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An investigation of healthcare professionals' intention to use Smart Card Technology

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Background: Patient records are essential to healthcare professionals access to health information, allow them to assess symptoms and signs across a wider temporal range and improve diagnosis and treatment. The study acknowledged the significance of healthcare informatics such as Smart Card Technology (SCT) in today's dynamic health systems.

Objectives: This study aimed to investigate factors that influence healthcare professionals' intentions to use SCT in public healthcare.

Method: The study adopted a quantitative research approach using questionnaire surveys as a means to collect data from a total of 406 healthcare professionals from hospitals in Tshwane.

Results: The findings showed that all of the variables based on the diffusion of innovation (DOI) theory, including behavioural intention (BI), social influence (SI), service quality (SQ), user satisfaction (US), compatibility (C), system use (SU) and information quality (IQ), as well as the health unified theory of acceptance of user technology (HUTAUT), DeLone and McLean's Information Systems Success (D&M ISS) model, had a positive impact on the intention to use the SCT. Continued use of SCT was positively correlated with user satisfaction and found a favourable correlation between BI and all of the factors.

Conclusion: The healthcare professionals' intention to utilise SCT was notably impacted by various factors, including SI, SQ, US, C, SU and IQ. These factors collectively influence the intention to utilise the SCT. In addition, these findings show that BI has an impact on the intention to utilise SCT.

Contribution: The results offer a more profound understanding of the variables that impact the use of SCT to improve patient outcomes. In developing countries, public hospitals can enhance their technology acceptance by utilising the SCT adoption framework. Furthermore, this study only included healthcare professionals who worked for public hospitals; to provide a more complete picture of both sectors, future research might concentrate on a target group of healthcare professionals who worked for both public and private hospitals. In addition, future studies should examine patient perceptions regarding the use of SCT in healthcare delivery and the characteristics that encourage patients to adopt and use the technology.

Keywords: healthcare; technology; smart card technology; patients; adoption.

Introduction

Developments in South Africa's public health system have resulted in the rapid application of technology in a variety of fields in the public health sector. Information and communication technology (ICT) has been used in healthcare as a new development to alleviate the burden of the delivery of affordable patient healthcare (Sezgin & Özkan-Yıldırım 2016). The purpose of the previous eHealth strategy was seen as the strategy that identified successes and lessons learnt were addressed, and risks and challenges were also identified. However, the current eHealth strategy could continue being a threat towards the implementation of the South African healthcare system (Mwim, Mtsweni & Mwim 2022). The South African government recently passed the National Health Insurance (NHI) Bill, which aims to improve the quality of healthcare (Bill 2019). The utilisation of smart card technology (SCT) in healthcare is being expedited by the advent of emerging advancements such as the Internet of Things (IoT) and the Fourth Industrial Revolution (4IR) (Peters 2017). Studies conducted in various developing countries have reported that the use of ICTs in healthcare facilities leads to better healthcare delivery (Nzuki & Mugo 2014).

Furthermore, for some years, the idea of having complete medical records on smart card-based technology has been studied (Alliance 2011). Majority of the physicians write their prescriptions by hand and advise their patients to get laboratory tests to confirm their illnesses (Peters 2017). Patients frequently misplace their past prescriptions as well as the results of laboratory tests, which makes it difficult for physicians to confirm their prior illnesses and make decisions (Acquah-Swanzy 2015). Healthcare and diagnostic facilities currently use electronic patient records in limited ways in urban areas, mostly for diagnostic purposes. However, they do not share or have access to their database with other hospitals. Patients feel like they are victims as even though they are paying high amounts for their medical services, they are receiving little benefits from these health care systems. Consequently, patients experience mental disappointment, isolate their vital medical records, encounter various issues and are unable to securely maintain their medical records (Nzuki & Mugo 2014).

Several problems and issues were encountered over the years in the efforts of some South African health departments to deploy hospital information systems and e-health programmes (Ilorah et al. 2017). Healthcare service delivery is also delayed by issues such as poor data management, communication and analysis at different levels of the system (Zulu, Hurtig, Kinsman and Michelo, 2015). The healthcare sector faces a problem in delivering well-coordinated and integrated healthcare services due to its heavy reliance on timely, relevant, and accurate patient-centered data and information (Abdelhalim et al. 2017). The literature, on the other hand, is scarce when it comes to understanding and addressing the obstacles to eHealth adoption in South Africa. The purpose of this study was to investigate factors that influence healthcare professionals' intentions to use SCT in South African public healthcare. To this end, a conceptual model was developed based on the Health Unified Technology of Acceptance Theory (HUTAUT) model, Maeko and Van Der Haar (2018), DeLone and McLean's Information Systems Success (D&M ISS) model (1992, 2003) and the diffusion of innovation (DOI) theory (Rogers 1962). The structural equation model (SEM) was used to analyse the data that had been gathered. A questionnaire was developed and distributed to medical healthcare professionals at the Steve Biko Academic Hospital, Tshwane District Hospital, Kalafong Tertiary Hospital and Pretoria West District Hospital in order to conduct this explanatory study. According to Mustafa, Nordin and Razzaq (2020), Analysis of Moment Structures (AMOS) was utilised in SEM to examine the hypotheses.

Smart card technology

Smart Card Technology is seen as another solution for resolving the day-to-day challenges in the public healthcare. Technology combination in healthcare assists the users to improve efficient services and provide optimal healthcare solutions (Al-Rawashdeh et al. 2022). Therefore, SCT is an embedded integrated circuit, such as a secure microcontroller, an equivalent processor with internal memory, or just a memory chip, which makes up a smart card (Dhagarra, Goswami & Kumar 2020). The hardware for SCT consists of a reader and a chip. In healthcare, professionals are the main users of the SCT tool. Therefore, the health professional has a terminal that is used to access medical information (Kawthankar et al. 2018). Smart card client software components may be fully dependent on the database server and related databases, according to Usman, Madu and Alkali (2019). Patients and healthcare providers have seen benefits from switching to the Cloud. In addition to improving patient outcomes, the Cloud also helps patients interact with their health insurance plans by providing them with generous access to extra healthcare data not included in the smart health card. According to Gautam, Ansari and Sharma (2019) and Jayaraman and Panneerselvam (2020), the interoperability of multiple health care business segments is involved when providing health care data in the Cloud. These categories include drugs, insurance and payments.

Related works

Implementation and authentication of smart card-based health care information systems have been the subject of numerous works. A smart health card monitoring system that is Cloud-based was created by Moudgil et al. (2017). Their suggested monitoring system manages all patient data electronically, safely and effectively, which benefits healthcare providers including hospitals, doctors and chemists. It sends real-time patient monitoring data using Bluetooth technology. In addition, it allows for the periodic updates of the Cloud database and the offline storage of medical data. Nevertheless, they ignore the mutual authentication system and the Cloud servers' and smart cards' synchronisation. Yang et al. (2018) created a MedShare system that uses a two-way authorisation mechanism to post patient data to a Cloud server. To publish data in the Cloud, they make advantage of the national identity card that patient's swipe. Nevertheless, identification cards do not include any health information; they are merely used for authentication. For the Telecare medical information systems (TMIS) system, Li, Shih and Wang (2018) created a mutual authentication and privacy preservation protocol. They encrypted patient data using the advanced encryption standard (AES) method. For a cutting-edge card-based healthcare system, Kausar (2021) created an intelligent card-based system utilising an iris-based biometric cryptosystem. They solely paid attention to the smart card's storage and retrieval of patient data. Xu et al. (2019), Jin and Dong (2018) stated that their system lacks Cloud storage integration and security phases.

A smart card-based biometric remote authentication system was proposed by Al-Saggaf and Sheltami (2019). To transport all the data, they employed a hashing method. They did not, however, address the particular cryptographic method used to store the data on the smart card. An elliptic curve cryptography (ECC)-based mutual authentication scheme meant for smart cards was designed by Kumari et al. (2020). The lab technician phase, medical data upload, health centre data upload and other phases are not supported by their system. Ganesh et al. (2020) presented the idea of an IoT-based smart, automated health device that serves the neighbourhood's healthcare needs. Sanjuan et al. (2020) talk about the use of smart cards throughout the authentication process to protect users' privacy. Healthcare professionals can utilise smart cards, which have significant potential to enhance healthcare delivery and save healthcare expenses, as demonstrated by their application in Health Information Services (HIS). Smart cards are seen to have a lot of potential to improve healthcare delivery and save healthcare costs when used in Health Information Services (HIS). Generally, SCT is used to overcome challenges by adopting the one-time password for authentication purposes by using the password when the user login. Liu, Wang and Wang (2022) found that smart cards achieve the two-way factor authentication by preventing unnecessary factors from assessing the server in certain mainstream applications (). The authors further state that SCT requires continuous process to increase asymmetric encryption algorithms for the detailed part of its implementation. As a result, security and efficiency are the traditional process of solving any issues between classes of the objects. Navaz et al. (2021) support that SCT can be seen as having immense capacity for transformation in healthcare based on its security features.

Theoretical framework

In order to conceptualise the factors for the successful adoption of standards for eHealth in South Africa's healthcare system, the study studied three theories of technology adoption as well as one model of standards adoption, including HUTAUT, DOI and D&M ISS model. The purpose of selecting these theories is to examine the variables that affect medical practitioners' intentions to implement SCT in South African public health. The HUTAUT model was developed by Maeko and Van Der Haar (2018) to encourage user influence and acceptability in public healthcare. Despite just having been tested as a novel model, the HUTAUT model has proven useful in understanding the many stages of technology adoption in the healthcare sector. However, hospital acceptance is hampered by the framework's strong need on user participation and skilled staff to execute a successful technology rollout. Malungana and Motsi (2023) also used the model to investigate the crucial success factors for SCT implementation. The diffusion of innovation theory (2003) and the DeLone and McLean information systems success model were included in the HUTAUT model to develop a conceptual framework. Regression analysis was used to test the framework using data obtained from 406 self-administered questionnaires from Pretoria West Hospital, Kalafong Hospital, Tshwane District Hospital and Steve Biko Academic Hospital.

DeLone and McLean (D&M) models have been frequently utilised by quantitative researchers to evaluate the efficacy of information systems (IS) (DeLone & McLean 1992, 2003). Usually, this assessment approach has been applied to ascertain the potential benefits to individuals and organisations of different success criteria. The D&M concept seems to be widespread, though. Therefore, more assessments are required to identify other plausible components that could positively influence healthcare providers' usage of the SCT in public hospitals. Smart card technology facilitates information exchange, advances technological know-how and enhances application across several platforms. Accordingly, an IS quality evaluation ought to cover knowledge quality for completion (Jeyaraj 2020). Healthcare systems are acquainted with the D&M model; yet because other e-health systems are required to be used, the D&M model is deemed unnecessary (Delone & McLean 2013). Therefore, when IS user performance is required, the D&M model needs to be updated with a better metric. The D&M models define user satisfaction as a metric for assessing the effectiveness of IS. Nonetheless, recurring measurements (Srur & Drew 2012) have a low explanatory capability because there is a high association between system quality, information quality and the subjective measure of user satisfaction construct (Aquino et al. 2018).

Diffusion of innovation theory has been employed in academics and other institutions to accept technology despite being utilised in the majority of qualitative investigations. According to Park and Choi (2019), the DOI is a theory that looks at how new ideas, concepts, time, social systems and innovation interact to determine whether a technology is adopted in a particular adopter market. Nonetheless, the majority of firms have long recognised that the success or failure of business objectives is directly related to the use or rejection of information technology (IT). Iyamu (2021) states that the acceptance of new technology by users and the capacity to convey it have become essential components of current IS research and practice. It has been noted that public healthcare might not be able to acknowledge the repercussions or input from medical experts as a result. This study aimed to investigate factors that influence healthcare professionals' intentions to use SCT in public healthcare.

Research model and hypotheses development

The conceptual model, which examines the variables influencing healthcare workers' intents to use SCT in public healthcare, was developed from the HUTAUT model, the D&M ISS model and the DOI theory using variables: behavioural intention (BI), social systems (SS), service quality (SQ), user satisfaction (US), compatibility (C), information quality (IQ) and system use (SU), adopted from these underpinning theories. The adopted constructs will be discussed in detail in the next section. The hypotheses and the causal linkages between the model's constructs are depicted in Figure 1.

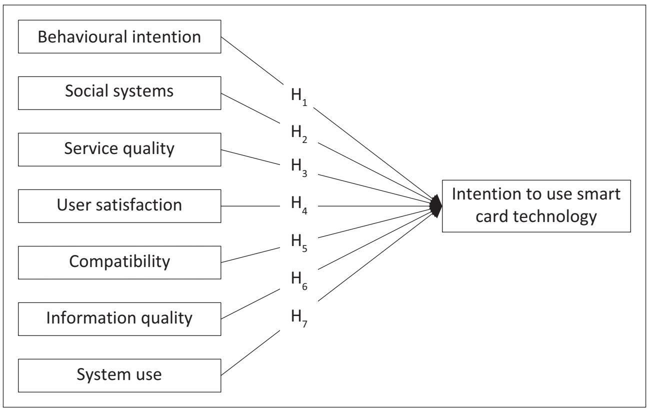

FIGURE 1: Research model.

Behavioural intention

Behavioural intention is a concept that pertains to an individual's preference or objective and serves as a direct factor in determining their subsequent actions (Kiwanuka 2015). The HUTAUT model considers factors that influence BI and technology use behaviour. In this study, these factors such as BI, SI, SQ, US, C, SU, IQ and the utilisation of technology are influenced by BI as well as the accompanying circumstances, whereas the BI and the prevailing conditions collectively dictate the adoption and implementation of technology. To influence BI, a mediating variable of motivation is needed that facilitates the process of investigating the healthcare professional's intention to use SCT (Arman & Dwiyanti 2015). This means that HUTAUT's three constructs are the most important predictors of BI for implementing and using technology. The BI construct was also derived from the UTAUT model as the BI is the major estimator of actual SCT use and the willingness of actual SCT use by health professionals, which is crucial for implementation:

H_1: Behavioural intention has an influence the utilisation of Smart Card Technology in the domain of public healthcare.

Social influence

The degree to which a person believes that other important people should use a new system is known as SI (Sallehudin, Safie & Satar 2019). Social influence leads the healthcare professional who intends to quit during an early stage of technology adoption because of work pressure (Amaral et al. 2013). Furthermore, user behaviour towards acceptance of using SCT in healthcare was modified (Kamal, Shafiq & Kakria 2020). Individual perceptions of social pressure to accept or not accept are related to both optional and mandatory situations as well as the SI, the subjective standard (Thong 2020). As a result, the SI constructs directly impact the intention to use SCT for healthcare professionals. This construct tends to make the organisation perceive that it is important to believe in SCT. When measuring BI, which has a direct bearing on using SCT, social impact carries more weight to ensure the usage become effective. The supporting conditions are also another construct that represents an independent variable. The construct is an independent variable that directly influences the BI for the intention of using SCT (Almuraqab & Jasimuddin 2017):

H_2: Social influences positively influence the use of Smart Card Technology in public healthcare.

Service quality

Service quality was defined in this study as the overall support provided to the service provider, whether the service is provided in-house or by a third party (Mardani et al. 2019). Smart card technology can be used to identify the various factors that influence the healthcare professional's experience to measure use. According to Halvorsrud, Kvale and Følstad (2016), this tool is employed for the purpose of evaluating the quality of service and detecting any inconsistencies or issues within service procedures. For this reason, SQ can be said to have a significant impact on user satisfaction. The concept of service quality is a framework for evaluating the quality of health professionals' ICT services (Hsu, Yen & Chung 2015):

H_3: Service quality influences positively influence the use of Smart Card Technology in public healthcare.

Compatibility

According to Rogers (1995), compatibility is the second aspect of the DOI, relating to how well the innovation is perceived to be consistent with shared principles, attitudes, experiences and needs. The degree to which an innovation is thought to be consistent with potential users' current beliefs, experiences and desires is known as compatibility (Ball et al. 2014). The innovation can be tested on an experimental basis without adding unnecessary work or costs; it can be implemented gradually while still providing significant benefits and numerous mechanisms, such as free downloads, trial versions, prototypes and so on, allowing users to quickly try the technology before planning. Rogers not only emphasises the creation of new ideas or innovations but focusses on how ideas are disseminated through individuals. The degree to which the SCT is compatible with nurses' work habits or desires is referred to as compatibility (Hung, Tsai & Chuang 2014). The theoretical innovation attributes, attitudes, individual beliefs and communication about innovation that the individual receives from the social environment are the fundamental constructs for the decision-making process:

H_4: Compatibility influences positively influence the use of Smart Card Technology in public healthcare.

User satisfaction

User satisfaction can be defined as the overall utilisation of technology, as indicated by feelings of fulfilment and enjoyment, as well as satisfaction with software and decision-making (Lau & Kuziemsky 2016). Hence, the level of US is inherently subjective, contingent upon the individuals participating in the assessment and the specific technologies they are utilising. Some studies measure satisfaction based on ease of use and others on attitudes towards IS. As a result, US is defined as the total rating of the user's experience with the system as well as the system's potential influence. Therefore, intention to use information is related to the level of satisfaction with that information. This relationship is also related to the level of satisfaction with their future use of information systems (Puspita, Supriyantoro & Hasyim 2020). However, for the benefit of this study, US is a mediating variable to measure human aptitude in an organisation (Puspita et al. 2020). User satisfaction from the D&M IS success model is used as the mediating variable intending to use the SCT. Furthermore, US is defined as the degree to which a user finds a device useful and wants to use it again (Aldholay et al. 2018). The D&M IS success model framework sets the guidelines provided to determine the area of improvement to ensure higher user satisfaction (Baç 2020):

H_5: User satisfaction influences positively influence the use of Smart Card Technology in public healthcare

System use

According to Acquah-Swanzy (2015), it is imperative for healthcare facilities to possess the capability of offering intelligent search functionalities, efficient and simultaneous access across several locations and the ability to digitally integrate fragmented data stored in databases that are geographically dispersed. Healthcare organisations should make concerted efforts to enhance the quality of their healthcare services. According to Sombat, Chaiyasoonthorn and Chaveesuk (2018), user commitments are met through the utilisation of technology features, including hardware, software and data. The way a system uses technology can be influenced by its design as well as other factors such as the characteristics of the technology. Smart card technologies entice healthcare professionals to use them for tasks like recording, patient information, laboratory, x-ray and pharmacy information. Every healthcare facility should be able to provide intelligent search capabilities, immediate and multi-site access and the capacity to digitally merge data pieces held in geographically distributed databases by utilising a single system (Acquah-Swanzy 2015). Healthcare organisations must strive to improve the quality of healthcare. Technology features such as hardware, software and data are used to fulfil user obligations (Sombat et al. 2018). User adoption and use of technology can be influenced by system design as well as other factors such as technical features. Smart card technologies have proven to be appealing to healthcare professionals because of their ability to facilitate several activities, including the recording of patient information, management of laboratory and radiology data (such as X-ray images), neonatal care and pharmacy-related information:

H_6: System use influences positively influence the use of Smart Card Technology in public healthcare.

Information quality

The measure of IQ pertains to the degree of efficacy with which information is conveyed to healthcare professionals. Additionally, it serves as an indicator of the effectiveness of the formatting and presentation of the material. The Department of Health sets guidelines for devices that guide the private and public sectors in installing a computerised system to improve the quality of healthcare. One could posit that the use of SCT has the potential to facilitate the seamless integration of business processes within hospitals and clinics. In the context of a comprehensive HIS deployment, the concept of information quality encompasses the harmonious integration of several elements, including human, organisational and technical variables (Kilsdonk, Peute & Jaspers 2017):

H_7: System quality influences positively influence the use of Smart Card Technology in public healthcare.

Research methodology

Both a quantitative methodology and a logical approach were used in this investigation. It explains the causal relationship between the variables, making it explanatory. Based on theory, the hypotheses were established in this study using the deductive technique, also called testing theory. Cross-sectional studies are used as they are also the least expensive and time consuming. Medical healthcare professionals from Steve Biko Academic Hospital, Tshwane District Hospital, Kalafong Tertiary Hospital and Pretoria West District Hospital comprised the study's population. Only four hospitals were included in the study's population because of resource and time limitations. As non-probability sampling is used in this study, each unit of the population is unknown and has a different chance of being included in the sample. While there are other non-probability sampling techniques, convenience sampling was employed in this study. It consists of reachable individuals. This approach is effective for the pilot study and offers the benefits of time and cost savings. For this reason, this type of sampling was selected for the study. The Morgan and Krejcie (1970) criterion was used to select the study's sample, which was 406 in this case.

There were two sections to the questionnaire. Seven variables and eight constructs specified in the research paradigm were measured with 42 items. The first section has 31 items (Figure 1). Eight factors were included in the analysis: (1) as dependent variables (the desire to use smart card technology) and (2) as independent variables (BI, SI, SQ, US, C, SU and IQ). There are several items that were used to measure each construct. A 5-point Likert scale was used to score questionnaire responses in order to quantify the constructs. The five response possibilities on the Likert scale ranged from 'strongly disagree', which corresponded to number 1, to 'strongly agree', which corresponded to number 5. A nominal scale was used to portray the demographic data in the second section. Basic data on respondent characteristics, such as gender, age, department and educational attainment, were gathered through the questionnaire. Furthermore, content and face validation were applied to the questionnaire's first version (Verfürth 2020; Zayapragassarazan & Kumar 2016). The opinions of two experts with e-health-related experience served as the foundation for the content validation procedure.

The experts offered their thoughts on the material's relativism and relevancy. An effort was made to create a brief and straightforward questionnaire. Following changes, the researcher tested the clarity of each item by administering the questionnaire to a subset of 20 medical healthcare professionals at the Tshwane District hospital. The suggested changes were included in the completed questionnaire.

Sample and procedure

The present study employed a convenient sampling technique to collect data. Questionnaires were administered at four healthcare facilities, namely Steve Biko Academic Hospital, Tshwane District Hospital, Kalafong Tertiary Hospital and Pretoria West District Hospital. The target population primarily consisted of individuals aged between 25 and 50 years. The target respondents consisted of mainly the healthcare professionals in the aforementioned hospitals. The collected data were analysed using the Statistical Package for the Social Sciences (SPSS) version 26, and the SEM was also used. Gender, age, department and level of education were among the demographic variables included in the questionnaire. The frequency statistics of these factors were extracted in the study, and the results were based on the females having the highest percentage of 63% while the males obtained the lowest variance of 37%. The study investigated the age category to which a respondent belongs. The options available for respondents to choose from were below 25 years, between 25 and 30 years, between 31 and 40 years, between 41 and 50 years and above 50 years. This shows that the age category with the highest representation is 31–40 years with a total of 53% of the sample, followed by the age category 25–30 with a total representation of 33%. In this study, a sample total of 8% of the respondents belonged to the age category 41–50 years, while the age categories below 25 years and above 50 years have an equal representation of 3%. Generally, the majority of the respondents are middle-aged, which is the age category that previous studies have classified as the technology age category (30–50 years).

Descriptive statistics of constructs

This study involved an examination and analysis of data about the distribution and central tendency of continuous variables, utilising descriptive statistics. The analysis utilised descriptive statistics, including the mean, minimum, maximum and skewness values, as influential factors for the application of the SCT. Furthermore, the organisation of the data collected from hospitals in the Tshwane District was considered. The mean value represents the central point within the given range. Skewness is a statistical term used to quantify the degree of asymmetry present in a dataset that follows a normal distribution. Skewness can be classified into two distinct categories: positive skewness and negative skewness. Table 1 presents a summary of the descriptive statistics obtained through the utilisation of SPSS.

The findings indicate that, with the exception of SQ, all indicators exhibit a minimum value of two, indicating a state of disagreement. This finding indicates that, among the various elements evaluated in the context of utilising SCT in healthcare facilities, SQ was the sole aspect where at least one respondent expressed strong disagreement regarding its significance. However, no respondents exhibited strong disagreement with respect to the remaining questions. In relation to the highest attainable value, each factor exhibited a maximum value of five, signifying unanimous agreement across all constructs. The results indicated that each component had at least one participant who strongly endorsed the significance of these factors in influencing the BI to utilise SCT. The minimum and maximum statistics provide insight into the general consensus among respondents regarding the questions pertaining to the influence of each element on BI to use SCT. However, in order to obtain a higher level of confidence, it is necessary to interpret the mean and skewness data.

According to Table 1, the average value for all the criteria is 4, indicating agreement. Additionally, the findings presented in Table 1 indicate that a significant proportion of the participants expressed agreement or strong agreement with the survey questions pertaining to the influence of various factors on the adoption of Smart Card Technology (SCT) in healthcare organisations. This alignment with the intended purpose of the study implies a positive inclination towards the use of SCT in the healthcare sector. The majority of participants expressed agreement, with a significant number strongly agreeing, in response to the inquiries on the influence of their involvement on the BI to utilise SCT within healthcare organisations. The SQ has negligible positive and negative skewness values of -0.003, indicating a near-zero skewness. This suggests a relatively even distribution of respondents who express agreement or strong agreement, as well as those who express disagreement or severe disagreement. Moreover, it is possible that a larger number of participants exhibited a neutral stance in response to the inquiries on the influence of communication and service quality on the BI to utilise SCT. The variables of SI, IQ and BI exhibit negative skewness, with values of 0.282, -0.250 and -0.222, respectively. The system quality exhibits the least negative skewness values, with a value of -0.015. In brief, the participants expressed agreement or strong agreement with the influence of the elements examined in this research on their BI to utilise SCT in the context of healthcare.

TABLE 1: Construct descriptive statistics.

Construct	Minimum	Maximum	Mean	Skewness
Social influence	2	5	4	-0.282
Behavioural intention	2	5	4	-0.222
Service quality	2	5	4	-0.003
System use	2	5	4	-0.156
Information quality	2	5	4	-0.250
User satisfaction	2	5	4	-0.162
Compatibility	2	5	4	-0.113

The results show that all factors except SQ has a minimum value of 2, which represents disagreement. This suggests that while SQ was the only element with at least one respondent strongly disagreeing regarding its importance in using SCT in healthcare institutions, none of the respondents strongly disagreed with the rest of the questions. In terms of maximum value, all factors had a maximum value of 5; it indicates that all constructs indicated that they strongly agree. The findings reflected that all factors had at least one respondent who strongly agreed with the role that these factors play in the BI to use SCT. These minimum and maximum statistics creates an understanding that the majority of respondents agreed or strongly agreed with the questions about the role of each factor in BI to use SCT; however, the mean and skewness statistics must be interpreted to be more confident.

Table 1 shows that the mean value for all the factors is 4, a value that represents agreement. Furthermore, this Table 1 suggests that for an average of 4 to be obtained, the majority of the respondents agreed and strongly agreed with the questions asked about the role of each factor in the intention to use SCT in healthcare institutions. Most of the respondents agreed and strongly agreed with the questions about the role they played in the BI to use SCT in healthcare institutions. Service quality has low positive and negative skewness values of -0.003, respectively, which are nearly zero, suggesting that there is a balance between respondents who agree or strongly agree and those who disagree or strongly disagree. Furthermore, there could be more respondents who were neutral to the questions asked about the role of communication and service quality towards the BI to use SCT. Negative skewness for SI, IQ, BI is 0.282, -0.250 and -0.222, respectively. The least negative skewness value is -0.015 for SQ. In summary, respondents agreed or strongly agreed that the factors investigated in this study played a role in BI to use SCT in healthcare.

Ethical considerations

Ethical clearance to conduct this study was obtained from UNISA-CAES Health Research Ethics Committee (No. 2020/CAES_HREC/081).

Results and discussions

The quantitative portion of the article relied on questionnaires to gather quantitative data from respondents to achieve the study's main objective. The quantitative data (SEM) was evaluated using the SPSS Version 26 and AMOS 26, which incorporates the SEM. The Cronbach's alpha coefficient exceeded the threshold of 0.7 following rigorous assessments of reliability and validity, suggesting that the data collected and evaluated in this study can be deemed credible. Scale reliability is the term used to describe the extent to which repeated measurements, conducted under identical conditions, approximate each other.

It is used to assess scale consistency and stability and can change over time and between respondents. External and internal reliability are both included in the term reliability. The former refers to the consistency of the constituents in the scale's items, while the latter pertains to interrater and inter-rater reliability. At this stage, the internal consistency of the scale items was assessed. This study addresses the acceptable reliability coefficient above 0.700. In this section, the reliability of all the scales is presented to demonstrate the reason for the removal of some scales and even a variable chronologically. In this section, the item-total statistics tables are also presented including the prevailing reliability coefficient and the final after some items were removed.

This study addressed the BI scale, which had a reliability of 0.665 and needed to be improved. It was found that after removing BI6 that had a low correlation, the reliability would move up to 0.725; hence it was removed. It was decided to remove SI because it had a very low correlation with the total set of items. Its correlation was 0.008. The scale's reliability increased from 0.560 to an acceptable level of 0.702 once it had been removed. The reliability analysis of the SQ scale was also conducted. The reliability of the scale was 0.626. The SQ5 scale was deleted as it had a negative correlation with the overall scale, bringing the scale reliability to 0.753. None of the items of the IQ scale were removed at the first stage but at the stage of reliability checks, IQ2 and IQ4 were removed to improve the reliability. The final reliability was 0.717, which is acceptable. The reliability of the US scale was 0.648. However, after the US5, US3 and then US1 had been removed, the dependability increased to 0.709. The removal was done independently, and after each removal, the reliability was checked. The CP scale recorded initial reliability of 0.650. Item CP3 had a very low item-total correlation of 0.063; hence it was removed. The reliability increased to 0.711 as a result of this action. The Kaiser-Meyer-Olkin (KMO) and Bartlett's tests constituted the subsequent outcomes of the principal component analysis (PCA) factor analysis. The KMO statistic is a numerical measure that varies between zero and one. For factor analysis to be considered effective, the KMO value should be near to one rather than zero. A number in close proximity to one signifies that correlation patterns exhibit a high level of compactness, suggesting that factor analysis is likely to produce distinct and dependable components.

According to Kaiser (1974), it is recommended to accept results that exceed 0.5. In addition, it is widely acknowledged that values ranging from 0.5 to 0.7 are deemed as poor, while values falling between 0.7 and 0.8 are regarded as highly commendable. Moreover, values within the range of 0.8 to 0.9 are thought to be of exceptional quality, while values over 0.9 are deemed to be inside the acceptable threshold. The KMO statistic value for the data used in this study was 0.949. The researcher can be confident that factor analysis is acceptable for this data because the value is in the within the acceptable range. Table 2 highlights the checking of multicollinearity; the same regression output was examined. In the collinearity statistics under the coefficients table, the tolerance and variance inflation factors (VIF) were screened for figures < 0.01 and > 10, respectively. The assumption of multicollinearity was satisfied because none of the tolerance figures were less than 0.01 and the VIF was more than 10.

The relationships between constructs were investigated following the development of the structural model. The summary extract from the AMOS output for the standardised significance levels obtained after running the structural model. These levels depict the hypothesised relationships between the latent variables that comprise the underlying causal structure of using the SCT. Chandra and Kumar (2018) suggested using a 1.96 threshold for the critical ratio values to establish the relevance of the hypothesised relationship (CR). This means that for a hypothesis to be significant or supported, its constructs must have a critical ratio value greater than 1.96 otherwise, the hypothesis is rejected. Finally, the SEM results show that the data fits the model. In summary, the findings show that BI, SU, SI, US, IQ, SQ and C effect the intention to use the SCT.

Conclusion

The purpose of this study was to examine the variables affecting the uptake and application of SCT in South African public hospitals. In order to accomplish the goal of this study, HUTAUT, D&M ISS and DOI served as a theoretical foundation. The relationship between BI and the constructs (SI, SU, SQ, C and IQ) was found based on the findings of this study. According to the results, each construct has a minimum score of 2, indicating disagreement, with the exception of system quality. This shows that none of the respondents significantly disagreed with the other questions, but SQ was the only factor about which at least one respondent strongly disagreed with its significance in adopting SCT in healthcare institutions. All of the factors obtained a maximum value of 5, indicating that all of the constructions expressed high agreement. According to the findings, at least one respondent strongly agreed with each factor's contribution to the BI to utilise SCT. Regarding their role in the Bi to use SCT in healthcare facilities, the majority of respondents agreed or strongly agreed.

TABLE 2: Coefficients.

Model 1							
Construct items	B	SD	Standardised coefficients		Collinearity statistics		VIF
			Beta	*T*	Sig.	Tolerance	
-	101.593	66.270	-	1.533	0.126	-	-
SI1	-8.614	8.807	-0.056	-0.978	0.329	0.311	3.214
SI3	26.286	7.786	0.211	3.376	0.001	0.263	3.801
SI5	2.129	7.822	0.015	0.272	0.786	0.332	3.016
BI1	10.349	8.080	0.101	1.281	0.201	0.165	6.067
BI2	-7.166	6.142	-0.067	-1.167	0.244	0.308	3.244
BI3	-7.671	8.053	-0.072	-0.952	0.342	0.182	5.508
BI5	-6.887	8.617	-0.043	-0.799	0.425	0.356	2.809
SQ2	7.738	6.943	0.060	1.115	0.266	0.351	2.853
SQ3	-21.321	7.689	-0.167	-2.773	0.006	0.283	3.530
SQ4	-7.391	6.611	-0.065	-1.118	0.264	0.304	3.286
SQ6	0.904	7.632	0.006	0.118	0.906	0.340	2.938
SU1	-9.396	9.001	-0.072	-1.044	0.297	0.215	4.649
SU4	3.135	7.032	0.027	0.446	0.656	0.285	3.515
SU5	24.652	6.962	0.201	3.541	0.000	0.317	3.158
IQ1	4.499	8.627	0.032	0.521	0.602	0.274	3.653
IQ3	7.193	7.489	0.052	0.960	0.337	0.344	2.907
IQ5	-18.493	7.460	-0.129	-2.479	0.014	0.378	2.648
US2	15.869	6.461	0.160	2.456	0.015	0.242	4.137
US4	3.047	6.521	0.024	0.467	0.641	0.380	2.632
US5	-12.392	7.079	-0.087	-1.751	0.081	0.417	2.397
C1	-3.670	7.879	-0.027	-0.466	0.642	0.301	3.327
C3	3.511	6.485	0.029	0.541	0.589	0.354	2.823
C5	4.679	6.791	0.036	0.689	0.491	0.378	2.649
C6	2.738	7.282	0.025	0.376	0.707	0.225	4.445
CP1	-1.944	8.940	-0.012	-0.217	0.828	0.352	2.841
CP2	8.947	6.047	0.093	1.480	0.140	0.259	3.867
CP4	-13.824	6.096	-0.120	-2.268	0.024	0.368	2.717
CP6	18.280	8.186	0.153	2.233	0.026	0.219	4.573
IM1	3.700	8.772	0.029	0.422	0.673	0.222	4.509
IM2	5.644	6.522	0.043	0.865	0.387	0.412	2.429
IM3	-14.727	7.988	-0.074	-1.844	0.066	0.636	1.573
IM5	-7.803	8.056	-0.063	-0.969	0.333	0.245	4.088
IM6	-19.703	8.290	-0.137	-2.377	0.018	0.307	3.256

Note: Dependent variable: intention to use smart card technology.

BI, behavioural intention; SI, social influence; SQ, Service quality; IQ, information quality; US, User satisfaction; C, Compatibility; VIF, variance inflation factors; CP, compatibility; SU, system use; IM, information matrix; SD, standard deviation.

The low positive and negative skewness scores of -0.003 and -0.003, respectively, imply that there is a balance between the respondents who strongly disagree and those who agree or highly agree about the quality of the service. Furthermore, the study's other findings demonstrated that the intention to use the SCT is influenced by SI, SQ, US, C, SU and IQ. In order to collect data for future study using a mixed method approach that includes interviews, given that healthcare is a very personal and unique experience for every individual, it would be ideal to have the most precise information available. In addition, only healthcare professionals employed by public hospitals were included in this study; future research may focus on a target group of healthcare professionals employed by both public and private hospitals to obtain a more thorough understanding of both sectors. Subsequent investigations could explore the attitudes of patients towards the use of SCT in healthcare delivery, as well as the factors that motivate them to embrace and utilise the technology.

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Competing interests

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Authors' contributions

L.Malungana and L.Motsi contributed towards the conception or design of the work and data collection, data analysis, interpretation and drafting the article. Both authors also contributed towards the critical revision of the article and funding and final approval of the version to be published.

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Data availability

The data that support the findings of this study are included in the article. Further inquiries can be directed to the corresponding author, L.MO.

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