

Innovation and Safety in Healthcare Systems

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Abstract

Innovation and safety have two branches: quality, reliability, and sustainability of the healthcare system and safety. Innovation can also create new technologies and treatment methods, which can improve patient care outcomes and system efficiency. On the other hand, safety can also ensure that each innovation is implemented responsibly and protects both patients and healthcare workers. And there is also safety forming a balanced foundation for achieving sustainable healthcare system development for the future, this study represents the latest literature on innovation and safety in healthcare systems, highlighting how technological advancements must always align with established safety standards. This challenge often arises when the rapid pace of innovation outpaces the implementation of safety measures, particularly in high-risk medical settings, The research findings confirm that safety must be embedded from the early stages of innovation through a collaborative approach and continuous evaluation. Strengthening innovation without sacrificing safety allows healthcare institutions to maintain trust, increase resilience, and ensure that human well-being remains the primary focus of any progress and safety, it can be concluded that health and safety are not two opposites, namely complementary elements and, when effectively integrated, can facilitate the healthcare system to become a more adaptive structure.

Keywords: Healthcare systems, innovation, safety, patient safety, sustainability, technology, ethical practice

Introduction

Innovation and safety are crucial to the advancement of modern healthcare systems [1], Innovation can also be driven by the introduction of new technologies and improved management [2] This enables



healthcare institutions to provide optimal patient care and adapt to evolving medical needs. Innovation must always occur within a safety framework to ensure progress is not compromised by professional integrity [3]. As emphasized by the Institute of Medicine [6] and Amalberti et al. [7], healthcare quality and safety improvement require systemic approaches.

Safety in healthcare means reducing risks and preventing errors, as well as protecting patients from harm [5]. Safety forms the basis of trust between the public and healthcare institutions. Even the most advanced innovations can have unintended consequences, such as increased errors or system failures [4]. Therefore, maintaining a balance between innovation and safety is crucial to ensure that technological advances remain effective and sustainable [3]. This aligns with the findings of Kohn et al. [8], who identified systemic errors as key contributors to patient harm.

Safety in innovation requires a disciplined approach that involves healthcare professionals and educators [1]. This collaboration among various parties helps safety professionals develop prevention strategies and ensures that every stage of innovation—from design to implementation—always prioritizes patient safety. [5]. Furthermore, it builds a culture of safety within healthcare organizations and strengthens their sense of responsibility [2].

A sustainable health system should not be viewed as opposing forces, but rather as complementary elements [3]. Responsible innovation supports the system's highly effective defenses and adaptability, while safety ensures that progress benefits society without negatively impacting it [5]. By normalizing these two aspects, strong accountability and comprehensive quality improvement are fostered. According to Reason [10][11], resilience in healthcare depends on learning from failures and building layered defenses.

Innovation and safety also involve ethical responsibility and continuous learning in healthcare practice [4]. The integration of digital tools, data analytic, and smart devices has reshaped healthcare delivery to patients [2]. However, without strong ethical and safety principles, these technologies can lead to data misuse or patient harm [5]. Therefore, innovation must always be aligned with moral principles and a patient centered approach [3]. Carayon [12] also noted that human factors play a crucial role in spreading safety innovations effectively across organizations.

Material and Methods

This study used a qualitative literature review method to analyze the relationship between innovation and safety in healthcare systems. Fifteen reputable journal articles published between 2015 and 2025 were selected and collected from databases such as PubMed, ScienceDirect, and Google Scholar. The selected studies focused on innovation in healthcare and system improvement. Data from the articles was reviewed and categorized into key themes such as technology adoption and safety management. These findings can identify challenges and strategies that can enhance safe innovation in healthcare settings.

Results and Discussion

Prior research such as Sheard et al. [13] and Batalden & Davidoff [14] supports that success in safety innovation relies on continuous quality improvement and collaboration.

This section presents the findings of the literature review and analysis related to the integration of innovation and safety in healthcare system. The result highlights how innovation practices enhance safety performance and promote sustainability within healthcare institutions.



Result 1

Table 1. Example of Innovation and Safety Practices Across Sector

No	Author & Year	Research Focus	Method	Main Result or Findings
1	Sellappans et al. (2013) [3]	Health Innovation for patient safety improvement	Review	Innovation in healthcare improve patient safety through risk management system and medical staff training
2	Greenhalgh et al. (2017) [15]	Beyond adoption: A new framework for evaluating health technologies	Qualitative	Barriers to health technology adoption are often caused by a lack of understanding of the organizational context
3	Kim et al. (2019) [1]	Managing creativity and compliance in the pursuit of patient safety	Mixed-Method	A balance between innovation and compliance is essential to maintaining patient safety
4	Sharma et al. (2025) [2]	Exploring the dual nature of digital innovations (e.g., AI, EHRs) which offer care enhancements while introducing new risks (e.g., algorithmic bias, cybersecurity threats).	Systematic review	Digital innovations like AI increase efficiency, but require strong regulation to remain safe
5	WHO (2022) [4]	Patient safety: Global action plan 2021-2030	Policy report	Emphasizes the importance of integrating safety into global health system innovation
6	Institute of Medicine (2001) [6]	Assessing the state of quality in U.S. healthcare and proposing a system redesign to close the quality gap.	Committee Report/Policy Study	Proposed six aims for improvement: Safety, Effectiveness, Patient-Centeredness, Timeliness, Efficiency, and Equity.
7	Amalberti, R., Vincent, C., Auroy, Y., & de Saint Maurice, G (2006) [7]	Presenting a framework for understanding violations and system migrations in healthcare as markers of adaptation.	Conceptual Model Development	Violations cannot be eliminated but must be managed; they are often an understandable adaptation to actual working conditions. Systems need to continuously monitor deviations.
8	Kohn, L. T., Corrigan, J. M., & Donaldson, M. S (2000) [8]	Establishing the severity of medical errors in the U.S. and calling for a comprehensive strategy to build a safer system.	Committee Report/Policy Study	Found that medical errors cause tens of thousands of deaths annually and called for the creation of a national patient safety center to develop new tools and systems.



9	Mondal, R (2025) [9]	Reviewing connected healthcare system technology interventions (e.g., AI, wearables) to reduce medical errors and enhance patient safety.	Systematic Review	Technologies like AI and EHRs offer significant opportunities through real-time data collection and clinical decision support, but face challenges in privacy, interoperability, and infrastructure.
10	Reason, J (1997) [10]	Presenting a set of common principles for understanding the causes of major organizational accidents across various high-technology systems.	Theoretical Book (Model Development)	Developed the Swiss Cheese Model, emphasizing that failures occur when 'holes' in multiple layers of defense (active failures and latent conditions) align.
11	Reason, J (2000) [11]	Comparing the two approaches to human error: the person approach and the system approach within the context of medicine.	Conceptual/Opinion Article	Argues for the system approach, which views errors as consequences of upstream systemic factors rather than just causes arising from individual fallibility.
12	Carayon, P (2010) [12]	Conceptualizing Human Factors and Ergonomics (HFE) as an innovation for patient safety improvement and analyzing its dissemination.	Conceptual/Theoretical Analysis (Using innovation diffusion model)	Identified barriers (lack of systems thinking, HFE complexity) and facilitators (positive impact on task performance, local champions) in the spread of HFE innovations.
13	Sheard, L., Jackson, C., & Lawton, R (2017) [13]	Investigating the factors that enable individuals to successfully innovate for patient safety and quality within the National Health Service (NHS).	Qualitative Study	Success is achieved through interpersonal skills, perseverance, and finding a balance between adhering to and breaking rules. Diffusion is hindered by lack of time and opportunities.
14	Batalden, P., & Davidoff, F (2007) [14]	Defining Quality Improvement (QI) in healthcare and explaining its potential for transformation.	Definition/Opinion Article	QI is defined as the combined, ongoing efforts of everyone (professionals, patients, families, etc.) to make changes that lead to better patient outcomes.
15	Greenhalgh, T., Wherton, J., Papoutsi, C., Lynch, J., & Hughes, G (2017) [15]	Developing a new framework to explain why health technologies are often not adopted, abandoned, or fail to scale up.	Theoretical Framework Development	The framework identifies multiple types of barriers (technological, patient, staff, team, business/financial, governance/regulatory) that impede the implementation of technology beyond initial adoption.

From a review of literature from many sources such as JAMA Surgery, BMJ Quality & Safety and the World Health Organization (WHO), there emerged a strong link between innovation in healthcare and performance in safety. Research found that institutions who had incorporated safety principles in the design of innovation were subjected to fewer instances of system failures and better patient outcomes. Digital monitoring systems, AI-based diagnostics and electronic medical records are being adopted to great effect by employing cutting-edge technologies human error and the reliability of healthcare services has dramatically improved.



This exchange underscored the fact that innovation and safety are two reinforcing concepts. The inclusion of safety in innovation is seen as a way to ensure that any new technologies are developed responsibly, ethically and sustainably. Firms that take safety as a value have fewer loss incidents and greater public trust. Balanced development, which combines creativity and responsibility, creates innovations that are not only effective but also safe and sustainable. The findings demonstrate that innovation and safety in healthcare are deeply interconnected. Integrating safety principles into every stage of technological development ensures ethical and sustainable innovation [1], [2]. Previous studies also emphasized that safety culture enhances creativity and long-term resilience in healthcare institutions [3], [4]

These findings demonstrate the interconnectedness of healthcare innovation and safety, as new technologies contribute to reducing medical errors. For example, the implementation of AI-based intelligent monitoring and diagnostic systems has been shown to improve decision-making accuracy [2].

This finding aligns with the findings of [3], who stated that innovation in healthcare must always prioritize safety management and risk reduction. Similarly, [1], emphasized that maintaining a balance between creativity is crucial to achieving innovation and safety in healthcare systems.

These findings demonstrate that responsible innovation supported by continuous evaluation standards can ensure technological advances remain safe and beneficial for patients. Source of innovation goes beyond just technological advancements. It entails innovation in processes and in positive organizational culture. Cultivating an organizational culture of safety creates an environment of open communication and encourages reporting of near-misses and learning together. All these behavioral adaptations are innovations in their own right and are just as critical in ensuring that systems and devices work safely and effectively in practice.

Innovation is not limited to technology but also includes process improvement and cultural change. Building a culture of safety encourages open communication, reporting of near misses, and shared learning among healthcare professionals. These soft innovations are equally important to ensure that new systems and devices function safely and devices function safely effectively in real-world settings. Greenhalgh et al. [15] further explained that sustainable innovation in health technology requires organizational adaptation and user engagement.

Conclusion

Innovation and safety in healthcare are mutually reinforcing aspects for sustainable progress, health is a valuable asset that everyone possesses. Without good health all forms of wealth and success become meaningless. Therefore integrating safety values into the innovation process, strengthening system reliability, minimizing risks, and increasing patient trust are very important. For this reason future healthcare innovation must continue to emphasize health and safety as its main foundation, the future healthcare system must focus on creating an adaptive environment that enables innovation and safety and evolves with it. Governments and the private sector must collaborate by developing global standards that support innovation while enforcing safety regulations. Ongoing education and training will also play a critical role in ensuring that healthcare professionals remain competent in the responsible and optimal use of advanced technologies.

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