A Conceptual Framework to Investigate Health Professionals' Blockchain Technology Adoption Readiness in Malaysia

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Abstract

Malaysia's healthcare industry has historically been slow to embrace health information technology. By enhancing the efficiency of electronic health records, blockchain technology can help eliminate medical errors and data breaches while also facilitating the exchange of health information. Before deploying blockchain, building a conceptual framework for assessing health professionals' readiness as the primary user can aid policymakers in planning technology and strategy development. In comparison to the number of studies on the acceptability of health technology, there is a shortage of research on the adoption of blockchain technology. A readiness assessment framework is currently absent from the blackchin-based health information technology literature. The current study explores the factors influencing health professionals' willingness to embrace blockchain technology in Malaysian public hospitals to overcome this gap. Additionally, this study develops a conceptual model that combines the Unified Theory of Acceptance and Use of Technology (UTAUT), the Norm Activation Model (NAM), and initial mediator trust. The suggested conceptual framework will be practically evaluated and validated in the future.

Keywords: *Blockchain technology, Electronic Health Records, Health Information Technology, Malaysia, Technology adoption*

1. Introduction

The use of blockchain technology (BcT) as the underlying mechanism for Electronic Health Records (EHR) is a viable solution to overcome the limitation and issues of existing EHRs in Malaysia like medical error, health data breaches. Additionally, there is a lag in horizontal innovation regarding patient identification and information blockage, which can be aided by using BcT as an underlying mechanism of EHR [1]. However, low Health Information Technology (HIT) adoption is a concerning issue that will likely hinder any technology adoption in the country, such as BcT. Despite Malaysia's aspiration to be a developed nation with a single health information system, adopting technologies in healthcare has been low. While comparing the progress with developing even other developed counties that began HIT initiatives like Malaysia, the rate shows that Malaysia is visibly lagging in technology adoption. EHR coverage in developed countries is 60%, and above, high-income developing countries Botswana and China have EHR coverage

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of 60% and 50%, respectively [2]. However, although EHR has a significant impact on improving quality of care and quality of life, the healthcare industry of developing countries is suffering due to the lack of EHR adoption. Malaysia is one of them. Figure 1 demonstrates that Malaysia has the lowest EHR coverage among the countries on the chart. In the case of Malaysia, the low adoption is concerning because the government is actively involved in digitalizing countries' healthcare sector. Malaysia has only about 25% EHR coverage in the country, which raises concern over the adoption of BcT.

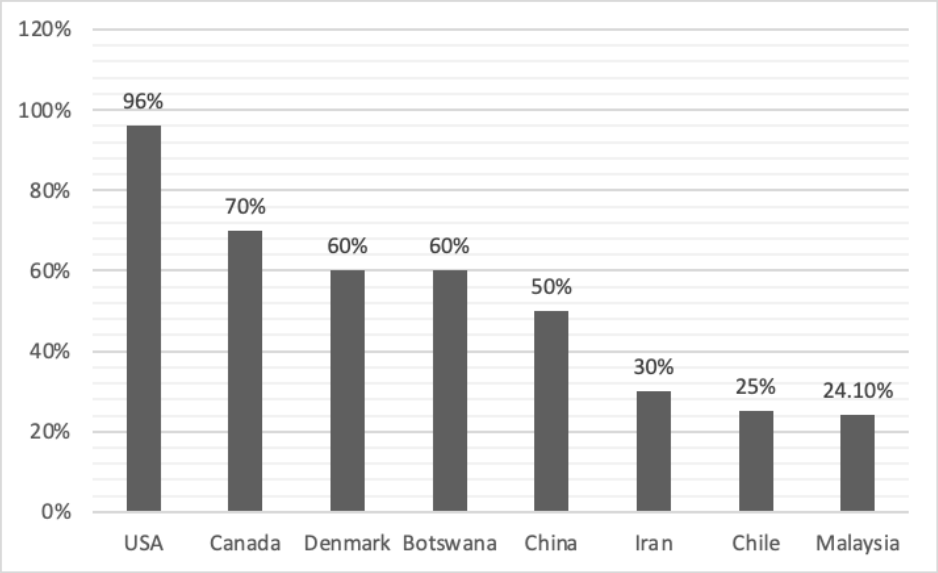

Figure 1. EHR coverage in developing and developed countries

One of the main reasons behind this is the lack of health professionals' readiness to adopt HIT. HIT projects involve a high risk of failure. Worldwide, half of the HIT (EMR) projects failed before achieving the targeted rate [2]. Even if it survives, the progress remains below expectation. In both cases, the goal of the project remains unaccomplished. Therefore, the reason behind HIT failure and slow adoption has been studied before. Therefore, assessing health professionals' readiness in the pre-implementation phase is recommended for swift technology adoption and diffusion. Although there is no formula to guarantee the success of the HIT initiatives, knowing the issues that can influence the uptake of HIT can increase the possibility of success and reduce the risk of failure [3]. Therefore, before the system implementation, users' readiness assessment must identify influential factors to overcome the BcT adoption barrier; furthermore, the lower the barrier, the better the speedy technology innovation diffusion. Therefore, HIT diffusion is the policymakers' prime priority [4]. The BcT is still in its infancy and is relatively unfamiliar to health professionals.

Consequently, before introducing the BcT to the Malaysian healthcare industry, it is critical to understand the factors contributing to BcT adoption from the health professional's perception. Furthermore, there is a clear gap between qualitative novel architecture-based system development studies to BcT adoption studies [5];

thus, a BcT adoption framework is unavailable. Therefore, this study intends to unearth the most influential factors of BcT enabled EHR adoption among health professionals in Malaysian public hospitals. Besides, the study aims to propose a BcT adoption framework that can be validated in the future.

The most crucial aspect for successful HIT adoption is the socio-technical factors, not the technical ones [6]. Because the end-users are concerned about self-interest, they look for the benefit of using the technology to make their day-to-day work more convenient. The better fit between technology with the user from the users' perspective is the greater chance of evolving for the HIT to be implemented successfully. Thus, the lack of understanding of individuals' (users') requirements will lead the HIT initiative towards failure. Therefore, to mitigate the risk of failure or slow implementation, it is necessary to understand the health professionals' intention to adopt BcT for EHR as part of their day-to-day work because they are the primary users of any HIT. Researchers further emphasize developing a socio-technical framework to understand users' technology adoption intention [6], [7]. However, the literature lacks a framework regarding the health professional's adoption of BcT for EHR to the author's best knowledge.

2. Literature Review

2.1. Theoretical Underpinning

Based on the literature review of relevant theories, the Unified Theory of Acceptance and Use of Technology (UTAUT) and norm activation model (NAM) has been chosen to support the proposed BcT adoption framework.

2.1.1. UTAUT: Figure 2 shoed the Unified Theory of Acceptance and Use of Technology (UTAUT), a well-known and widely used theory to assess individual-level technology adoption, thus appropriate for this study. This study eliminates the moderators (age, gender, experience, voluntariness of use).

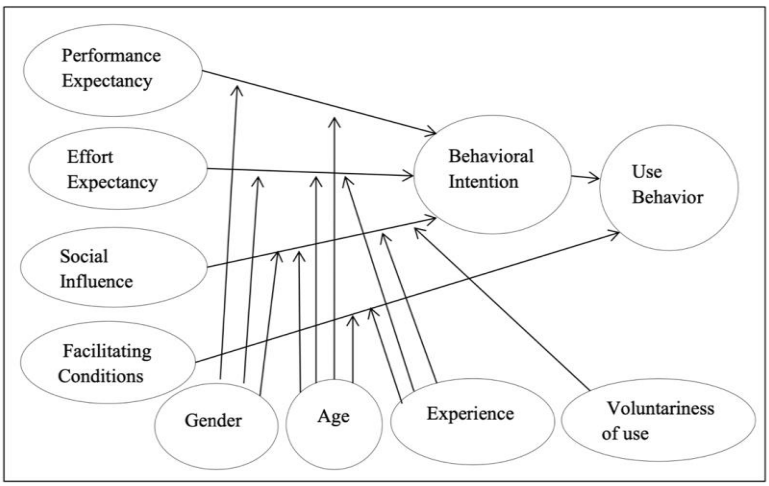

Figure 2. The UTAUT Model

2.1.2. NAM: The norm activation model (NAM), as in Figure 3, is mainly used to explain pro-environmental behavior. However, pro-environmental behavior is pro-social behavior since health professionals serve the community beyond duty, thus likely to behave pro-socially.

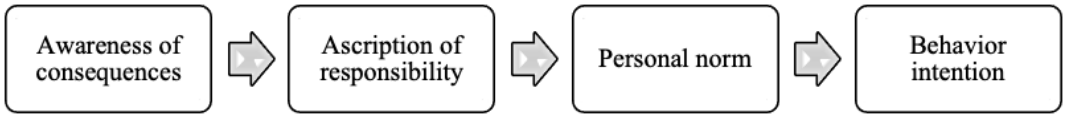

Figure 3. The NAM Model

2.2. Hypothesis Development

This study develops a hypothesis and conceptual model considering the UTAUT, NAM, and initial trust. The hypothesis and proposed model are presented below in the forthcoming sections.

2.2.1. Performance Expectancy: Performance Expectancy (PE) means the extent to which technological usage gives users efficiency in carrying out activities [8]. In this study, PE refers to the extent to which BcT is useful in performing healthcare professionals' tasks and service delivery at the workplace. Thus, PE denotes the degree to which medical professionals think technology can improve their healthcare service delivery efficiency. Therefore, PE is hypothesized to positively influence the user's behavioral intention towards accepting the BcT technology. Based on the discussion, the below hypothesis is formulated.

H1 Performance expectancy positively impacts the adaption intention.

2.2.2. Effort Expectancy: Effort Expectancy (EE) means the degree of ease related to using the system" [8]. The importance of EE is it works as a tool to develop a sense of the usefulness of a particular technology. Therefore, the users tend to consider technology for easy task accomplishment [9]. Moreover, in BcT enabled EHR, EE is linked to the users' perception that the BcT will not require much effort (easy to use) be more beneficial for health service delivery outcomes. The description of EE for this study is, the easier it is to utilize BcT, the more likely health professionals are to use it. Consequently, the following hypothesis is developed.

H2 Effort Expectancy positively impacts the adoption intention.

2.2.3. Social Influence: Social Influence (SI) is defined as the extent to which a person sees the importance of peer opinions on whether they should utilize the technology [8]. The view of the affiliated others will influence an individuals' behavior towards technology. The influence can be positive or negative. However, the SI will affect an individual's decision to adopt a technology. In BcT–based EHR, the SI is predicted to impact health professionals' adoption intention positively. Furthermore, it is essential to note that social and psychological frameworks

encompass social and personal norms (PN). PN (in NAM) is not the same as social norms [10]. Maity et al. [11] assert that SI (or subjective norm) influences an Individual's attitudes and beliefs [8], and in their study context, PN is an attitude. Thus, they further anticipated that SI shapes PNs regardless of whether they are normative (green information technology) or non-normative (digital piracy). They hypothesized that a high SI would result in this more positive PN. The findings for both cases, green information technology, and digital piracy, were positive and significant. In line with their study, the following hypothesis has been developed.

H3 Social Influence positively impacts adaption intention.
H4 Social Influence positively impacts personal norms.

2.2.4. Personal Norm: Personal norm (PN) is "feelings of moral obligation to perform or refrain from specific actions" [12]. Feelings morally obliged towards society play an essential role in reflecting individuals' pro-social behavior [13]. Empirical studies that tested NAM in the realm of pro-environmental behavior (e.g., Vining and Ebreo [14]) indicate it can explain individuals' pro-social behavior. PNs can affect pro-social behavior. Health professionals behave pro-socially due to their job nature. As a result, the following hypothesis is developed.

H5 Personal norm positively impacts the adaption intention.

2.2.5. Ascription of Responsibility: Ascription of responsibility (AR) is also called outcome efficacy. AR is one of the three factors of NAM that influences individuals' pro-social behavior. AR or outcome efficacy is a concept that describes a sense of responsibility while conducting a particular task [10]. Consistent with the NAM, it is anticipated that if health professionals accept the duty to act in mitigating medical data management related issues (i.e., medical error, data breach risk reduction), they will have a greater desire to embrace BcT-based EHR and will also feel more obligated to behave pro-socially. Consequently, the following hypothesis is developed.

H6 Ascription of responsibility positively impacts adaption intention.
H7 Ascription of responsibility positively impacts personal norms.

2.2.6. Awareness of Consequence: Awareness of consequence (AC) means being conscious that engaging in (or refraining from engaging) a particular act can result in specific outcomes [10]. According to this definition, if the health professionals understand that BcT adoption has positive effects such as reducing medical error, effective data management, and improved quality of patient care, they will adopt the technology. Also, this AC will activate their AR. According to Maity et al. [11], considerable research that already has utilized NAM in various pro-social scenarios shows that users' awareness of their actions has distinct effects that affect their sense of accountability and moral duty for that activity. These studies indicate that AC positively influences PN, a relationship that we expect in our research. According to the researcher, using BcT-based EHR is a socially desirable activity. The user is also aware of the implications, which could lead to the establishment of PN. As a result, BcT is expected to have a favorable effect on PN. Individuals' PN are also

engaged when perceiving that a specific event constitutes harm to others [15]. Therefore, AC (problem awareness) should activate a PN or a "perceived moral" need to preserve the patient's health and wellbeing. As mentioned by Dalvi-Esfahani et al., [16], according to Nordlund and Garvill (2003; p. 341), individuals who are conscious about the harmful impact of their act on environmental damage develop moral obligation thus, behave environmentally friendly. Similarly, health professionals aware of the adverse effects of lack of medical data availability are more likely to create a moral imperative to act pro-socially. In BcT-based EHR, the more health professionals are obliged to behave pro-socially and the more they intend to adopt BcT. Therefore, the following hypothesis is developed.

H8 awareness of consequence positively impacts adaption intention.
H9 awareness of consequence positively impacts ascription of responsibility

2.2.7. Initial Trust: Trust has been vital in developing relationships among individuals or organizations [17]. However, technology trust is different from those (individual to Individual or Individual to organizational) trust as it is between individuals and technology. This study's focus is trust between individuals and technology. There are two types of technology trust, namely, initial trust and continuance trust. Also, trust formation has three stages: initial trust-building, trust maintaining, and trust recession. BcT is still at a nascent stage of development, likely to face difficulty in initial trust-building [18]. Initial technology trust develops before interacting with it. In other words, Initial trust is created before first-hand contact with the technology. At this point, the technology trust begins at zero [19]. User's trust in the initial phage goes through stages, and based on Initial trust later, they determine whether they want to use the technology [20]. There is a pre-conceived principle in the case of technology trust - "no trust, no use" [21]. That means the potential users will only adopt the technology (in this case, BcT based EHR) when they have a positive initial trust in the technology [22]. The Initial trust develops the desire to rely on variables that cause an individual to accept the risk and uncertainty associated with the technology adoption [19]. Health professionals' concern about patients' privacy may cause a delay in technology uptake and diffusion, particularly for BcT as it will be directly involved with patients' information. Therefore, initial trust in BcT-based EHR may play a vital role in health professionals' BcT adoption intention. These study hypotheses are mentioned below.

H10 Initial trust has a positive effect on adoption intention
H11 Initial trust mediates the relationship between self-interest factors and adoption intention
H11a Initial trust mediates the relationship between performance expectancy and adoption intention
H11b Initial trust mediates the relationship between effort expectancy and adoption intention
H11c Initial trust mediates the relationship between social influence and adoption intention
H12 Initial trust mediates the relationship between normative factors and adoption intention

H12a	Initial trust mediates the relationship between personal norm and adoption intention
H12b	Initial trust mediates the relationship between ascription of responsibility and adoption intention
H12c	Initial trust mediates the relationship between awareness of consequence and adoption intention

This study's objective is to propose the research framework depicted in Figure 4. The UTAUT and NAM have endorsed the framework.

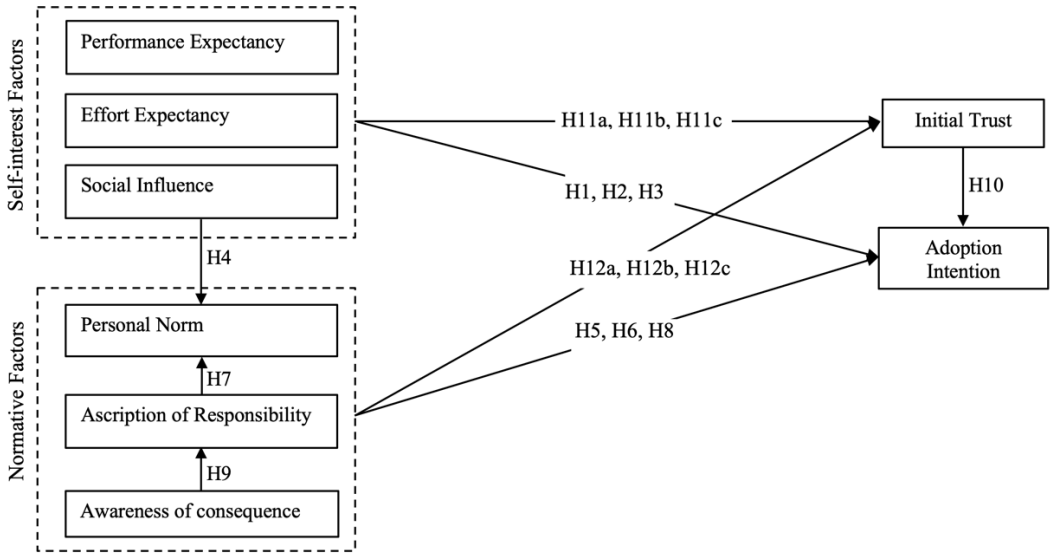

Figure 4. Conceptual Framework

3. Methodology and Data Analysis

The study will follow the quantitative research methodology to reach the research aim. Ideally, a quantitative analysis offers objective data and is undertaken to incorporate programs in an aspect-oriented manner. Also, this analysis method guarantees the authenticity of conclusions supported with robust mechanisms of justification and definition. The proposed model will be empirically tested using the collected from a questionnaire survey. Health professionals from 145 public hospitals in Malaysia will respond to this individual-level study to generalize the finding. According to Krejcie and Morgan's [23] table, the sample size should be 384. It is unlikely that all distributed questionnaires will be usable; therefore, an additional 10 percent of questionnaires will be distributed for 422. The fundamental research will be conducted following the phases as illustrated in Figure 5.

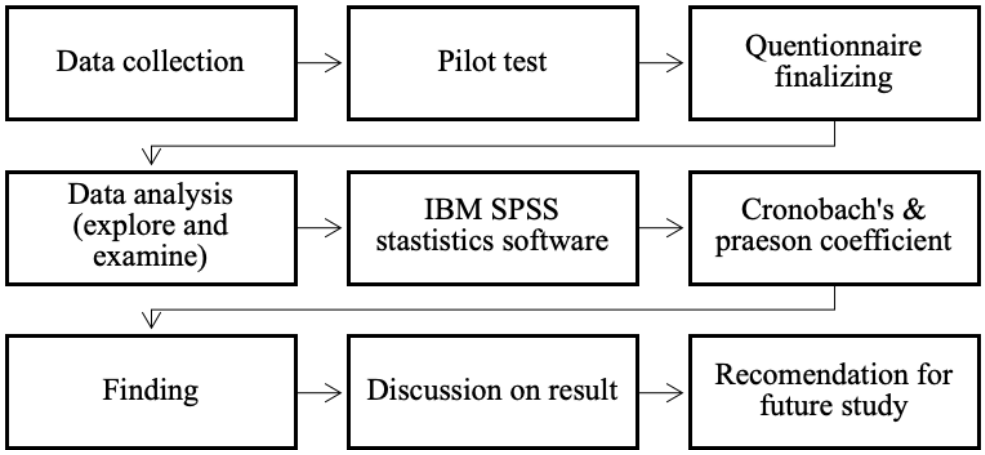

Figure 5. Research Phases from Data Collection to Recommendation

4. Conclusion

Technology adoption studies have been conducted for the last three decades. The more we are getting into technologies, the more technology adoption is gaining importance. The technology ought to be accepted by the end-users to be successfully implemented; thus, assessing users' readiness is a crucial undertaking. This study proposes a conceptual model that will be further empirically tested to assess health professionals' readiness to adopt BcT technology for EHR, which is lacking in the literature.

The conceptual model incorporates self-interest and normative factors, initial trust to investigate clinical and non-clinical medical professionals' intention to adopt BcT technology in Malaysian public hospitals. UTAUT and NAM theory has been used to develop the proposed model. The contribution to the knowledge of this study is the use of NAM theory that remained unexplored in the HIT adoption study context. This study is expected to bring substantial benefits for the future sustainability of the Healthcare System through improved efficiency of resources. It provides a foundation for further research. This study is expected to bring meaningful insight to support the ministry of health, public hospital management in decision-making and planning BcT intervention in the public hospitals of Malaysia. BcT technology implementation has the potential to establish a sustainable, safer, and patient-centric healthcare delivery system. User readiness to adopt this technology is one of the primary concerns that may hinder this novel technology's implementation and diffusion. Therefore, pre-implementation phase user readiness assessment is advisable to mitigate the risk of project failure, low adoption, or slow implementation of BcT technology in the Malaysian healthcare industry.

Acknowledgments

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