Automation of Medical Records using Blockchain Technology (BCT)

Preserving and protecting data through the automation of medical records is a major aim of BCT as evidenced by the stages of change theories during the knowledge, persuasion, decision, modification, and confirmation processes of diffusion of innovation theory (DIT). BCT-based electronic health record (EHR) methods can address the potential inequality of healthcare resources, the carbon footprint of computational needs, and potential distrust of health providers and patients that may ensue with wider use of BCT. The use of change theories—planned change and DIT—is helpful in providing clarity around the automation of medical records/electronic health records (EHRs) using BCT. The various stages of change theories play an integral role in explaining how BCT is used in the automation of medical records.

Change management supports the application of information technology (IT) in BCT's role in the automation of medical records to enable healthcare organizations to streamline processes while providing quality, patient-driven care. Determining how BCT provides for the safe and secure sharing of health information through automation, the theory that aligns with BCT and medical record automation in the developmental stages of innovation and design, the benefits of BCT in healthcare, how to garner public trust in the development and implementation of BCT in medical record automation, the barriers of implementing BCT in healthcare, and how future research inform the next steps in the planning and design for the automation of medical records are key components to understanding how change management can be an integral force in the current and future state of BCT. Even when an innovation shows promise, there are layers to the processes of implementation and application. The promise of BCT was shown in the knowledge-producing stage, but the knowledge was not sufficient in healthcare. Therefore, even though BCT was not a new innovation, there simply was not enough information for the public to make an informed decision.

BCT allows for the automation of EHRs to create, manage, and distribute health information electronically. It reinvents the manner that patient's EHRs are shared and stored by providing safer mechanisms for health information exchange (HIE) of medical data in healthcare. Further, BCT ledger technology allows healthcare scientists and researchers to discover genetic codes by facilitating the safe and secure transfer of EHRs and managing pharmaceutical chains. HIE can become redundant and an inefficient use of time leading to an increase in costs that can be reduced by BCT, which can support healthcare culture globally through the unified workflow process.

The Stages of DIT in BCT

DIT is a conceptual and empirical framework established in 2003 by Rogers that employs five stages (knowledge, persuasion, decision, implementation, and confirmation) of development for adopting innovation like BCT for medical records automation (Rupino da Cunha, 2021) and other processes. Rogers (2003) asserted that technology consists of hardware and software created together to solve a problem derived from a cause-and-effect relationship (p. 13). Change theory allows users to be a part of the process of change and adoption, and the model outlines factors that can positively influence a patient's perspective about an innovation, including its relative advantages or disadvantages and its compatibility with their current beliefs and practices. Change management focuses on the individual and can aid in building trust in the system which is relevant and necessary in implementing BCT in any industry, especially healthcare. According to Rogers (2003), diffusion occurs through the innovation itself, communicating the innovation through channels, and it happens over time through a social system (p. 11). BCT 1.0 through BCT 4.0 shows how each of the stages of change theory applied to each level of progression.

Knowledge

The knowledge phase of the innovation-design model applies to each stage of the BCT evolution. It involves the introduction of a product, service, or program to an audience for the first time (awareness knowledge). They learn the ins and outs of how the product works, why it is important, and why a customer may want to use it (how-to knowledge). Adopting the innovation would require enough how-to knowledge to be persuaded to use it (Frei-Landau et al., 2022). (BCT began in 2008 with Distributed Ledger Technology (DLT) that focused on the financial industry. DLT enabled the public to avoid double spending in cryptocurrency by because of its capacity to decentralize. According to Elangovan et al. (2022), BCT provided a system that was not prone to hacking because it offered a decentralized system, which nearly eliminates data breaches and problems with data validity (p. 2).

Persuasion

Users began to decide if BCT was suited for the healthcare industry. Because the BCT in automating medical records was decentralized, it was integral in persuading the healthcare industry to use it. It utilized a public ledger from every patient encounter, and the information was made available to the patient and the car providers, which allowed for much more transparency and public trust in the technology (Elangovan et al., 2022). Much like with bitcoin, once the knowledge of BCT was introduced, this stage of the DIT is heavily focused on emotion, where the learner may have been influenced by several factors, including social encouragement and peers (Frei-Landau et al., 2022).

The persuasion stage led to stage 3 in the BCT evolution because not enough trust was gained for Bitcoin to manifest the longevity at first believed.

Decision

The number of opportunities for a learner to try out an innovation greatly determines whether they will adopt it. Factors influencing the decision include personal desire, peer pressures, or pressures from someone in a position of authority (Frei-Landau et al., 2022). The decision stage is where the product or new innovation is adopted. Potential benefits are weighed against the risks. BCT progressed from cryptocurrency to healthcare and AI due to the level of interest shown in the knowledge and persuasion stages. BCT application in managing EHRs allows patients to exercise more control over their data and in their healthcare. Like BCT, the innovation-decision model shows progression with the advent of EMRs and EHRs which allowed for scalability, interoperability, and trust. Immutability, reliability, security, privacy, and smart contracts are some of the characteristics of BCT in the automation of medical records. Immutability is important because it protects patient's health information from manipulation because certain information cannot be edited or deleted.

Implementation

Feedback, assistance, support, and reinvention are necessary at this stage of DIT. The innovation is typically redesigned at this stage, adjusting to the needs of the innovation requirements. The implementation is when attitudes and behaviors about an innovation begin to shift. Users and organizations begin to use the products with the understanding that further enhancements may need to be instituted. BCT was implemented into healthcare through the use of EHRs and electronic medical records. According to Saeed (2022), BCT emerged within healthcare more than a decade ago when advanced interventions were implemented to manage, store, distribute, and process clinical data. BCT provided mechanisms to secure and safely share patient health information within compromising privacy through the automation of medical records and the development of EHRs.

Confirmation

BCT is not yet complete, especially in healthcare, nor will it ever be since healthcare is constantly evolving. However, information security is the most important component in BCT in health delivery. Part of keeping the data and information secure is data integrity, which dictates the information collected and stored must be accurate and consistent. The confirmation stage allows individuals and organizations to evaluate their decision (stage 3) in determining adoption of the innovation (stage 4). The aforementioned stages culminate in the confirmation stage where users begin to share feedback about the new innovation. This model allows for the creation and strategic

decisions to encourage adoption (stage 2) of their design. Rogers (2003) posits that an invention need not be a novel concept to be perceived as an innovation because if individuals have heard of an invention but either rejected it or was neutral on the idea, then it is new to them (p. 12).

BCT Stages 1.0 – 4.0: Integration of Medical Record Automation

Decentralization was a key component that allowed for the digitization of peer-to-peer currency (Bitcoin) that eliminated the need for financial institutions as a central authority or agency in the process. There were some trust issues with using Bitcoin, and to mitigate those issues, tools like consensus models with implemented to uphold the highest integrity and authenticity of the product (Mukherjee & Pradhan, 2021).

BCT 2.0

Mukherjee, P., & Pradhan (2021) posits that due to the limitations of BCT 1.0, including its restricted ability for data mining and scalability, further enhancements and additions were necessary. Therefore, BCT 2.0 incorporated crowdsourcing through smart contracts since caveats had been instituted to resolve some of the trust issues. According to Taherhoost (2023), smart contracts are decentralized digital scripts on the BCT framework that allow for programming predetermined transactions like unrealized assets. This process provided the necessary framework for introducing the automation of medical records.

BCT 3.0

Healthcare became a major priority in the third stage with the incorporation of data immutability and decentralization applications that allowed for a network of computers to be used instead of a singular centralized authority. Decentralization is tantamount in healthcare because this capability does not allow for the modification of medical records once they have been created and stored. Sharding, whereby each node in the blockchain houses a portion of data instead of all pertinent information, was introduced in BCT 3.0. This was integral for healthcare because it meant that some data elements were immutable or could not be modified. For instance, prescriptions, test procedures, and test results should never be altered. Instead, these documents can be appended or archived for future reference instead of modified or deleted. This version of BCT was much faster than previous versions and included interoperability, scalability, privacy, and sustainability (Mukherjee, P., & Pradhan, 2021). Because this version was highly decentralized, there were issues that necessitated the need for a fourth version of BCT.

BCT 4.0

BCT 4.0 is an amalgamation of several business platforms under one umbrella to allow for seamless integration to fulfill business and industry needs (Mukherjee, P., & Pradhan, 2021).

Artificial Intelligence (AI) was also a major focus of this version of BCT that allows for even faster processing of transactions and data throughput. Saeed et al. (2022) reviewed nearly 1,200 studies in BCT and its correlation to the automation of medical records, and of those studies, fifty-one articles were selected for a systematic review to determine how BCT addresses critical dilemmas related to health diagnostics, enhancing the patient healthcare process in remote monitoring or emergencies, data integrity, and fraud prevention. The evidence presented provided clarity around the evolution of BCT's development by sharing the stages of implementation to build out the technology. As an information technology resource, the features of BCT, i.e., immutability, automation, and transparency, Medina et al. (2024) provided framework that formulates the change theory decision tree based on the five stages that document the innovation decision process—knowledge, persuasion, decision, implementation, and confirmation.

Benefit(s) of BCT Healthcare Delivery

There are many benefits of incorporating BCT in the automation of medical records, as supported by Haleem et al. (2021) who provided critical analysis regarding BCT and its benefits to the ever-changing landscape of healthcare, including accessibility to health information and appropriateness of care. Because healthcare is becoming more patient-centric, BCT can reduce inefficiencies in EHR automation by eliminating privacy concerns by organizing the data in blockchains (Han et al., 2022). This shows progression and evolution, which is necessary to educate users on BCT design and the importance in the automation of EHRs (Rupino da Cunha, 2021).

BCT decentralizes data stored in blocks throughout the network as opposed to being stored in a central location (Han et al., 2022). BCT can be used for data aggregation for research since patients are often unwilling to participate in data sharing across organizations due to the current lack of appropriate data sharing mechanisms and distributed coordination efforts such as signing and sending consent forms to different entities (Schmeelk et al., 2022). Because of BCT's capability of securing health information over a decentralized peer-to-peer network, this DLT can aid in supporting and understanding of its use in the healthcare domain (Mayer et al., 2020). These findings have significant implications for healthcare because BCT can strengthen and secure data sharing and the storage of digitized health information, while ensuring the confidentiality, privacy, and integrity of medical records through automation (Reegu et al., 2023). Not only does BCT allow for data sharing and access to health records, it also allows for stakeholders to share access to their various networks.

The Role of Public Trust in BCT Medical Record Automation

Maintaining trust while satisfying an increasing demand for exchange of data within the

healthcare domain are crucial components to achieving new and improved solutions to build and preserve trust. BCT-based solutions to mitigate trust have been explored in a few EHR, personal health record (PHR) and clinical trial system use cases to improve processes and services within the health domain (Hasselgren et al., 2022). Medina et al. (2024) asserts negative aspects of BCT adoption, in general, are related to long-term oriented trust and have been identified as both a driver and a hurdle. Without the public's trust in using this technology, which was initially associated with the failed successes of bitcoin, increased uses of EHRs are not possible. Health literacy is necessary to inform and educate the healthcare community in the safety and security of using IT for EHR and medical record automation.

Studies show BCT provides safer methods to interchange health information in various healthcare settings and allows for immutability, security, and user control on stored records without the need for centralized storage. BCT can assist in health delivery by ensuring the confidentiality, privacy, and integrity of medical records through automation. To build public trust in BCT, Ghosh et al. (2023) presented three different types of BCTs—private, public, and consortium—so the public, particularly the healthcare sector, can see the differences in blockchains that allow for low, medium, and the highest security levels to protect and maintain data integrity.

Private BCT

Only authorized users within an organization can access the private BCT network. Private BCT is optimal in healthcare because anyone who accesses the network creates a pathway that can be tracked. According to Moonsavi and Taherdoost (2023), private BCTs make up 38% of users (p. 67). Blockchain category types are selected by user or organization requirements and needs, which is why healthcare organizations opt for private security.

Public BCT

Public blockchains do not require permission. This means that every user who desires to access the network can do so without restriction. Public BCTs encompass 35% of users (Moonsavi & Taherdoost, 2023, p. 67). The process of using public BCT is much slower than private or consortium. Consensus modeling data is transmitted from across networks in the private and public categories, which means enhanced security and accountability protocols ensure interface independence (Ghosh et al., 2023, p. 3).

Consortium BCT

Consortiums consist of both private and public BCT with multiple organizations accessing the network. Consortiums make up 27% of users (Moonsavi & Taherdoost, 2023, p. 67). Consortium

BCTs do maintain some decentralization, but it is more limited than with private blockchains and more secure than public blockchains.

BCT may ultimately provide a platform for connecting different healthcare systems for improved patient care (Schmeelk et al., 2022). The analyses of current literature reviews highlight additional research that is being conducted on BCT in healthcare for the development of concepts that can assist academicians in achieving multi-domain efficiencies and application feasibility that supports several stages in the innovation design model or change theory methods. Much of the research systematically synthesized where BCT has been utilized (or proposed to be utilized) to improve processes and services within the health domain. In addition to examining existing evidence, an overview of what has been done, what is known, and the potential direction of BCT shows gaps in the BCT EHR framework that elucidate quality and scientific research focused on an interoperable infrastructure that would meet national and international standards.

Additional challenges and multiple barriers persist with data management efficiency, fairness of access, and trust in the BCT system. Sharding can reduce some of the issues with latency and power computations. BCT may continue to provide a platform for connecting different healthcare systems for improved patient care. However, future research must be conducted to inform the next steps in the planning and the design for the automation of medical records with BCT that can allay concerns and fear within the public to mitigate trust issues that still exist.

If you'd like to hear more about this topic, let me know. Send me a note at services@fluiditywriting.com.