

Improving Healthcare Outcomes with RF-enabled Health Information Systems

Ahmad Tasnim Siddiqui*

Abstract

Health Information Technology (HIT) plays a crucial role in improving healthcare by making medical data more accessible, accurate, and efficient. Using radio frequency (RF) technology, HIT enables the wireless sharing of important health information, like patient records, diagnoses, and treatments, between patients, doctors, and other healthcare providers. This helps reduce paperwork, cut costs, and improve the quality of care. By reducing the reliance on paper-based records, RF-based HIT helps streamline administrative processes, cut costs, and minimize the risk of human error. For example, electronic health records (EHRs) and personal health records (PHRs) make it easier for healthcare providers to access up-to-date patient information, leading to more accurate diagnoses and timely treatments. RF technology holds significant promise in healthcare, offering numerous benefits such as enhancing care quality, reducing costs, minimizing paperwork, and supporting more accurate diagnoses. It also plays a key role in improving safety by lowering the risk of medication errors and safeguarding sensitive patient data. Additionally, hospitals can use it to track and store patient information, aiding research and informed decision-making. With the advancements in health information technology, RF-enabled systems have brought greater focus to shared decision-making. As the American Medical Association (2012) explains, "shared decision-making is a process or tool that empowers both patients and doctors to collaborate in determining the best treatment approach based on medical evidence and the patient's care needs." RF technology also supports real-time communication, allowing medical teams to collaborate more effectively, even when they are in different locations. By integrating electronic health records (EHRs), personal health records (PHRs), and security measures, RF-based HIT ensures that sensitive information remains safe while supporting real-time decision-making and communication. This study looks at how RF technology is transforming healthcare, the benefits it brings, and the challenges we still need to overcome to make it even more effective.

Keywords: RF, EHRs, PHRs, HIT, healthcare, information technology

INTRODUCTION

This document dives into the exciting role of RF-based Health Information Technology (HIT) and how it is transforming healthcare. In simple terms, HIT is an electronic system that helps store, share, and analyze health data; and RF (radio frequency) technology makes this faster and more efficient through wireless communication [1]. The healthcare industry has been quick to adopt these IT-based solutions, using RF tech to connect patients, doctors, service providers, and even insurance companies in real-time. Systems like Electronic Health Records (EHR), Electronic Medical Records (EMR), and Personal Health Records (PHR) rely on this technology to ensure accurate and secure data sharing [2].

*Author for Correspondence

Ahmad Tasnim Siddiqui
E-mail: tasnim5@yahoo.com

Associate Professor, Department of Computer Science and Engineering, Skyline University College, Sharjah, The United Arab Emirates

Received Date: January 18, 2025

Accepted Date: March 29, 2025

Published Date: April 05, 2025

Citation: Ahmad Tasnim Siddiqui. Improving Healthcare Outcomes with RF-enabled Health Information Systems. International Journal of Radio Frequency Innovations. 2025; 3(1): 8–13p.

RF Technology has Huge Potential

It can improve the quality of care, reduce costs, cut down on paperwork, and help doctors make more accurate diagnoses. It also enhances safety by lowering the chances of medication errors and protecting sensitive patient information. Plus, hospitals can use it to track and store patient data for research and better decision-making. Combining Information and Communication Technology (ICT) with RF innovations can revolutionize healthcare in both developed and developing countries. These systems help manage disease control, preventive care, and research; and they make shared decision-making between doctors and patients easier by giving everyone access to the right information.

RF-enhanced health information technology (HIT) also plays a pivotal role in ensuring patient safety and data privacy [3]. By enabling secure wireless data transmission, RF systems improve the security of patients' sensitive information and help reduce medication errors. Ideally, widespread and consistent use of RF-enabled HIT would enhance healthcare efficiency, improve care quality, increase diagnostic accuracy, prevent medical errors, lower healthcare costs, increase administrative efficiency, reduce paperwork and idle work time, provide better real-time health informatics communications among health professionals, and expand access to affordable care [4]. The traceability feature of RF-based information technologies allows hospitals to collect and store detailed patient treatment records, which can be utilized for research and the creation of comprehensive visualized reports [5]. Information and Communication Technology (ICT), combined with RF innovations, holds enormous potential to support and improve public health systems in both developed and developing countries. These technologies offer significant improvements in healthcare delivery, management, disease control and monitoring, preventive care, and research [6]. Shared decision making, facilitated by RF-enabled systems, has gained attention alongside health information technology advancements. According to the American Medical Association (2012), "shared decision making is a process or tool that allows both patients and doctors to collaborate to form the best treatment opinion based on medical evidence and the patient's need for care" [7].

LITERATURE REVIEW

An overview of the body of research on the effects of various health information technologies on patient safety is given in this study. By lowering prescription errors, limiting adverse drug responses, and guaranteeing better adherence to medical guidelines, these technologies assist in improving patient safety, according to a review of numerous studies and conclusions.

This literature survey focuses on the Turkish health system from the perspective of integrated care, with a special focus on noncommunicable diseases (NCDs). It aims to provide insights for policymakers and healthcare practitioners on the needs and opportunities for developing a more comprehensive care integration model. It also offers specific recommendations to improve coordination and collaboration among primary healthcare (PHC) providers [8].

SYSTEM'S FLOWCHART

Figure 1 illustrates an RF-enabled Health Information Technology (HIT) ecosystem, showing the interconnected flow of data and communication among various components. Key elements include:

- *Electronic Health Records (EHR)*: Digital health data integrated into the health cloud.
- *Health Cloud*: A centralized system enabling seamless wireless data exchange.
- *Wearable Devices*: RF-based monitoring devices capturing real-time health metrics.
- *Biobanks and Clinical Trials Database*: Repositories for health data accessible through wireless networks.
- *Networking Devices*: RF-enabled hardware facilitating secure data transmission.
- *RFID Devices*: Tools for patient identification and monitoring, enhancing data accuracy.
- *Medical Apps/Tablets*: Interfaces for accessing and managing health information on the go.
- *Healthcare Personnel*: Physicians and service providers utilizing these tools for patient care and decision-making.

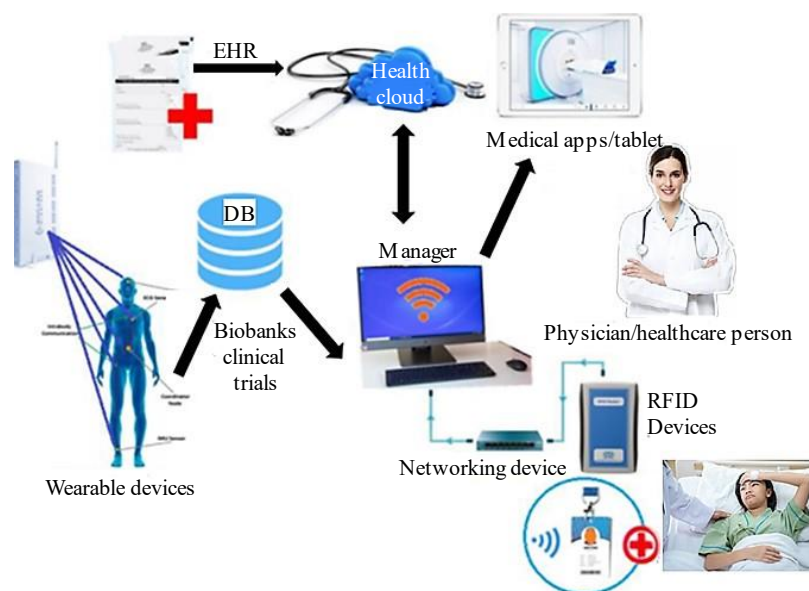


Figure 1. Health IT in practice [9].

OBJECTIVES

This research work aims to explore how information technology affects healthcare and how easy it is to use, based on the experiences of both patients and healthcare professionals. It focuses on its role in hospitals, clinics, and other healthcare facilities.

METHODOLOGY

This study is based on reports, research papers, policy reviews, and input from people working in private and government hospitals in some of India's major healthcare regions like Delhi-NCR, Tamil Nadu, Uttar Pradesh, and Karnataka. These states are known for their strong healthcare systems, serving both local and international patients. The research also takes ideas from a report by Safir *et al.* about improving primary healthcare in Turkey. The report analyzes and proposes methods for integration within the primary care stages, and it appears to be a good starting point for integrated care in Turkey [8].

USABILITY OF HEALTHCARE IT

"A recent report in US trade literature called "Death by 1000 Clicks" talks about the problems with Electronic Health Records (EHR) and where they went wrong. The report highlights how poor usability in health IT systems can negatively affect patient care. Doctors, nurses, and other medical professionals often struggle with these systems, and those issues can lead to serious problems for both healthcare providers and patients [10–14].

The ideal procedure for developing health information technology is to test usability as part of the project plan. Usability testing is less expensive if we start from the beginning. Otherwise, the cost will be high due to changes in design and coding [15]. Usability has numerous definitions and characteristics [16]. Usability includes navigation, familiarity, consistency, visual clarity, error prevention, feedback, flexibility, and efficiency. In other words, usability refers to usefulness. It is more than just a look and feel, also known as a GUI. It also prioritizes user experience, learnability, efficiency, and satisfaction. It is also about knowledge. In general, a system with good usability is simple to use and is effective. It is spontaneous, forgiving of errors, and enables users to complete critical tasks quickly, efficiently, and with minimal effort [17].

We need to improve the usability of health IT systems by offering more patient safety training. Users of health information technology systems should gain a deeper understanding. To avoid

misunderstandings, users of health IT should meet with the system's designers and developers. They must understand health information technology in order to identify where and when usability is created and broken down [18]. Usability means how easy and effective a system is to use. It includes things like a simple, intuitive design, how quickly people can learn it, how efficiently they can use it, how easy it is to remember, how often mistakes happen and how serious they are, and how satisfied users feel while using it.

Usability testing for health IT systems happens in four stages: planning, design, testing, and deployment. But making sure these systems support patient safety comes with several challenges. Usability is one of the most important parts of health information technology: if it is not properly evaluated, it can lead to lower efficiency, dissatisfaction, and poor performance.

One big issue is that there is no required reporting for medical errors caused by health IT systems. Healthcare providers may avoid reporting mistakes because of contracts and intellectual property rights (IPR) agreements with IT vendors. They worry that sharing these problems could risk their contracts or services.

These usability challenges often remain ongoing. In Gawande's article "Why Doctors Hate Their Computers?" from *The New Yorker*, doctors express frustration because they spend too much time and effort on technology, when it should help them do their jobs more easily [19].

When health IT systems are hard to use, they can put patients and medical staff at risk. They also cause frustration and burnout, which hurts the entire healthcare system, from frontline workers to upper management.

CHALLENGES OF USING HEALTH IT

The pandemic has brought new and bigger IT challenges to the healthcare industry, pushing many big companies to create medical technology and specialized applications. Even with these challenges, technology has played a crucial role in helping healthcare providers. Whether it is insurers or other key players, the goal is to provide a smooth and connected patient care experience. Here are some of the biggest IT challenges in healthcare:

Data Management and Integration

Integrating various types of data from various sources remains a persistent technological challenge in healthcare. A patient's file can include information from different places and in different formats. To keep things organized and efficient, clinics and hospitals are moving their processes online.

Billing Process

Billing processes can be confusing and inefficient, frustrating patients and partners. Software tools make it easier to manage accounts and invoices, predict finances, and save time by automating routine tasks [20–23].

Amenability

Things like billing, keeping medical equipment working, and updating software often have changing rules. Healthcare providers must deal with a lot of legal requirements to make sure they are protecting their patients' information.

Privacy and Security

Compliance rules focus on keeping patient data safe and private to stop things like identity theft, fraud, and wrong diagnoses. In fact, a report from the *HIPAA Journal* showed that in January 2022 alone, there were 50 data breaches in healthcare, each affecting 500 or more patient records. Data breaches increased by 38.9% compared to January 2021 [23].

Tele Infrastructure

Healthcare IT systems are really feeling the pressure because of the rise of telehealth, where doctors treat patients remotely. Patient information is being shared between different apps and personal devices, like video call platforms, which makes it harder to keep that data safe and follow privacy rules.

Equitable Access

Despite significant improvements in healthcare IT, a digital divide persists, particularly in the United States, where some demographics are unable to fully utilize health technology.

CONCLUSION

The large-scale implementation of health information technology is revolutionizing the healthcare industry, offering innovative tools that enhance data management and decision-making processes. The widespread adoption of RF-based HIT presents opportunities for advanced features like data visualization, efficient information processing, and real-time decision support through dashboards and alert systems. While this study addresses essential aspects like system architecture, platforms, security requirements, and associated challenges, there is still much ground to cover in understanding and improving these systems. Future research should explore emerging technologies like the Internet of Things (IoT), big data, and augmented reality, which could further enhance the capabilities of health information systems. Moreover, developing comprehensive policies and regulations is crucial to ensuring the safe, efficient, and equitable deployment of these technologies in healthcare.

REFERENCES

1. Rodrigues JJ, Segundo DB, Junqueira HA, Sabino MH, Prince RM, Al-Muhtadi J, De Albuquerque VH. Enabling technologies for the internet of health things. *IEEE Access*. 2018 Jan 4; 6: 13129–41.
2. Fadahunsi KP, Akinlua JT, O'Connor S, Wark PA, Gallagher J, Carroll C, Majeed A, O'Donoghue J. Protocol for a systematic review and qualitative synthesis of information quality frameworks in eHealth. *BMJ open*. 2019 Mar 1; 9(3): e024722.
3. Alotaibi YK, Federico F. The impact of health information technology on patient safety. *Saudi Med J*. 2017 Dec; 38(12): 1173–1180.
4. Shekelle PG, Morton SC, Keeler EB. Costs and benefits of health information technology. *Evid Rep Technol Assess (Full Rep)*. 2006; (132): 1–71. doi:10.23970/ahrqepcerta132. PMID: 17627328; PMCID: PMC4781594.
5. "La dosis adecuada" (2017 Feb 23). Cluster Salud, La Industria de la vida (in Spanish). [Online]. Retrieved 2021-08-19.
6. Courtney KL, Shabestari O, Kuo A editors. Enabling health and healthcare through ICT: Available, Tailored and Closer. Vol. 183 of *Studies in Health Technology and Informatics*. IOS Press; Amsterdam. 2013.
7. American Medical Association. (2012). Getting the most for our healthcare dollars: Shared decision-making. [Online]. Available from: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.666.5358&rep=rep1&type=pdf> (accessed on 23.8.2021)
8. Safir S, Joanne S, Ahmet LY. (2019). Building an improved primary health care system in turkey through care integration. [Online]. The World Bank. <http://hdl.handle.net/10986/33098>
9. Siddiqui AT, Pathak PC. Methodical IoT-based information system in healthcare industry. In: *Mining Biomedical Text, Images and Visual Features for Information Retrieval*. Academic Press; Massachusetts, United States. 2025 Jan 1; 87–98.
10. Schulte F, Fry E. (2019 Mar 27). Death by 1,000 clicks: Where electronic health records went wrong. [Online]. Kaiser Health News.
11. Stagers N, Elias BL, Makar E, Alexander GL. The imperative of solving nurses' usability problems with health information technology. *J Nurs Adm*. 2018; 48(04): 191–6.

12. Kutney-Lee A, Sloane DM, Bowles KH, Burns LR, Aiken L. Electronic health record adoption and nurse reports of usability and quality of care: The role of work environment. *App Clin Inform.* 2019; 10(01): 129–39.
13. Shanafelt TD, Dyrbye LN, Sinsky C, Hasan O, Satele D, Sloan J. Relationship between clerical burden and characteristics of the electronic environment with physician burnout and professional satisfaction. *Mayo Clin Proc.* 2016; 91(07): 836–48.
14. Singh H, Spitzmueller C, Petersen NJ, Sawhney MK, Sittig DF. Information overload and missed test results in electronic health record-based settings. *JAMA Intern Med.* 2013; 173(08): 702–4.
15. Shenoy G. (2008 Sep 15). Benefits of early usability testing. [Online]. <https://productmanagementtips.com/2008/09/15/product-manager-usability-testing/>
16. Shultz S, Hand MW. Usability: A concept analysis. *J Theory Constr Test.* 2015; 19(2): 65–69.
17. Boldt K. (2018). EHR Usability: What is it, why is it so important, and how can it be measured? [Online]. Retrieved from <https://www.medsphere.com/blog/ehr-usability/>
18. Boldt K. (2018). EHR Usability: What is it, why it's important, & how can it be measured? (Infographic). [online] Medsphere. Available from: <https://www.medsphere.com/blog/ehr-usability/>
19. Atul Gawande. (2018). Why Doctors Hate Their Computers. [online] *The New Yorker*. Available from: <https://www.newyorker.com/magazine/2018/11/12/why-doctors-hate-their-computers>.
20. Usability: Home. (2019 Aug 24). Usability Evaluation Basics. [Online]. Retrieved from <https://www.usability.gov/what-and-why/usability-evaluation.html> on 21/05/2023
21. Carayon P, Hoonakker P. Human Factors and Usability for Health Information Technology: Old and New Challenges. *Yearb Med Inform.* 2019; 28(1): 71–77. <https://doi.org/10.1055/s-0039-1677907>
22. Franklin, Zhang J. Chapter 22: Cognitive Considerations for Health Information Technology. In: Greenes Robert A, editor. *Clinical Decision Support*. 2nd Edn. Academic Press; 2014; 619–640. ISBN 9780123984760, <https://doi.org/10.1016/B978-0-12-398476-0.00022-1>.
23. Steve Alder. (2022 Feb 22). January 2022 Healthcare Data Breach Report. [Online]. Retrieved from <https://www.hipaajournal.com/january-2022-healthcare-data-breach-report/>. Accessed on 21/05/2023.