

Innovation Adoption Research in Healthcare: Understanding Context and Embracing Complexity

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Abstract: This paper presents a literature review on innovation adoption in healthcare. Healthcare is one of the world's largest and fastest-growing industries, driven by demands such as ageing populations, increasing co-morbidity, and improving technologies. Innovation continues to be a key driver in balancing cost containment and improving quality for health systems. However, healthcare has been slow to adopt and utilize the numerous innovations available to improve patient outcomes and efficiency. Stakeholders in healthcare innovation need to understand the influences on innovation adoption to increase the success rate of implementing innovation into practice. This literature review was conducted via searches of publication databases using selected keywords regarding innovation and adoption in general, and in healthcare specifically. Publications from academic journals and grey literature were assessed based on relevance to the topic, quality, influence, and citations. Key papers, theories, findings, and conclusions in the field are discussed in this review. The review revealed that innovation adoption has been extensively studied in multiple disciplines over decades. However, most empirical research and theory development has taken place in the context of information technologies (IT) and their adoption in various industries and sectors. Research has mainly focused on individual acceptance and adoption of technology, which is less appropriate in healthcare due to its complex organizational structures, processes, and highly skilled workforce with significant social influence. Research into organizational adoption of innovation has been conducted, but these models have generally been utilized less in research and practice, both in general and specifically in healthcare. Within healthcare literature, innovation adoption has been recognized as a complex and challenging issue with multiple factors influencing success. However, research and theory development have generally been more limited in this setting. The review concludes with suggestions to bring learning from disciplines with stronger theory development to the healthcare setting. A novel conceptual model specific to healthcare is posited, accounting for the complexity of the system and understanding the process through a holistic approach. This model should be useful to and useable by any healthcare innovation stakeholder, from clinicians, to industry, to policy makers, as well as by researchers in this field.

Keywords: Innovation, Adoption, Healthcare, Technology, Acceptance

1. Introduction

Healthcare is one of the world's largest and fastest-growing industries, fuelled by demands including an ageing population, co-morbidities and improved detection technology while encompassing multiple business and service sectors. Innovation is increasingly used to reduce spiralling costs while improving healthcare quality (Omachonu and Einspruch, 2010). In healthcare, an innovation in professional practice may be described as a novel idea, product, service, or care pathway that has clear benefits when compared to what is currently undertaken (improved efficacy, safety, quality etc).

In the practice of healthcare, the process of innovation refers to the entire process from the conception of the idea to its adoption and widespread use in clinical practice. The process is often conceptualised as linear, from basic research through applied research, targeted development, manufacturing and marketing, adoption and finally its wider use. However, the process is rarely that straightforward, being more dynamic and iterative in practice (Gelijns & Rosenberg, 1994). For this review, the latter stages of the cycle are of greatest interest: the 'adoption' and 'use' of innovations, where there is less modification to the innovation, the scope and specification of the technological innovation is known, and professionals can (and are permitted to) apply the technology in practice.

This is known as 'technology adoption' or the 'diffusion of innovations' and has been recognised and studied as via various approaches across numerous settings, sectors, and academic disciplines. Decades of theory development have resulted in several models being produced (Greenhalgh et al 2004; Oliveira & Martins, 2011; Alomary & Woollard, 2015; Taherdoost, 2018).

Specific to the healthcare sector myriad innovations remain unadopted even though evidence suggest they could improve outcomes for patients and/or efficiency for health systems. This is especially true for the UK's National Health Service (NHS), which has historically led the world in inventing and testing new innovations but has struggled with adoption and diffusion of innovations (Kelly and Young 2017). Understanding and influencing innovation adoption to improve the likelihood of success is therefore highly important for healthcare stakeholders to consider.

This literature review was conducted to review the research in the field of innovation adoption, both in the healthcare setting specifically, and across broader settings. By broadening the scope, the hope is to identify potential opportunities for cross-disciplinary learning and the application of research approaches and practice from other areas to healthcare.

2. Methodology

The following research questions guided the approach to this literature review: How is innovation adoption researched, conceptualized, and understood in healthcare, and; what knowledge from innovation adoption research in other settings, such as theories and models, could be utilized and applied to healthcare innovation adoption research and practice?

A combination of systematic and targeted search was undertaken between 2018 and 2022, searching online databases, including Google Scholar, PubMed, Scopus, and Web of Science. Keywords included variations of 'technology adoption', 'innovation adoption', 'diffusion of innovation'. For the healthcare specific searches, this also included modifiers 'health', 'care' or 'healthcare'. Articles needed to focus on innovation adoption as the major topic of the study. Snowballing and citation searches were used to expand the search. Document types included journal articles or reviews written in English, and grey literature was included where relevant.

A review of the most relevant literature was then undertaken to identify key theories, concepts and other findings, influential studies (assessed by number of citations and journal metrics) and seminal works, and type of research undertaken (e.g., empirical vs non-empirical, qualitative vs quantitative). This paper contains the pertinent findings from this review, i.e., the most useful knowledge for healthcare innovation stakeholders to apply in research and practice.

3. Findings and discussion of literature review on the adoption of innovation in healthcare

3.1 Key Findings in Healthcare Innovation Adoption Literature

Medical innovation often occurs differently to other industries due to emotional factors attached to the concept of health and illness, and the political commitment to offer people the latest advancements in medicine (Roberts, 1981). Furthermore, novel biomedical technologies usually share two major features: present the promise of longer and/or higher quality of life, while also being associated with the prohibitive cost of care and services. In the context of limited resources and attempts to reduce expenditure, health policy- and decision-makers must prioritise and therefore some technologies may 'diffuse', while others do not (Petkova et al. 2010). This prioritization is (or should be) based on a combination of evidence of benefit, and cost-effectiveness. However, there is a perceived gap between the 'best evidence' and 'evidence-based practice'. Technology with reported clinical efficacy and safety in clinical trials often fails to subsequently integrate into medical use, thus preventing patients from benefitting from the best scientific advances (Lang et al., 2007). This raises questions of why clinical evidence alone appears to be insufficient to push forward innovation, and what other factors are having an influence on an innovation's adoption.

Healthcare systems are complex and diverse groups play a role in decision-making around introducing innovation, with the medical profession being particularly influential. Fitzgerald et al., (2002) studied eight different healthcare innovations in the UK and found several influences that can facilitate or inhibit diffusion, including inter-professional alliances, change networks and collaboration; ambiguity and contention around new scientific knowledge; 'active adopters' serving as role models; 'go to see' sites where the innovation can be observed in practice. Examples in the study showed that strong clinical evidence (or lack thereof) and cost-effectiveness are often not the deciding factors in an innovation's adoption, multiple different context-specific factors and social influences all playing a role (Fitzgerald et al, 2002).

Gelijns & Rosenberg's 1994 health economics study explored the impact of technological innovations on rising healthcare spending. This showed that the rate of innovation is sensitive to changes in the financing and delivery

of healthcare services. Other key factors influencing adoption included the extent of competition over price and operating costs of technology; competition between health and care specialties, and the influence of key opinion leaders (KOLs). Leadership from KOLs is mentioned in multiple studies (Gelijns and Rosenberg, 1994; Rogers, 1995; Fitzgerald et al., 2002), demonstrating a mechanism for role modelling, so that the spread of ideas among individuals occurs by imitation of these important leaders in their specific field (Greenhalgh, et al., 2004; Petkova, et al., 2010). Any attempt to influence diffusion would arguably need to address the attitudes of these individuals (Rogers, 1995; Fitzgerald et al., 2002; Greenhalgh et al., 2004; Petkova et al., 2010). This may be achieved through mass media and persuasion, or what emerges as a more effective approach: through strong interpersonal ties, e.g., via exchanges about the innovation with peers. These are thought to be more trusted channels to deal with resistance or apathy to an innovation, and to influence strongly held attitudes (Rogers, 1995; Petkova, et al., 2010;)

Other social forces and contingencies can influence adoption, even in cases where robust evidence confirms or rejects the need for innovation, such as in the case of the inconsistent availability of the breast cancer drug Trastuzumab to early-stage patients in the UK NHS. The case attracted negative media attention, and due to sustained pressure by cancer charities, clinicians, patient groups, politicians and the public, the National Institute for Health & Care Excellence (NICE) changed its guidance to allow access (Nahta & Esteve, 2007). This suggests diffusion is affected by macrocontextual factors, such as stakeholders' interests, the political climate (temporal), and public expectations. Further empirical studies have shown that innovations with suitable clinical evidence, technical attributes and cost-effectiveness can fail to reach widespread implementation (e.g., Meyer and Goes, 1988; Champagne et al., 1991; Hughes et al., 2002).

This suggests that few medical innovations accomplish their originally intended use. Petkova et al (2010) suggested that others 'drift' into other applications or rapidly become legacies where workarounds are introduced, justifying a need for new theoretical frameworks.

A highly influential review of the diffusion of innovation in UK healthcare, conducted by Greenhalgh et al., (2004) resulted in an extensive list of influences on the diffusion of innovation in service organisations. The authors of this review noted that few studies acknowledged, let alone empirically researched, the complexities of spreading and sustaining innovation in healthcare. Most studies concentrated on relatively few components and fail to account for interactions between components or their contextual and contingent features (Greenhalgh et al., 2004). This is also evidenced in the studies from the healthcare innovation literature mentioned previously in this section.

This gap in the body of knowledge is in part due to the difficulty of identifying and scientifically controlling for 'confounding variables' to improve the objectivity of any research. Hypothesis-driven, positivistic empirical approaches that attempt to achieve objectivity cannot account for the complexity and dynamism of innovation adoption in a healthcare system, and the context and confounders are inextricably linked. Previously published research showed that influences are likely to interact in numerous and often unpredictable ways in different settings and contexts, and this should be a part of the research process, and not controlled for.

Greenhalgh et al., (2004) recommended that research in this area should be theory-driven; process rather than 'package' oriented; explore the effect of setting; standardized; collaborative and coordinated; multidisciplinary and multimethod; detailed; and engage stakeholders.

In summary, the seminal studies of pragmatic innovation adoption practice show significant variance and conflict in terms of process and how influencing factors (and combinations of factors) explain adoption or failure to adopt. Furthermore, there is a lack of theory-driven research that takes a holistic approach to capture all significant context-specific details as well as embrace the complexity of healthcare as a system, and the adoption of innovation within it.

3.2 Innovation Adoption Theories, Models, and Frameworks

The previous section 3.1 highlighted the relative lack of theory-driven research in the healthcare setting, therefore this review also looked more broadly at adoption research across disciplines, to review theory built up in other areas, which will be discussed in this section.

3.2.1 Technology Acceptance and Adoption at the Level of the Individual

Technology acceptance is a component of adoption and defines the process by which users come to accept and use a technology. It is usually considered the first stage of adoption, followed by the integration and wider

spread and use of technology. By proportion, most of the research and theory development in innovation adoption has focused specifically on the acceptance of technology by individuals and has been conducted in the context of information technology (IT).

Amongst the many models developed to explore and understand technology acceptance (see Taherdoost 2018 for comprehensive review), the technology acceptance model (TAM) developed by Davis (1989) from the theory of reasoned action (TRA), remains one of the most utilized likely as it is easier to use and less research intensive to apply than other models, and it has received substantial empirical support. Figure 1 shows the model and its components, which explain the motivation of users via three main factors: perceived usefulness, perceived ease of use, and attitude. Sometimes other factors (external variables) are included.

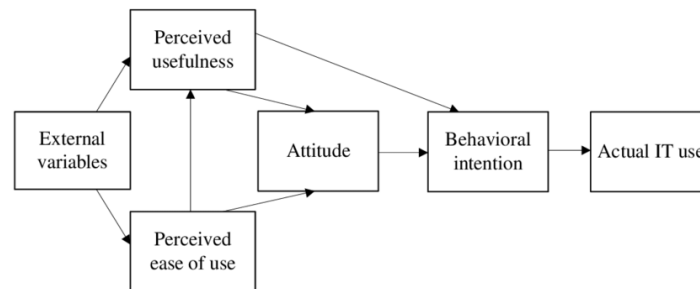


Figure 1: The Technology Acceptance Model (Davis, 1989).

Other models, such as the theory of planned behaviour (TPB) (Ajzen, 1985), or the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003), include additional or different components, but the common theme is a combination factors that influence an acceptance of a technology by individuals, focused on characteristics of that technology and the individual adopters (AlQudah et al., 2021). Most studies using these models approach research via positivist, quantitative survey-based design.

While these approaches provide a suitable mechanism for explaining the acceptance of technology by individuals, they are limited in scope and reductionist. As previously discussed, when aiming to understand adoption in a complex setting, with complex organisations and multiple influences outside of characteristics of a technology, a TAM (or similar model) based approach is unable to account for all relevant details, nuance, and provide a holistic view of the system.

3.2.2 Organisation-level adoption

Innovation adoption can occur at various levels: from individuals to larger groups, to entire organisations and even whole systems or industries. While the findings of individual level research can be generalized to larger groups/populations, the influences on the adoption of innovation by larger units differ, and there is a significant body of research and a few theories developed to explain and understand adoption by organisations (Oliveira and Martins, 2011).

Two prominent organisation-level models will be discussed here, the Diffusion of Innovation (DOI) theory (Rogers, 1995), and the Technology, Organisation, Environment (TOE) framework (Tornatzky, Fleischer, and Chakrabarti, 1990).

Rogers' work on DOI theory has been a reference point for many adoption studies, including some previously referenced in this review (including Meyer & Goes, 1988, Fitzgerald et al., 2002; Greenhalgh et al., 2004). There are a few different aspects of DOI theory, covering the mechanisms, the reasons, and the rate that innovation spreads through members of a social system, and can operate at the individual or the organisation level (Rogers, 1995). At the organisation level, the innovation process is more complex, generally involving several individuals, including both supporters and opponents of the innovation, that play a role in the innovation decision. Figure 2 depicts DOI theory at organisation level, showing that organisation innovativeness (i.e., propensity to adopt innovation) is related to the variables 'individual (leader) characteristics', 'internal characteristics of organizational structure' and 'external characteristics of the organization'. Since the early applications of DOI to innovation adoption research, the theory has been applied and adapted in various ways. (Oliveira and Martins, 2011).

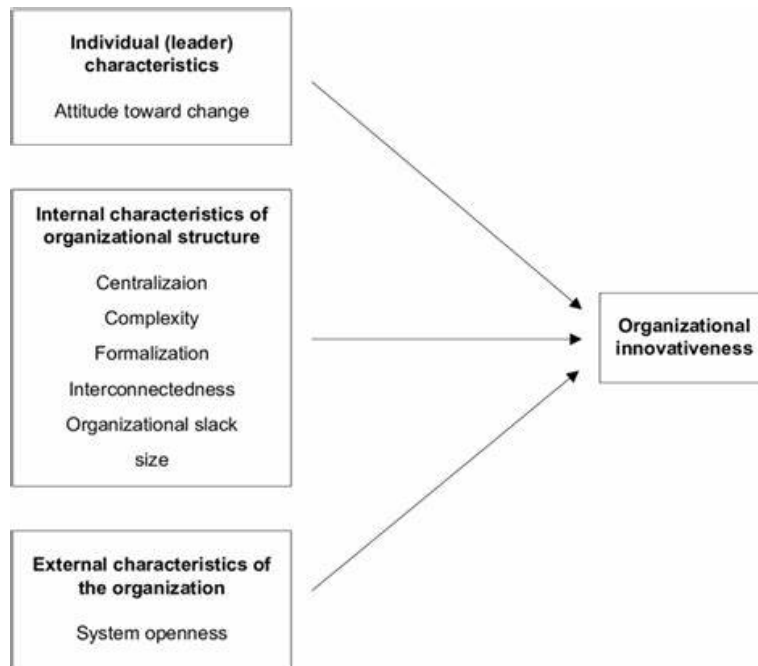


Figure 2: Roger’s Diffusion of Innovations (Rogers, 1995)

The second prominent organisation-level adoption model, the TOE framework, has been widely utilized in the fields of management research, engineering, manufacturing, and information systems. It identifies three contexts relevant to an organisation that influence the process by which it adopts and implements innovation, shown below in Figure 3.

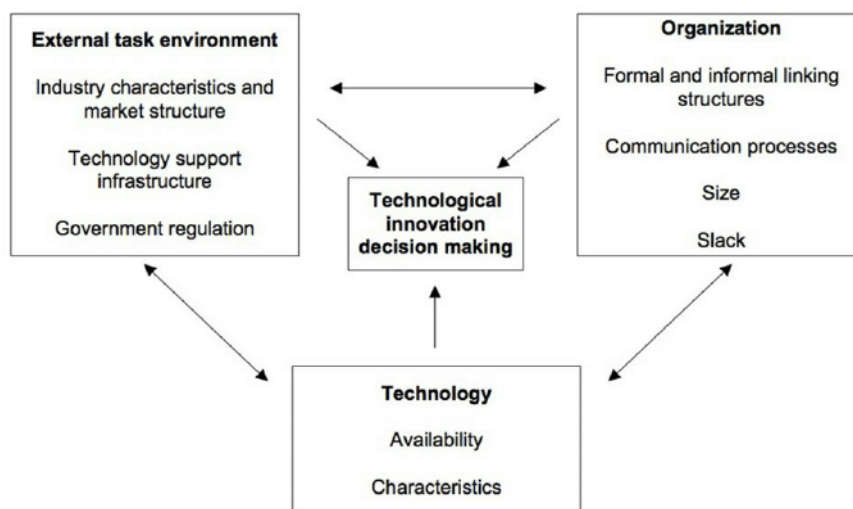


Figure 3: The Technology-Organization-Environment Framework (Tornatzky, Fleischer, and Chakrabarti, 1990).

The Technological context is defined in terms of both internal and external technologies relevant to the firm, and their availability. The Organizational context is defined in terms of descriptive measures about the organisation such as scope, size, and managerial structure, and acknowledges informal linkages between employees within the organisation. The Environmental context is the ‘arena’ in which an organisation conducts its operations, for example its industry, competitors, and governmental interaction (Tornatzky et al., 1990).

Even though the available technology to an organisation could be considered as part of its ‘arena’, or environment, Tornatzky et al. (1990) intentionally separated the Technological context from the rest of the Environment context to focus attention on how the features of the technologies themselves can influence both the adoption process and implementation.

The TOE framework has strong theoretical underpinnings (see Tornatzky et al., 1990) and has seen consistent use in empirical studies of organisation level adoption (e.g., Meyer & Goes, 1988; Grover, 1993; Chau & Tam, 1997; Lee & Shim, 2007; Ramdani et al., 2009; Nguyen et al 2022). Most research again has focused on IT adoption, and the factors under the three contexts are often varied between studies.

The TOE framework and DOI theory are consistent, as the components of DOI are covered by the Technological and Organizational context of TOE (Ngongo et al, 2019). TOE goes beyond DOI with the important addition of the Environment context, which can present both barriers and opportunities for technological innovation and adoption. Groups such as industry members, knowledge producers, regulators, customers, and suppliers can be beneficial by providing information, financial or human resources, or detrimental by constraining innovation through policy and regulation, capital availability, restrictions on innovation flow (Tornatzky et al., 1990). TOE acknowledges that the three contexts are linked to and influence each other, for example organisations can set up ‘boundary spanning mechanisms’ to communicate with their external environment (Tornatzky et al., 1990).

The features of TOE make it a suitable candidate for studying innovation adoption in the setting of healthcare, due to the unit of analysis being the organisation, and the three interlinked contexts and associated factors allowing a more comprehensive view of the influences on innovation adoption, compared with other technology acceptance and adoption models.

However, there is still only a smaller weight given to social influences (contained within Organization context) which have been noted to be highly influential in healthcare (Gelijns & Rosenberg, 1994; Fitzgerald et al. 2002; Greenhalgh et al., 2004; Nahta and Esteva, 2007).

3.3 Sociotechnical systems theory and healthcare

The sociotechnical systems (STS) theory originates from the field of organizational change and development, and has seen considerable use in research in this field and others (Appelbaum, 1997). It is based on the premise that an organisation or a work unit is a combination of social and technical parts, and that it is open to its environment (Figure 4). The theory posits that the design and performance of any organizational system can only be understood and improved if the approach brings together and aims for joint optimization between all aspects of that system (Trist and Bamforth, 1951).

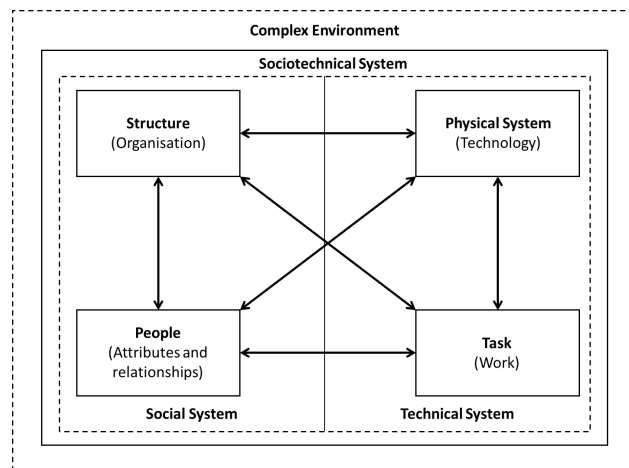


Figure 4: The Sociotechnical Systems Theory (Trist and Bamforth, 1951)

The social subsystem of the organisation is comprised of the attributes of and relationships between people, and the reward systems and authority structures. The technical subsystem is concerned with the technology utilized, and processes and tasks carried out in the organisation.

STS is a suitable construct to apply to healthcare as it is a setting comprised of organizational units and systems of increasing size and complexity, from individual clinics to the NHS. While it does not originate in innovation or technology adoption research, it does acknowledge and cover implementation of technology as a type of change to an organisation, that will affect and be influenced by the social system of that organization – which is important in healthcare, as mentioned.

While not common, there have been instances of STS use in innovation adoption literature. For example, Geels (2004) found that for complex network of organisations like healthcare, an STS approach incorporating user side

into analysis allowed greater focus on diffusion and use of technology; and an analytical distinction between systems, the actors involved in them, and the institutions which guide actor's perceptions and activities.

Ulucanlar et al., (2013) used STS to study adoption of medical devices in the NHS. They found that: organisational adoption decisions are influenced within a dynamic 'adoption space' transcending organisational and geographic boundaries; technologies acquire socially constructed 'identities' in the adoption space (influenced by industry, healthcare organisations and practice, health technology assessment and policy) which relate to novelty, effectiveness, utility, risks, and requirements; and technologies' identities shape their desirability, acceptability, and adoptability.

3.4 Comparing TOE and STS

TOE & STS cover much of the same ground, while also having a few key differences. TOE is explicitly an adoption model, while STS was not intended as such. STS has been utilized with high frequency in other fields but has had much less empirical support in adoption focused studies. A related point can be made of TOE regarding healthcare, as most of its empirical support comes from IT adoption studies, with relatively fewer studies in the healthcare setting, whereas STS has seen broader use in this setting.

The theories themselves have potentially significant overlap. Components of STS can be grouped under the three contexts of TOE: technology from technical subsystem (STS) can be grouped into the Technological context. People, relationships, and structure (from the social subsystem), processes, and tasks (from technical subsystem) could be grouped under the Organizational context. Finally, the external environment subsystem is directly comparable to the Environmental context. In the same way, aspects of TOE can be split between the components of STS.

While neither theory explicitly weighs its components, their arrangement sheds light on what is viewed as important. In TOE, technology has its own context, separated intentionally from the others due to its considered importance (Tornatzky et al., 1990), whereas it is only one component of a technical subsystem in STS. Conversely, social factors are a significant part of STS, whereas in TOE there is only the factor 'formal and informal linking structures' under Organizational context, suggesting STS places higher weight on these influences.

Naturally, some of the differences between the two are due to their different conceptualizations and intended use. STS conceptualizes an organisation as a sociotechnical system, hence why organisation-related factors are split between the different subsystems, whereas in TOE they are grouped under one context, due to TOEs arrangement as key contexts of influence in innovation adoption.

3.5 Conceptual Model for innovation adoption in healthcare

Due to the significant compatibility of the TOE framework and STS theories, there is potential to combine them to create a conceptual model for explaining and understanding innovation adoption. Supported by healthcare innovation and adoption literature already discussed, a model is proposed below in Figure 5.

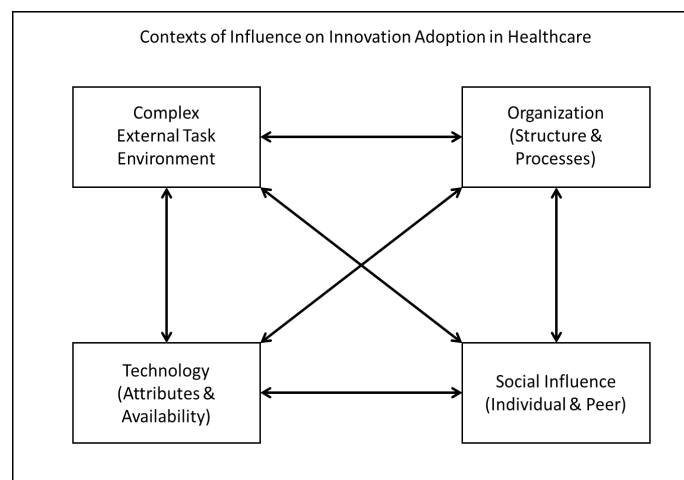


Figure 5: Contexts of influence on innovation adoption in healthcare model.

This model is designed for adoption research in healthcare, following a similar approach to TOE, STS, and other models. It builds upon TOE by introducing a fourth context, "Social Influence," which recognizes the significant impact of social factors on healthcare innovation adoption, as highlighted by STS's social subsystem.

Within this model, social aspects previously considered under TOE's Organization context are now categorized within the Social context, similar to how TOE separates technological factors from the environmental factors due to their distinct importance and influence. While the four contexts are presented as separate, it is acknowledged that they are interconnected and mutually influence each other.

Specific factors under each context are not provided in this model, as they are likely to differ from TOE and STS. Empirical research is needed to identify and validate these factors. It is anticipated that many factors identified in previous STS, TOE, and other adoption model research will apply to healthcare. Additionally, it is expected that unique factors with greater influence on adoption in healthcare will be discovered.

4. Conclusions

The healthcare innovation literature shows how complex healthcare is as an industry and practice setting, and how challenging it is to innovate and support adoption within its processes of decision-making and its multiple actors. Numerous influences on healthcare innovation adoption have been identified and investigated, with social influences being consistently mentioned, in a variety of organisations, and various approaches to research have been explored.

Much of this research has either focused on the individual, utilized fewer factors, not utilized established adoption theory or conceptual models, and by design is not able to account for all contextual influences and complexity of healthcare systems.

The TOE framework is a well-established approach used to study adoption in healthcare organizations. It has a solid theoretical foundation, empirical support, and focuses on organizational-level analysis. However, its application has been mainly limited to IT adoption within healthcare, and it lacks a strong consideration of social influence on adoption.

On the other hand, the STS theory offers a valuable perspective for understanding healthcare organizations. It has been empirically applied in innovation adoption research and recognizes social influence as a crucial factor in organizational change, including the adoption of innovations.

This paper presents a novel conceptual adoption model, supported by healthcare innovation adoption literature, which posits four contexts of influence on innovation adoption in healthcare, the Social, Organizational, Technological, and Environmental.

The model represents an opportunity for valuable insights into the factors that influence technology acceptance and adoption. The model can inform the design and implementation of interventions via advance the understanding of technology acceptance in healthcare and evidence-based strategies for successful technology implementation- leading to improved patient care and outcomes.

Future research should be undertaken to validate the model, using similar methodology to TOE research, while also being detailed and nuanced to capture all relevant factors of influence, understand context, and embrace complexity.

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