legislation would put a project on hold indefinitely. In this way, to comprehend the concept of IoT in healthcare, one would need to stop wondering whether technology is useful but rather how various subsystems of healthcare institutions and society in general relate to each other to determine how the concept of IoT would be implemented in the real world.

The sociotechnical systems approach offers an effective prism in terms of researching the implementation of IoT. This worldview is based on the premise that both technological and social systems are mutually dependent, in that, any alteration in one subsystem such as technology, infrastructure, organizational processes, and regulatory conditions is bound to have an effect on the rest. This implies that the introduction of IoT in healthcare does not only entail a drop in devices but a renegotiation of the professional positions, the adjustment of workflows, a stable source of funds, and legal aspects. In a recent review, Kronlid and others classified 94 influences on IoT adoption into themes which included financial circumstances, infrastructure, people, procedures, regulatory frameworks, and stakeholder dynamics. Nevertheless, although adoption factors are being reported more often, there is little empirical evidence given specifically to implementation(3). The difference points to the necessity of further research into the practical aspects of incorporating IoT into the work of healthcare organizations.

The current discourse thus redefines the interest on the five critical factors that are most significant in IoT implementation and they include regulatory frameworks, organizational support, user focus, financial circumstances and infrastructure. All these are subsystems that dynamically interact with each other and are the determinants of IoT initiatives success or failure. Regulation frameworks set legal and ethical limits within which IoT has to work and influence all the elements of the process, such as informed consent and data control. Organizational support includes leadership commitment, presence of support functions and cultural preparedness of institutions to accept digital innovation. User focus also has to do with the significance of engaging the patients as well as the healthcare personnel in the design and decision-making process to ensure that technologies are not based on abstract ideas but rather on a practical need. Financial and economic conditions mean the way of assigning resources, the sustainability of funding, and the clarity of who covers the costs both during and after pilot projects. Lastly, infrastructure is the technical base of IoT, such as the reliability of the internet connection, the connection to the existing systems, or the presence of safe data storage facilities.

With these factors placed in the context of a sociotechnical framework, the discussion respects the fact that the implementation of the IoT is not linear, but it is a negotiation of several competing demands. To illustrate, even organizational assistance can result in nothing when the infrastructure is poor, or passionate patient engagement can be spoiled through the limiting regulatory obstacles. On the same note, a lack of finance might dilute the priorities of an organization, and the lack of infrastructure can lead to frustration among end-users; this decreases their desire to cooperate with new systems. All factors therefore become an enabler and a possible barrier depending on their interaction with other factors.

When examining such dynamics, this paper will be informed by both the findings of recent IoT projects as well as made comparisons to other related areas of digital health innovation. The focus is not only to find out challenges but to point out strategies that can help healthcare organizations navigate through them. A case in point is that, in

Volume 1, Issue 2 | October-2025
e-ISSN: 3068-6415 ISSN Print: 3068-6407

some projects, regulatory obstacles have been overcome by using academic research protocols to test IoT solutions using lighter compliance requirements. Other developers have also reduced staff resistance via participatory design methodology so that the caregivers and the patients could actively define system features. Similarly, fiscal ambiguities have been slightly overcome by showing definite cost-benefit results that compel policymakers and administrators to maintain funding. These cases show that the barriers are present but innovative solutions and adjustive as well as adaptive thinking may make a huge difference in reducing the gap between pilot projects and full implementation(4).

The last point is that the proper implementation of IoT in healthcare requires a comprehensive view of how law, organization, people, money, and technology interact. All the identified five factors are decisive regarding the direction of the IoT projects, yet none of them works in isolation. With an analysis of these factors in the context of the sociotechnical systems theory, we are better equipped to understand the interdependencies that cause or harm digital transformation in healthcare. Not only does this holistic perspective contribute to academic knowledge on the implementation of the IoT, but also offers practical advice to policymakers, managers, and technology developers who must spearhead a revolution within the healthcare systems. Each of these factors will be discussed in the subsequent sections, which will further detail how they influence the implementation journey and what solutions can be used to make sure that IoT solutions fulfill their potential regarding improving patient care.

2.Methods

Study Approach

This study utilized a qualitative multiple-case study to produce deep knowledge on the integration of Internet of Things (IoT) technologies into the healthcare setting. The multi-case approach was selected due to the possibility to compare various initiatives and extract common themes and situational-related issues. In contrast to single-case studies that can have detailed but limited information, multiple-case studies enhance validity of the results using replication logic where the evidence produced in one case study can be validated or disagreed with evidence produced in another(5). Since the field of implementation of IoT in healthcare is exploratory, this approach was especially suitable to discover the subtle, dynamic, and situation-specific variables that contribute to success or failure.

TABLE 1 Summary of Methods

Aspect	Description
Study Design	Qualitative multi-case approach to explore IoT implementation in healthcare.
Case Selection	5 pilot projects chosen from 72 Swedish IoT initiatives focused on healthcare.
Participants	22 semi-structured interviews with project managers, healthcare staff, officials, and private partners.
Data Collection	Interviews + review of project documents (grant applications, reports).
Data Analysis	Thematic coding combined with sociotechnical systems framework (abductive approach).
Ethical Considerations	Voluntary participation, informed consent, anonymity ensured; no compensation.

Case Identification and Selection

In order to choose the appropriate cases, the research team has performed a review of the development projects related to IoT funded by a Swedish organization that takes care of developing digital health solutions. Out of 72 funded initiatives, 20 projects could be found to be of direct interest in healthcare applications. Among them there were to be studied in more detail five projects that had already passed past the conceptual design and entered initial implementation stages or pilot projects(6). The chosen cases were different in terms of scope but all of them were united by the idea of testing the applicability of IoT to healthcare delivery. They exemplified the diverse categories of users, such as patients with chronic conditions, elderly people either in home-care or possibly in institutions, and those patients with special clinical needs. Although none of the cases were at full-scale public deployment,

their pilot state gave excellent opportunities to test actual implementation dynamics at small scales prior to large-scaled rollouts.

Participants and Recruitment

In each of the projects, interviews were conducted with the key actors. Project managers were the first approached as the central informants because they were strategic and operationally involved. These managers then suggested more stakeholders, such as health workers, city officials, the business community, and technical advisors, and they could give wider views on implementation procedures. This snowball recruitment resulted into the study getting the perspective of varied professional roles and organization level thus enriching the data. Overall, 22 semi-structured interviews were held involving participants across areas of public authorities, healthcare providers and private companies(7).

Data Collection Procedures

The instruments of data collection were semi-structured interviews with the assistance of an interview guide that included project backgrounds, implementation experience, perceived barriers, and enabling factors. Interviews were conducted over a range of 22 to 57 minutes and audio-taped with the consent of the participants. Transcription of all interviews was verbatim in order to facilitate analysis. Other than conducting interviews, the researchers looked at documentation on projects including grant applications, mid-term reports and internal evaluations. All this triangulation of interviews and documentation enabled cross-verification of information, and the findings were more reliable.

Analytical Strategy

The data analysis involved an abductive orientation, which involved two aspects, inductive and deductive. First, a systematic thematic analysis was applied to transcripts in order to identify codes and patterns based on the views of participants. These codes were then arranged in emerging themes which portrayed common challenges and success factors in the cases. The themes were overlaid onto an adapted sociotechnical systems model in order to place the results into a wider theoretical context. The model focuses on how regulatory environments, organizational support, user engagement, financial structures and infrastructure are interdependent subsystems that affect the outcome of the implementation. The iterative approach was conducted through the cooperation of several researchers and the independent coded data was discussed by authors where differences were debated and finally consensus attained and ensured analytical rigor.

Ethical Considerations

The study conformed to ethical standards of the country. The Swedish Ethics Review Authority concluded there was no need to conduct a complete ethical review of this study, since data analysis did not involve access to sensitive patient records but involved professional interviews and project documentation. However, voluntary principles of participation, informed consent and confidentiality were highly adhered to. The purpose of the study was informed to all the participants as well as their ability to withdraw at any time. Transcripts were stripped of identifiable information to maintain anonymity and no monetary incentive was provided to research participants.

3.Results

Overview of Findings

A study of five pilot IoT projects in Swedish healthcare showed that the results of implementation were the product of a complex interrelation of legal, organizational, financial, user-related, and infrastructural factors. The projects did not focus on the same population and work in different local environments, but similar themes were identified in the cases. These themes are introduced as five inextricably interrelated domains: regulatory environment, institutional support, user-centered practices, resource allocation, and technological infrastructure.

1. Regulatory Environment and Compliance Pressures

The decisive role of legal and regulatory frameworks was one of the most consistent findings in all of the projects. Legislations on patient privacy, on informed consent, and on data protection tended to dictate whether such initiatives proceeded. An example of this is the legal obstacle in applications to older adults whereby the participants with cognitive limitations could not give informed consent, which was the same people who would have most benefited the technology. In a different case, the IoT devices that took pictures were re-examined under the current laws as data gathering equipment and their use was stalled altogether.

A number of initiatives tried innovative approaches to manoeuvre within constraining structures. Other teams shielded their work under an academic research protocol, which implied less strict compliance and, therefore, gave

Volume 1, Issue 2 | October-2025
e-ISSN: 3068-6415 ISSN Print: 3068-6407

them greater freedom in testing technologies. Still others attempted to reuse the existing registries or local data solutions in order to prevent a clash with the national legislation. However, issues relating to procurement procedures, certification, and obsolete legal frameworks continued to be a major impediment. Regulations, being aimed at patient protection, often fell behind the curve of technologic advancement, and there was a conflict between safety and innovation.

2. Institutional Support and Organizational Readiness

Another major factor was the institutional support. Those projects that were actively encouraged by the municipal or healthcare leadership progressed at an easy pace since the leaders promoted digital innovation and invested in experimentation. In municipalities where managers and employees actively supported the use of IoT solutions, not only did projects receive more resources, but also were better accommodated into day-to-day operations.

Projects that were not institutionally aligned, on the other hand, stalled. In a project, the internal IT departments resisted solutions put forward by the project citing legal or technical issues which led to delays and disagreement. In addition, healthcare organizations work within changing political priorities which in some cases diverted focus and funding out of pilot projects. Knowledge differences between managers regarding digital implementation also had an impact on success- managers who better understood the digital implementation were in a position to lead their teams better yet those who had little knowledge experienced uncertainty and inconsistency.

3. User-Centered Involvement

One overriding theme through all the cases was the need to engage end-users in design and decisions, not only the patients themselves, but also frontline staff. Active user involvement at the project's outset was noted to result in enhanced project acceptance and easier integration. To illustrate an example, other efforts engaged patients and caregivers to test prototypes and recommend design changes, resulting in solutions that were easier to use and better matched the needs of the real world. Elsewhere, medical personnel stressed that their participation was not only making usability more effective but enhancing their adoption of the new practice(8).

Nevertheless, the interaction with users did not go without difficulties. Other healthcare workers complained that the growing need of technology further diverted them out of the direct care giving careers. Digital tools were also challenging to patients who in some cases struggled with instructions that were not well aligned with their capabilities. Nevertheless, the projects were able to verify that disregarding user views is a cost that can be more damaging to the acceptance, whereas joint designing enhances technical performance as well as social validity.

4. Financial Resources and Sustainability

Another pattern here was the availability of resources, especially financial resources, which repeatedly determined success. Although pilot phases were usually financed early, the sustainable future was cast into doubt as major uncertainty arose on how the project would be funded in the long term. Respondents were common in noting a lack of explicit responsibility in meeting the costs of continued operations: hospitals, municipalities, and technology developers all wanted the other to cover costs. Such a lack of clarity usually created stagnant projects after the external funding was depleted.

The issue was worsened by short project durations. IoT solutions will take time to install technology and also to re-train employees and change procedures. This process was limited by the limited budgets, and therefore the likelihood that pilot projects would become a regular practice was minimized. Other project managers tried to solve this by making cost benefit analysis to the decision makers but this did not consistently assure them of the financial sustainability.

5. Infrastructure and Technical Foundations

Lastly, technological infrastructure, which may be assumed as a given, was also decisive in predetermining the results of implementation. Some initiatives have faced delays because of poor Wi-Fi connectivity that caused systems to crash, false alarms or untrustworthy surveillance. With home-based care, patients needed to ensure that they had their own internet connections which posed an added barrier when a household had no reliable internet.

Cloud computing was another significant infrastructural problem. In other cases, regional IT departments denied authorization to the cloud-based storage using the reasons of security even when cloud services were essential to overall system functioning. Regional solutions, including the possibility to enter into an agreement with local cloud providers, were sometimes a way out, yet not always possible. Even minor technical problems, like the use of old communication gadgets by hospital workers, slacked down the processes and caused frustration.

Nevertheless, projects that either restructured their infrastructure or negotiated with the IT departments to come up with customized solutions had improved results. To illustrate a point, secure national web platforms in one

project facilitated video consultations, which proves that fitted infrastructure could directly contribute to the successful incorporation of IoT(9).

Synthesis of Findings

Collectively, the five domains indicate that the implementation of IoT is not a fully technical issue but rather a sociotechnical process that is influenced by a variety of, and mutually dependent, subsystems. The obstacles posed by regulation may prevent access to groups of users; failure to secure organizational support may cripple otherwise well-financed projects; and poor infrastructure may destroy user confidence, even in a place where the leadership and funding were effective. On the contrary, the projects that incorporated supportive leadership, involvement of users, adaptive regulatory policies, consistent funding, and trustworthy infrastructure were more likely to record improvement.

4.Conclusion

The results of the given research underline the idea that the implementation of Internet of Things (IoT) technologies in healthcare can not be limited to questions on technical adoption. In its place, the success of integration relies on a wider system of legal, organizational, financial, user, and infrastructural circumstances that combine to influence the manner of integration of new tools into daily practice. The projects analyzed help demonstrate that the ambiguous nature of regulatory rules, the strictness of procurement procedures, and outlived legal frameworks remain obstacles to innovation despite the availability of technical solutions and their effectiveness. The above challenges demonstrate that hospitals should collaborate more closely with their policymakers and legal professionals to make sure that their regulatory frameworks keep up with the advances in technology.

The role of the organizational leadership also matters. Digital transformation is supported by strong managerial support, which is supported by effective communication and allocation of resources. In the absence of this support, projects tend to either stagnate or may not graduate out of the pilot phase. Another continuing challenge is financial sustainability. Pilot projects will often be funded, but long-term funding is unpredictable so a service may run out of funds once that initial capital has been spent. This highlights the need to work out effective mechanisms to fund allocation and show decision-makers the cost-benefit effects that would be measurable.

The relevance of the user involvement is also emphasized in the study. In case these technologies should be relevant, accessible, and widely spread, patients, families, and healthcare staff has to be active participants in the development and implementation of IoT solutions. Cautions against neglecting the views of the users as this will create resistance and compromise the desired gains of digital innovation. Another essential enabler that should not be ignored is infrastructure: the most promising IoT solutions can be ineffective in practice without the stable internet connection, secure data systems, and compatible communication tools.

Collectively, these observations indicate that the implementation of IoT in healthcare entails a systems approach. The five domains identified regulatory frameworks, organizational support, user engagement, financial planning, and infrastructure are not isolated influences but interdependent components of a complex sociotechnical environment. Only by working on a single issue separately will it be possible to achieve sustainable results; development requires concerted efforts based on legal, technical, financial, and human approaches.

To summarize, the IoT technologies have enormous potential and can help foster better healthcare delivery, better patient outcomes, and enhanced efficiency in the systems. Nevertheless, to achieve this potential, it takes more than an interest in innovation. It requires prudent planning, active regulatory harmonisation, dedicated leadership, inclusive design methods and durable infrastructure. With recognition and reaction to these interconnected aspects, healthcare systems can proceed past pilot projects to sustainable digital transformation, and the IoT solutions will be meaningful towards the future of patient care.

Acknowledgement: Nil

Conflicts of interest

The authors have no conflicts of interest to declare

References

1. Atzori L, Iera A, Morabito G. The Internet of Things: A survey. Computer Networks. 2010;54(15):2787–2805.

Volume 1, Issue 2 | October-2025

e-ISSN: 3068-6415 ISSN Print: 3068-6407

2. Islam S, Kwak D, Kabir H. The Internet of Things for health care: A comprehensive survey. IEEE Access. 2015;3:678–708.
3. Miorandi D, Sicari S, De Pellegrini F. Internet of Things: Vision, applications and research challenges. Ad Hoc Networks. 2012;10(7):1497–1516.
4. Gubbi J, Buyya R, Marusic S. Internet of Things (IoT): A vision, architectural elements, and future directions. Future Generation Computer Systems. 2013;29(7):1645–1660.
5. Albahri A, Albahri O, Mohammed K. Systematic review of real-time remote health monitoring system in triage and priority-based sensor technology: Taxonomy, open challenges, motivation and recommendations. Journal of Medical Systems. 2018;42(5):80–99.
6. Al-Turjman F. Healthcare paradigm over big data and IoT: Quality of service and security concerns. Journal of Ambient Intelligence and Humanized Computing. 2018;9(3):441–452.
7. Li X, Da Xu L, Zhao S. The internet of things: A survey. Information Systems Frontiers. 2015;17(2):243–259.
8. Fernandez M, Pallis G. Opportunities and challenges of the Internet of Things for healthcare: Systems engineering perspective. International Journal of Healthcare Information Systems and Informatics. 2014;9(1):45–60.
9. Elhoseny M, Ramírez-González G, Abu-Elnasr O. Secure medical data transmission model for IoT-based healthcare systems. IEEE Access. 2018;6:20596–20608.