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Guiding Healthcare Technology Implementation

A New Integrated Technology Implementation Model

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Healthcare technology is used to improve delivery of safe patient care by providing tools for early diagnosis, ongoing monitoring, and treatment of patients. This technology includes bedside physiologic monitors, pulse oximetry devices, electrocardiogram machines, bedside telemetry, infusion pumps, ventilators, and electronic health records. Healthcare costs are a challenge for society, and hospitals are pushed to lower costs by discharging patients sooner. Healthcare technology is being used to facilitate these early discharges. There is little understanding of how healthcare facilities purchase, implement, and adopt technology. There are two areas of theories and models currently used when investigating technology: technology adoption and implementation science. Technology adoption focuses mainly on how the end users adopt technology, whereas implementation science describes methods, interventions, and variables that promote the use of evidence-based practice. These two approaches are not well informed by each other. In addition, amplifying the knowledge gap is the limited conceptualization of healthcare technology implementation frameworks. To bridge this gap, an all-encompassing model is needed. To understand the key technology implementation factors utilized by leading healthcare facilities, the prevailing technology adoption and implementation science theories and models were reviewed. From this review, an integrated technology implementation model will be set forth.

KEY WORDS

Adoption • Implementation • Integrated technology implementation model • Technology

Consumers expect quality, safe patient care as essential factors when choosing healthcare services. Care providers work in complex environments where they are required to make critical care decisions for sickly patients while working with sophisticated technology. The Institute of Medicine report, *The Future of Nursing: Leading Change, Advancing Health*,[1] recommends that healthcare organizations, as well as "private and public funders collaborate… to advance research on innovative solutions, including technology, that will enable nurses to contribute to improved healthcare."[1(p11)] The report recommends that healthcare organizations engage "frontline staff in design, development, purchase, implementation, and evaluation of" devices and technology products.

Realizing the vision of the *Future of Nursing* report requires transformation of the care environment and use of technology to assist with this change. Implementation of technology varies across nursing units, organizations, and practice settings. Use of health technology is the application of organized knowledge and skills in the use of devices, medicines, vaccines, procedures, and systems designed to solve health problems and improve quality of lives.[2,3]

It is essential that the workforce can sustain the implementation of new technologies in these environments as a routine to promote cost-effective, safe, quality care. Many factors, at all levels of healthcare delivery, affect the success of program implementation.[4] These factors of implementation within specific contexts of care delivery are not well understood, especially with technology implementation in healthcare. The first step to try to understand these phenomena was to review 51 theories for technology research,

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and examples of implementation science (IS) include Social-Technical theory, Complexity theory, General Systems, Social Cognitive, Diffusion of Innovation (DOI), Unifying Model of Innovations, Knowledge-to-Action model, and Translation of Research Into Practice (TRIP). The emphasis of the review was the theories focused on the organization, individual, or both. In addition, theories were evaluated if implementation strategies were provided. The most widely used models were further evaluated and used with the conceptualization of the integrated technology implementation model (ITIM).

With this review, there are two theoretical areas that can guide technology use: technology adoption and IS. The first, technology adoption, focuses mainly on how the end users adopt technology. The latter, IS, describes methods, interventions, and variables that promote the use of a variety of innovations such as evidence-based practices (EBPs) and models of care delivery.

MOTIVATION FOR A NEW RESEARCH MODEL

Given the major differences regarding healthcare technology and implementation frameworks, an integrative model of technology adoption informed by IS is set forth. This integrated model provides a framework for analyzing studies of technology implementation and explicating implementation in healthcare settings. If a technology system is not implemented successfully, it may lead the nurse to develop workarounds or even refuse to use the technology. The potential resulting impact of unintended consequences may cause errors and patient safety concerns. A model is needed that incorporates the characteristics associated with information technology success and the factors noted to result in a successful implementation. An ITIM is set forth to guide researchers, healthcare facility leadership, and engineers on organizational and individual factors that must be considered to lead to a proactive and positive implementation and full adoption of the technology.

BACKGROUND

Technology adoption models (TAMs) study how users come to accept and use the technology innovation.[5–9] These models are concerned with perceived usefulness, ease of use, actual use of the technology, and social influences. Implementation science is the study of methods, interventions, and variables that promote the uptake and sustained use of EBPs by individuals and organizations to improve clinical and operational decision making with the goal of improving healthcare quality.[10–13] Eccles et al[10] stress the importance of considering the multiple levels in which healthcare is delivered, as well as the interplay between the practice culture and the development of an intervention that involves choosing a technology and method of delivery to influence a behavior change.

TECHNOLOGY ADOPTION MODELS

Most of the TAMs focus on the individual user's behavior with the intention to use the technology. Little attention is paid to which implementation strategies work, in what setting these strategies work, and why. When exploring key factors that influence technology adoption in healthcare facilities, the actual physical setting, types of providers, team skills, education level, experience with technology, workload, support staff, and communication of the implementation process are important considerations in developing strategies for the implementation of technology. Finally, the external drivers, such as accreditation standards, government funding sources, vendors, and so on, and how they can affect the implementation process, are not discussed within these models.

CRITICAL ANALYSIS OF TECHNOLOGY ADOPTION MODELS

There are several models of technology adoption[6,7,9,14] that focus on the individual user's perception of use and ease of use of technology leading to adoption, within the context of information technology. Later TAMs, such as DOI, attempted to address how additional factors influence adoption such as the technology's relative advantage, compatibility, complexity, and trialability factors.[8] Several models were extended to measure net benefits (outcomes). The strength of these models is their focus on the individual adopter. Limitations of these models are in their explanatory power with gaps in actual strategies and steps (process) needed for systematic implementation of technology, resulting in tangible practice changes. Technology is deployed in organizations where the behaviors of multiple individuals are interwoven to comprise an organizational behavior. In addition, in some instances, technology may be beneficial for one professional but contrary for another. The TAMs do not address how the organization behaves and reacts to assist individuals so that users and the organization can be more effective. Organizational variables that should be addressed include leadership styles, values, goals, strategies, social norms, nature of job duties, time constraints, costs, and technology environment factors (infrastructure), with some or all of the variables fostering the individual adoption of the technology. Technology adoption models did not address which organizational change or implementation strategies should be used to lead to technology adoption. Other considerations that were not addressed with TAMs include the context of patient care or external forces such as policy decisions, regulations, and accreditation

standards. To understand the necessary implementation strategies, the IS models for healthcare were reviewed.

IMPLEMENTATION SCIENCE MODELS

Implementation science theories and frameworks try to answer the question of how innovations are diffused throughout an organization and sustained in daily healthcare practices. Implementation science focuses on understanding which implementation strategies work, in which context, and why.[15–17] There is no overarching implementation theory, but rather a variety of implementation models and frameworks including the Unifying Model of Innovations, Promoting Action to Research in Healthcare (PARiHS), Knowledge-to-Action, and TRIP.

CRITICAL ANALYSIS OF IMPLEMENTATION MODELS

The implementation frameworks and models are diverse, and each has key features that differ in their precision and in the actual process of implementation. All of the models share the dependent variable, adoption of the innovation. The implementation frameworks and models are directed at designing implementation strategies to get evidence into healthcare practice. The majority of the frameworks and models are also focused on the translation of research evidence into practice. The exception is the Unifying Model of Innovation,[18] which describes the innovation as an idea, practice, or object (ie, product, device, system, process, policy, program, or service). Given that IS models are predominately used in introducing EBP, which is considered an innovation, these models provide approaches to assist in a successful implementation strategy for an assortment of evidence, individuals, and contexts. These approaches can easily transfer to other implementations such as technology. For example, leaders have a key role in creating a culture and defining clear roles, teamwork, and organizational structures to support the technology implementation. Another example is the use of informatics nurses as facilitators who promote the use of the technology in clinical practice.

The frameworks and models define potential users of the EBPs as healthcare providers and healthcare systems. The Knowledge-to-Action framework and Unifying Model of Innovation also include policy makers as potential users. Common functions across the implementation models and frameworks include identification of a clinical problem, analyzing and synthesizing the quality of evidence, and defining and using implementation strategies and evaluation of adoption of EBPs.

Studies using IS models used with healthcare technology implementation research is limited. One study conducted by Tschannen et al[19] found using the TRIP model assisted with the implementation of diffusion of an electronic tool that was printed daily by the nurse addressed complex pressure ulcer prevention and treatment. Another study evaluated using an implementation framework with developing strategies for a computer-based tool for screening and brief intervention regarding alcohol use and physical activity.[20] The study found that using the framework was more successful than a strategy in which the tool was introduced and immediately used for patients. The focus of these studies is to get knowledge into practice using a technological tool as one element of the implementation. Finally, another study used a multilevel framework predicting implementation outcomes with preferences of users of the electronic medical records and quantifying the importance of barriers and facilitators of innovation. This study revealed different users have different needs during the implementation of the electronic health record (EHR) innovation.[21]

TECHNOLOGY ADOPTION MODEL AND IMPLEMENTATION SCIENCE COMMONALITIES AND DIFFERENCES

Technology adoption models and IS models share the level of analysis at the individual level with innovation adoption. See Table 1 for commonalities and differences across IS and TAM models. The major difference between the models is that IS models focus on strategies for implementation, whereas TAM models focus on the individual user's perceptions. Implementation science models focus on analysis at the organizational level, a practice environment that is limited to health systems, consideration of external influences (ie, regulations), and implementation strategies that are provided. Many of these models simply describe the process of implementation. Technology adoption models focus on the individual user's perception of usefulness, ease of use, and actual use. Newer technology frameworks and models have been extended to include demographics of the user, social influence, context, attributes of the innovation, and facilitating conditions.

INTEGRATED TECHNOLOGY IMPLEMENTATION MODEL

The purpose of the newly developed ITIM (Figure 1) is to highlight elements that affect the process of incorporating technology into practice. The key construct of the ITIM is healthcare technology implementation and adoption. The ITIM model addresses the key concepts associated with the technology implementation and adoption.

Theoretical factors were derived from the systematic reviews of the TAM literature. These studies found TAMs focus on the individual's behavior with the intention to use the technology.[5–9,14,22–30] Key findings of these reviews

Table 1

Commonalities and Differences Across IS and TAM Models

Comparison	IS Model	TAM
Level of analysis	Organization	Individual
Dependent variable	Adoption of EBP	Adoption of technology
Implementation interventions	Yes	No
Context	Healthcare	Information technology and other technologies
Assess for barriers	Yes	No
Patient experience	Yes	No
External factors considered	Yes	No

included the user's perception of using the technology, technology's relative advantage, compatibility, complexity, and trialability. Other key factors include age, gender, and user profession, whereas IS factors were found with synthesis of existing implementation theories from the literature and systematic reviews.[13,18,31–38] Key findings included the innovation, context, planned change, social system, users, and communication, which all affect a successful implementation.

The benefits of the new comprehensive model are directed at designing strategies for a successful implementation with focus on the innovation, methods, interventions, and variables. The combined model focuses on the interdependencies of the two sciences, with each emphasizing end users adopting the technology. An example of the interdependencies is that if comprehensive training is not provided (IS element), the user may find that the technology is not easy to use. Given that most technology innovation decisions to solve a problem are made at the organization level, this model focuses on both the organization and the individual adopting the technology innovation. The technology acceptance and IS models guided the development of the ITIM. This new model is informed by (1) Unifying Model of Innovations and (2) concepts from DOI, TRIP, and PARiHS models.

The new ITIM has two major environments, an inner and an outer context, that organize its concepts.[18] The inner context is defined as the organizational structures (eg, decision making, rules and procedures, and technical knowledge), the culture, and the ways of working within the organization that lead to adoption of the technology. The outer context is defined as factors external to the organization that influence, in part, the organization's adoption of a technology. Examples of these factors include accreditation and regulatory standards, economic environmental variables such as uncertainty, the vendor, and a facilitator role. These elements of the model, the inner and outer contexts, are used to organize the major concepts that affect an organization when implementing technology.

The ITIM (Figure 1) is composed of 12 concepts that are central to the process of technology adoption, which have been extracted from IS and technology models: (1) adoption, (2) implementation, (3) nature of the innovation/technology, (4) interfacing systems, (5) workflow, (6) users (adopters), (7) leadership, (8) communication, (9) accreditation/regulation, (10) economic environment, (11) facilitators (boundary spanner), and (12) vendor. Table 2 provides a narrative description of each of these elements.

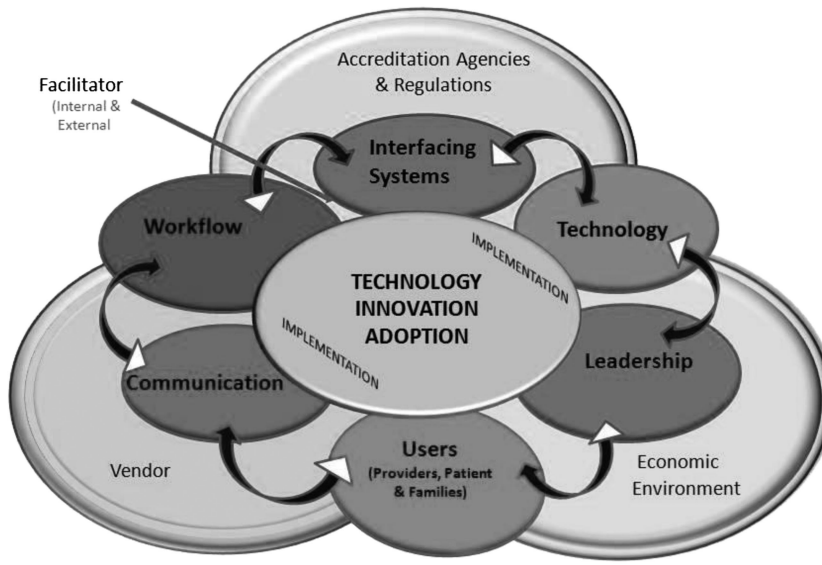

FIGURE 1. Integrated technology implementation model (ITIM).

Table 2

Integrated Technology Implementation Model

Concepts	Definition
Inner context	Organizational context that influences the adoption, spread, and sustainability of the technology innovation through active implementation strategies
Adoption (D)	When a user is introduced to a new technology and begins to use it routinely and fully when delivering patient care
Implementation	The path to identify specifications, creations, and installation of technology; organizational readiness; and active implementation strategies, including users' attitudes, are changed, skills are built, and policies/procedures for each of the components are defined and executed
Nature of the innovation/ technology	Technology innovation is a device that is used when delivering patient care and usually has two components: software—provides information; knowledge, hardware—tool that embodies the technology as material or physical object. Characteristics include the relative advantage, complexity, compatibility with norms, values, perceived need, trialability
Interfacing systems	Supplementary technology that interfaces or communicates with the new primary technology (innovation)
Workflow	The systematic steps of accomplishing a patient care task (when using a technical process or device) to achieve a desired outcome
Users (adopters)	Individuals who are in a social system (ie, LTC) that the technology is targeted to be used by for delivering care; may include RNs, LPNs, aides, physicians, pharmacists, administrators, directors of nursing, clerks, and patients. Characteristics include users' education preparation, profession, context of the work environment, experience with using technology
Leadership	Roles, specific responsibilities, and required activities (executives, managers, consultants) that promote technology adoption
Communication	Is the process of sharing information with a targeted social system using a variety of strategies that include interactive education programs, written communication, communication roles and networks, and audit and feedback
Outer context	The processes and factors external to the organization that have a synergetic relationship to the internal factors affecting a successful technology implementation. These include accreditation standards, the economic environment, regulatory requirements, vendor, technical environment changes
Accreditation/regulation	An official agency (external force) that identifies criteria to meet established standards that influence the adoption of the technology
Economic environment	The extraorganizational economic determinants that affect the organizations innovativeness such as the changing economic and political environment, government sponsor program, business competition, etc
Facilitators (boundary spanner)	A person who assists, directly or indirectly, by providing guidance to the implementation of technology. This person can be internal or external to the organization
Vendor	Any person or company that represents, sells and services the technology, which may/or may not be the innovator. Commitment of the vendor to assist and support the facility operations (quality, knowledge, resources, costs), experience with implementing the technology, etc

Abbreviations: D, dependent variable; LTC, long-term care.

The newly defined model examines individual and organizational elements that address the multifaceted active implementation strategies needed to promote technology adoption. From IS, the ITIM was informed by the concepts of communication, leadership, facilitators, users (adopters), accreditation and regulatory groups, and economic environment. Technology adoption models informed the new model as well, with the concepts of adoption, workflow, vendor, systems, and nature of the innovation.

Diffusion of Innovation informed the new model by defining the technology innovation as a device that is used "for instrumental action that reduces uncertainty in cause-effect relationships involved in achieving a desired outcome."[8(p13)] The device usually has both a hardware and software component.

Dependent Variable: Technology Innovation Adoption

Technology adoption is the dependent variable of the new ITIM. Technology adoption is defined as when a user is introduced to a new technology and begins to use it routinely and fully.

Inner Context

Once the organization has identified a need to change, and the appropriate technology has been identified, it must

scrutinize system factors and active implementation strategies to address the patient care delivery needs. This will ensure that systematic steps are taken so that the human-to-technology interactions achieve efficiencies for the nurse and safe outcomes for patients. Here, the inner context comes into play.

The inner context is defined as the processes and factors internal to an organization that must be addressed for a successful technology implementation. The inner context is further described as an organizational context (healthcare services facilities) that influences the adoption, spread, and sustainability of the technology innovation through active implementation strategies. The ITIM's inner context concepts include system factors such as other processes or technology that affect the technology innovation (ie, interfaces and policy changes), leadership types and activities, users of the technology, communication processes utilized to influence adoption, and workflow assessment.

Nature of the technology/innovation. Technology in the ITIM is defined as a new technological-based solution for use in accomplishing a specific task or care process to achieve defined outcomes. This definition is aligned with Rogers's[8] definition of innovation as a practice or object new to individual or groups. The technology has a software component that provides information and knowledge to the user. In addition, technology has a hardware component that embodies the technology as a material or physical object, such as a server that runs the software, a mouse, keyboard, and wires. Next, the solution involves the actual physical location of the equipment. For example, the function of charging of supplies in an EHR is inhibited if there is not a workstation in the supply room. Attention must focus on the amount of equipment that is available and located at a convenient location to facilitate the use. Another consideration is ergonomics, which is the interaction between the user and the computer system. The computer locations need to be at a comfortable level to prevent physical stress such as shoulders cramping when charting using a kiosk workstation positioned too high. The characteristics of the technology innovation include the user's perceptions regarding its relative advantage, complexity, compatibility with norms, values, and need for the innovation. The relative advantage of the technology is perceived as better than the previous process used for completing the care requirement. Compatibility with norms is the perceived alignment of the technology with existing organizational and individual values, past experiences, and actual need. Complexity of technology is the simplicity or degree of understanding and number of actual steps in using the technology in care delivery.

Interfacing systems. It is important to have the primary technology solution (EHR) interface with existing and future systems to achieve higher levels of care coordination between providers and other facilities in reaching the national goals of improved care. In the ITIM, the new primary technology solution functions independently but also interfaces to communicate with other systems outside the organization. With this new model, interfacing systems have been identified as a separate concept as many healthcare facilities such as long-term-care need to interface to contracted services such as pharmacy systems. These interfaces require a significant amount of coordination between the organization, multiple vendors, and other facilities such as hospitals. These secondary systems bring together the primary system and information systems located outside the organization that is critical for patient care. These components may include other technology software or devices. For example, telemedicine cardiac monitor technology not only functions on its own but also interfaces with a phone for notification to the nurse that an abnormal rhythm has occurred.

Workflow. The third concept in the ITIM, workflow, is defined as the systematic steps in accomplishing a patient care task to achieve a desired outcome.[39] This clinical sequence of care delivery focuses on the patient's condition, patient care plan, interventions performed, and the patient's response to these interventions.[40] This workflow analysis is needed to understand this sequence and how it will be affected by using the new technology. The analysis should include identifying critical elements, potential barriers to workflow, and any improvements based on use of the technology.

During planning and implementation, understanding the workflow of clinicians or others affected by the technology provides a baseline for workflow processes critical to safe patient care delivery and the relationship to a new technology. Organizations that evaluate workflow design are more likely to be successful in adoption of technology.[41] This will also help ensure an end result where fewer patient care errors are made by staff. A goal of this analysis is to minimize disruption to patient care during and after the technology implementation.

Users. The ITIM's fourth concept, users, is informed by DOI and is defined as members of a social system who adopt an innovation. There are specific user characteristics that have been found to influence adoption. These include greater intelligence, increased social participation, greater ability to cope with change, higher education, and greater knowledge of innovations.[8] Building on these notions, the ITIM defines users as individuals in a social system (healthcare services facility) where technology is targeted for use for delivery of care by RNs, LPNs, aides, physicians, pharmacists, administrators, directors of nursing, and patients. Specific characteristics of users are education preparation, context of the work environment, and experience with working with technology.

Leadership. The IS literature describes the concept of leadership as creating an environment that embraces innovation and establishes organizational strategies, structures, and systems that facilitate an innovation.[18] Building on this IS description, ITIM defines leadership as the roles, responsibilities, and required activities of leaders. Leaders important to technology adoption are executives, nursing directors, and frontline managers. Activities of leaders are setting forth

organizational vision, goals and strategic plans, policy development, performance expectations, and communication strategies. Technology implementation in healthcare facilities will require many months of planning for the change, where leaders must formally share their plans for purchasing and deploying the technology. Leaders must also effectively communicate all aspects of the change including the positive impact of technology on patient care so that employees are well informed and feel supported through the implementation process.

Communication. The ITIM defines communication as the process of sharing information in a targeted social system using a variety of strategies that include interactive education programs, written communication, communication roles, networks, audit, and feedback that affect adoption.[8,18,42] This communication is targeted at the reasons an organization is going to use the technology, outlining workflow changes, addressing how other interfacing systems will be affected, and defining changes in users' roles and responsibilities.

Strategies include using didactic and disseminated approaches through e-mails, newsletters, and announcements to stakeholders about the innovation during the knowledge stage. During the decision making and persuasion stages, the healthcare provider actually uses the innovative technology.[8,13] The communication process occurs within a targeted social system of interrelated individuals who are involved with joint problem solving using patient care technology.[8]

Rycroft-Malone and Bucknall[43] indicated strategies for communication roles. The roles include social networks that provide support and communication (RN unit staff), change champions who continue to support the use of the innovation, opinion leaders from the local setting who are respected and influence their peers, and boundary spanners who have social ties within and external to the organization who can filter and link knowledge about the innovation during the early stages of implementation.

Another important communication strategy is to utilize audit and feedback, which provides users with information regarding their current performance and areas for improvement. Hysong[44] found that using a combination of strategies, such as providing specific suggestions, placing these in writing, and providing feedback frequently, has a positive effect on quality outcomes. Using graphs and providing verbal feedback, however, had less of an effect with change.

Outer Context

Once the organization has identified a need to change, a technology has been identified, and the inner context concepts have been addressed, the organizations must also address external system factors. Here, the ITIM's outer context comes into play. The ITIM describes the outer context as the processes and factors external to the organization that possess a synergetic relationship with the internal factors, thereby affecting a successful technology implementation.[18] These factors include accreditation and regulation agencies, accreditation standards, the economic environment, a facilitator, and vendors that are further described in the following sections.

Accreditation/regulations. The ITIM incorporates accreditation and regulatory requirements from external official agencies such as Centers for Medicare & Medicaid Services (CMS). The agency identifies or mandates criteria to meet established care standards, which influences the selection of technology. For example, CMS[45] has identified standards with physical restraints to prevent harmful effects to the patient. These regulations influence the selection of technology to meet the standard that physical or chemical restraints are not used for staff convenience, and patients have a right to move around in these facilities.

Economic environment. The ITIM defines the economic environment as external factors that influence the ability of the organization to purchase and use technology. These factors include government incentives for procurement of technology such as the EHR, interest rates, public policies, and legislation such as Patient Protection and the Affordable Care Act.

Facilitator. Another important concept within the ITIM is the facilitator role, which guides the implementation. Integrated technology implementation model builds on the IS literature, which defines facilitation as the process of making implementation simpler. This may involve individuals guiding the change, environmental or political factors, or a leadership philosophy of commitment to change and endorsement of the innovation for the organization.[46–48]

A facilitator is the person whose specific role is to assist the team and individuals in implementing the innovation.[37,49,50] The facilitators may be internal or external to the organization.[18,31] Large organizations have the ability to have employees serve this function, whereas smaller facilities such as physician offices or long-term-care facilities require vendors to serve in this role. The role of the facilitator can be fulfilled by many different individuals such as super users, vendor employees, and hired consultants. Other facilitators are information technology departments initially serving in the facilitator role with ongoing responsibilities of technology support. As well, informatics nurses initially serve as facilitators because they understand the complexities of healthcare practices and are able to assist with the implementation of technology innovations while promoting the continuum of care and safety. Many large organizations hire nursing informatics staff to be part of their leadership team while providing ongoing translation of patient and staff needs into technology systems, whereas smaller organizations will hire this role only for the implementation. Facilitators possess skills and knowledge that can effectively assist users in applying the innovation to their routine practice. These include excellent communication skills to market the innovation, project management expertise, technical skills, practical skills that lend clinical credibility to users, and the ability to be flexible to meet the needs of the facility.[51,52]

The ITIM defines a facilitator as a person who, either directly or indirectly, assists by providing guidance in the implementation of technology. Facilitators contribute structure and process to the interactions of groups so that they can function effectively and make quality decisions.[53] These decisions may be related to the economic resources, training requirements, and conflict resolution. Facilitators can provide information and influence decisions within the facility and can represent the facility in the external environment such as with the vendor.[18,31,53] Greenhalgh et al[18] describe boundary spanning as linking the facility to the external healthcare environment. The new model represents the facilitator, with linkages of the internal and external context, as boundary spanners to facilitate implementation. This role is critical to a successful implementation.

Vendors. Vendors are the final concept in the ITIM and have a significant impact on acceptance and implementation. Business and marketing science define a stable vendor as a reputable organization with a sound financial position. They have the ability to provide a product and service at a reasonable price, openly communicate with the customer (healthcare facility), and service their product after implementation.[54] Vendors provide facilitation of the implementation process. Many complex technology solutions and the implementation depend on the cooperation among multiple vendors. For example, in long-term care, the pharmacy software vendor will need to work with the EHR vendor to ensure interoperability. This work is done outside the context of the long-term-care healthcare agency. The ITIM defines the vendor as the entity that makes and sells the technology. They may or may not be the innovator. The vendor role includes supporting the functionality between and among products, devices, and accessories.[55]

Attributes of vendors that promote implementation include (1) technical expertise (certifications and experience) to assist with problem solving, (2) ability to communicate with technical staff in the organization on current systems and make recommendations for upgrades, (3) ability to provide a detailed explanation of the current systems and make recommendations for upgrades, (4) ability to be creative in identifying solutions to reach patient care need goals, (5) ability to complete the work within the technology budget, (6) knowledge of new and relevant technology and able to make recommendations to be considered for the future, (7) share the urgency of restoring facility operations when the technology is malfunctioning, (8) ability to troubleshoot problems and provide correct solutions, and (9) cooperation among the vendors for the solution to ensure the technologies support all critical functions.

SUMMARY

Beyond the technology intervention design, studies are needed to examine adoption interventions that promote use of technology in healthcare. The ITIM herein provides a conceptual guide for selecting interventions to test in healthcare technology adoption research studies. Studies should address inner and outer organizational contexts that are central to the process of implementation: (1) the nature of the technology, (2) interfacing systems, (3) workflow, (4) users, (5) leadership, (6) communication, (7) accreditation and regulation, (8) economic environment, (9) facilitators (boundary spanners), and (10) and the vendor community. Using the new ITIM to guide research on technology adoption in healthcare makes a significant contribution to explicating factors that impact technology implementation and use in a variety of healthcare settings. This empirical understanding is essential to maximize technology applications to improve processes and outcomes of care delivery. At present, the new ITIM is being tested in a variety of healthcare settings to support its use in research.

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