



# Impact of knowledge factors on implementation of smart card technology in public healthcare

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**Background:** Healthcare quality continues to advance with the use of innovative, adaptable technology, which will also reduce costs, increase efficiency, divide the number of errors, boost patient satisfaction, and enhance reimbursement for inpatient and outpatient healthcare professionals.

**Aim:** The study's aim was to investigate the impact of knowledge factors on the implementation of smart card technology (SCT) in public healthcare. Furthermore, it contributes equally to the understanding of the important determinants that influence the implementation of SCT in these hospitals.

**Setting:** The study examined how knowledge factors affected the use of smart card technology in public healthcare in Southern Africa.

**Methods:** The study used quantitative research approach. There were 489 healthcare professionals who took part in the initial data collection. As a result, 439 questionnaires were sent out and 406 of them were analysed.

**Results:** The outcome of this study revealed that healthcare professionals had an impact on SCT implementation. According to the data, 2.2% and 2.5% of respondents, respectively, had very excellent and decent knowledge of SCT, compared to 33% of respondents who have a good understanding of SCT. A significant correlation between the application of SCT and effort expectancy (EE) may also have an impact on these outcomes. Effort expectancy was found to have a positive, considerable influence on the application of SCT in public healthcare in this study.

**Conclusion:** This study showed that the Department of Health's ability to properly administer SCT depends on certain factors that affect how it is implemented in South African public hospitals. Given these reasons, the possibility for adopting these e-health programs is of utmost importance.

**Contribution:** The study can assist the Department of Health to understand how different knowledge-related factors impact the implementation of SCT in public healthcare.

**Keywords:** smart card technology; implementation; information systems; healthcare; healthcare professionals.

## Introduction

Hospitals are concerned with the lives and health of their patients. Well-trained doctors and nurses, as well as high-quality facilities and equipment, are essential components of a good medical care system. If accurate, comprehensive, up-to-date, and accessible medical records are not available, medical personnel may not provide the best treatment or may misdiagnose a condition. According to Garba and Harande (2016), protecting healthcare patients is associated with records such as X-rays, specimens, and drug records, and patient registers must be well managed. A smart card (SC) as a chip card, or integrated circuit card, is defined as any pocket-sized card with embedded integrated circuits that can process information (Gates et al. 2018). As it handles health-sensitive information and personal health information, smart card technology (SCT) achieves a higher level of security and privacy protection in this study. Furthermore, SCT has emerged as a form of personal identification and entitlement schemes at regional, national, and international levels worldwide (Pinciroli et al. 2010). More evidence indicates that the SCT is used to provide quality healthcare, with far-reaching implications for patients and healthcare professionals. Furthermore, the embedded chip enables it to securely store, access, and exchange data with card readers and other systems (Howell et al. 2016).

Moreover, SCT can increase the productivity of healthcare professionals in hospitals by allowing them to learn computer skills and new skills through soft skills development programmes

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(Yeh 2017). Using SCs in healthcare has several advantages, including: (1) easier access to medical records, (2) integration of patient medical data, (3) providing remote care to patients, and (4) allowing access to previous notes and the patient's history. However, one of the disadvantages of SC is their lack of security, as SC must be able to interact with a variety of interfaces to function properly. Another disadvantage of SC is their small size and light weight. If it is lost, it may cause the owner inconvenience and even serious harm because important information stored on it may be lost if there is no advance backup. Card readers are not cheap, even though SCT is.

Smart card technology can play a key role in sharing patient-specific information. As a result, the mandatory process in the healthcare environment is fulfilled by the information system (IS) (Arman & Hartati 2015). Due to the increase in the capabilities of hospital automation systems, intelligent storage and retrieval mechanism is used. Nurunnisha and Dalimunthe (2018) noted that there is a growing number of internet users, and it would now make sense for the marketplace to provide digital or online services based on a comparable notion, such as the SCT in public health. Yet, according to numerous researchers, including Wu and Hadzic (2008), Aqeel-ur-Rehman et al. (2016), Vuong and Nguyen (2015), Weiner et al. (2017), and Susanto and Mahadika (2018), SCT can be a very effective tool in achieving objectives in public healthcare. Smart card technology can be implemented in other fields such as transportation, banking sectors, and many others (Spies & Muwanguzi 2014). The study identified a gap by empirically investigating the impact of knowledge factors on the implementation of SCT in public healthcare. In addition, the study was conducted at Steve Biko Academic Hospital, Kalafong Tertiary Hospital, and Pretoria West and Tshwane District hospitals in the City of Tshwane Metropolitan.

## Literature review

The use of various ISs within public healthcare has become a challenge, affecting its efficiency and effectiveness. When implementing such technology systems, several factors must be considered (Marufu & Maboe 2017). Within healthcare, ISs become more sophisticated as it is supposed to be designed for addressing the patient's needs and healthcare professionals (Sethia, Gupta & Saran 2019).

### Factors affecting the smart card technology implementation

In today's world, the need for automated systems in hospitals is gaining more traction each day. The purpose of the automated systems is to increase the accuracy and the speed of knowledge circulation which will lead to better service for patients and increase response efficiency of hospital personnel (Starren, Hakonarson & Hayes 2014). The following are some of the factors influencing the implementation of SCT in public healthcare. In this study, a theoretical framework was developed to investigate Healthcare Unified Theory of

Acceptance of User Technology (HUTAUT) model (2018), DeLone and McLean IS success model (2003) (D&M), and Diffusion of Innovation Theory (DOI) (2003). Healthcare Unified Theory of Acceptance of User Technology adopted the following constructs from these theories: behaviour intention (BI), effort expectancy (EE), performance expectancy (PE), social influence (SI), and facilitating conditions (FC). The selected constructs in the D&M model were user satisfaction (US), information quality (IQ), system quality (SQ), and system use (SU), whereas the DOI has chosen compatibility, communication, and trialability as factors influencing SCT implementation in public healthcare. These adopted constructs served as a lens through which to examine the factors influencing the impact of SCT implementation in public healthcare.

### Effort expectancy

Effort expectancy is one of the core determinants of users' intentions to use the system (Tran, Zhao & Diop 2019). Effort expectancy considers the notions of perceived ease of use and complexity. The degree of ease associated with the use of the system refers to EE (Oye, Iahad & Rahim 2014). The key to influencing perceptions regarding the usefulness of innovation is significant in both mandatory and voluntary perspectives. The Nine Pillars of the Health Systems and Service Improvement Plan outlines the Presidential Health Compact and includes the training of healthcare workers (needs and implementation of systems) (National Health Research Committee 2021). The complexity of the technology also plays a key role in this construct and people are often influenced by the complexity of the technology and its energy needs.

### Information quality

Information quality measures how well the information is presented to healthcare professionals. The concept of IQ refers to the integration of various factors such as human factors, organisational factors, and technical factors into a good health IS implementation. It also indicates how well the information is formatted and presented. One of the National Digital Health strategies is to run interoperability hackathons to allow system developers to test systems and demonstrate interoperability (South African National Department of Health 2019). The National Health Strategy states that integration and guidance to health systems policy strategies and investment must be the focus for healthcare ISs (South African National Department of Health 2019). Therefore, to improve the quality of healthcare services, the Department of Health devises policies that guide the private and government sectors in implementing computerised systems to assist in providing quality information to the public. There is a need for better access to healthcare information, both by medical staff and patients (FTI Consulting 2019).

### System quality

System quality refers to the component of an IS dimension and, thus, subsumes various measures of the system itself. Therefore, SQ is seen as contributing to convenience, the

flexibility of technology, system accuracy, response time, and ease of use (Lau & Kuziemsy 2016). Additionally, SQ is referred to as the technical aspects of Health Information Technology (HIT) and has three categories of measures on system functionality, performance, and security. Functionality covers the type and level of SCT features present, such as order entry with decision support for reminders and alerts. Performance covers the technical behaviour of SCT in terms of its accessibility, reliability, and response time. However, SQ ability is often seen in conjunction with the security aspect of the system to protect the integrity of the information or data captured to ensure proper authorisation.

## Knowledge factors affecting smart card technology implementation

### Smart card technology interactions

The paper-based systems, such as a doctor's written signature, result in duplication of information being edited and modified by another healthcare professional. The availability of technologies such as the SCT can assist in preventing such from happening (Asghar et al. 2017). The technology is beneficial for the healthcare professional only if the information on the card is complete (Aubert & Hamel 2020). Information quality is aimed at examining how health information leads to US (Shim & Jo 2020). Therefore, SCT interactions play a role in IQ becoming a critical factor in the implementation of SCT.

### Computer literacy level

There is growing evidence of the benefits of digital health for improving the performance of health systems and outcomes in developed countries (Curioso 2019). Due to resource-constrained settings, the impact of technological characteristics, user characteristics, as well as socioeconomic and environmental factors are prevalent in the factors for SCT implementation in public healthcare. Individuals with weak learning skills can experience difficulty in performing their routines; as such, it can reduce their ability to use computers and information technology (IT) (Sallehudin et al. 2020).

### Smart card technology knowledge

In Nigeria, the success of electronic health information management system (EHIMS) was measured on several factors, such as SQ, IQ, and service quality as well as usage (Ojo & Popoola 2015). Based on the study's findings, an understanding of the factors responsible for the success of the EHIMS was critical to improved healthcare. Therefore, healthcare professionals are mostly data-driven, and it depends on the accuracy and availability of the data because most of the data are in paper format (Sikhondze & Erasmus 2016). However, system knowledge plays an important role in the delivery of healthcare in SCT.

## Research methods and design

In order to investigate the impact of knowledge factors towards the implementation of SCT in healthcare, quantitative

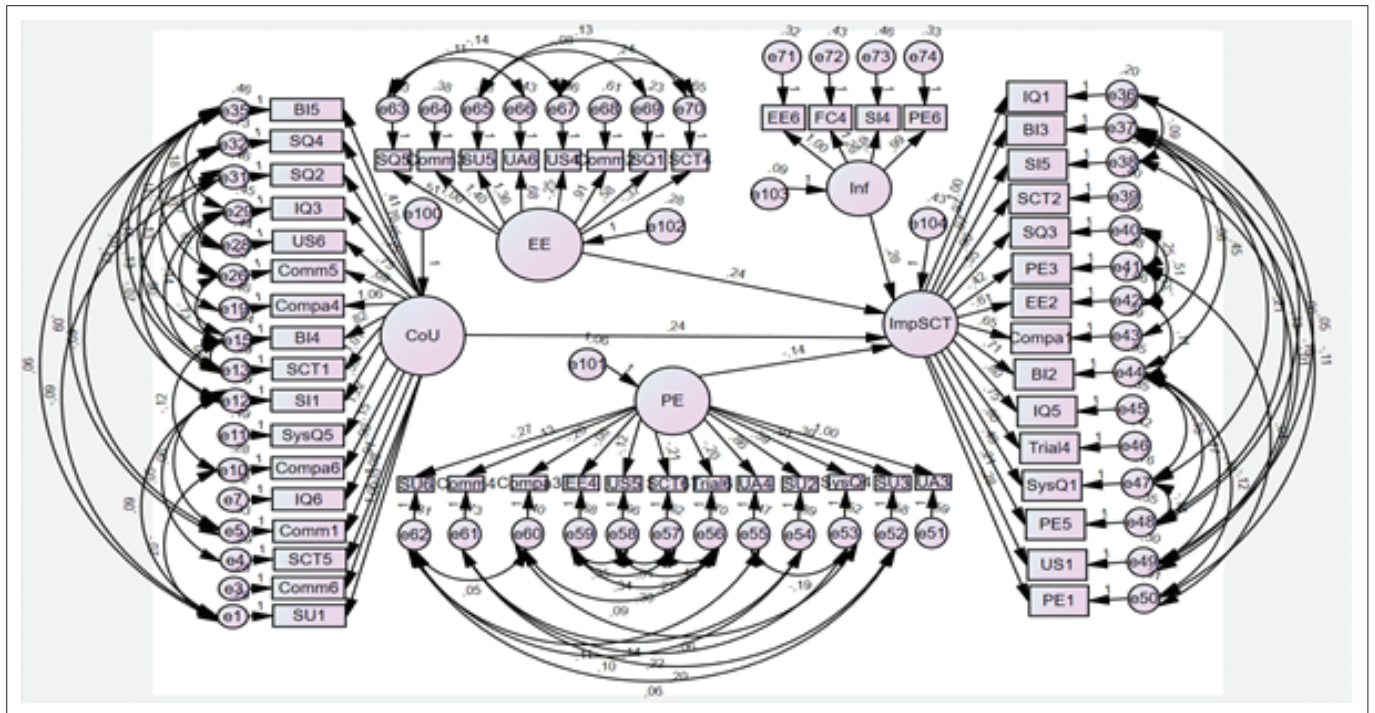
research methodology and a survey questionnaire were used as data collection instrument. The study's participants were chosen from Tshwane District hospitals (Steve Biko Academic Hospital, Kalafong Tertiary Hospital, Tshwane and Pretoria West District Hospital) in South Africa's Gauteng province. Each survey had three sections: demographics, technology, internet usage, interaction, and variables influencing SCT implementation. The questionnaires contained 97 questions in total. As a result of the uncompleted questions, 439 questionnaires were received from the four hospitals, with only 406 validated survey questionnaires on SPSS. To aid in the research, descriptive statistics were used. The questionnaires distributed were brief, and many challenges were encountered, including low turnout due to the coronavirus disease 2019 (COVID-19) pandemic and time constraints. The emergency, midwifery, paediatric, neonatal, surgical, and other departments, including medical care and the oncology department, were all included in the questionnaire.

Purposive sampling was used together with the questionnaire as data collection tool. Due to the COVID-19 pandemic which started with the countrywide lockdown in March 2020, mainly nursing professionals responded to the survey, namely, emergency, midwifery, paediatric, neonatal, surgical, medical care, and oncology nurses. Covid-19 infection rates were very high at the time, which meant that most doctors were already booked; therefore, only healthcare professionals were allowed to participate. A detailed questionnaire was developed. As stated in Table 1, healthcare professionals (nurses) were mentioned as working in the above-mentioned departments for this publication.

Structural equation modelling (SEM), as seen in Figure 1, uses SPSS Windows programme version 24. In this study, the unit analysis was based on healthcare professionals (nurses). Structural equation modelling, which examines causal relationships between latent variables, is the most widely used analytical technique (Tran et al. 2019). In general, SEM investigates the relationships between latent factors, which are measured by several consistent items. Factor analysis is a method of modelling the covariation among a set of observed variables as a function of one or more latent constructs. Factor analysis is used for determining the nature of the latent constructs that underpin the variables of interest (Bandalos & Finney 2019). Factor analysis seeks to identify underlying variables or factors that explain the pattern of correlations within a set of observed variables or construct items (Mukherjee, Sinha & Chattopadhyay 2018). One common goal of factor analysis is to produce a small number of factors that can be used to replace a much larger number of variables (Comrey & Lee 2013). Factor analysis is a data reduction technique that attempts to identify a small number of factors that explain most of the variance observed in a much larger number of manifest variables (Mukherjee et al. 2018). This means that at the end of factor analysis, the researcher will be left with variables that explain most of the variance while those that explain the least variance are discarded.

**TABLE 1:** Departmental survey instruments.

Departments	Steve Biko Academic Hospital	Kalafong Hospital	Pretoria West Hospital	Tshwane District Hospital	Total
Emergency	37	18	15	12	82
Midwifery	55	38	18	17	128
Paediatric	14	13	9	7	43
Neonatal	6	7	2	5	20
Surgical	59	43	14	16	132
Others (oncology and medical)	1	0	0	0	1
<b>Total</b>	<b>172</b>	<b>119</b>	<b>58</b>	<b>57</b>	<b>406</b>



EE, effort expectancy; SCT, smart card technology; SQ, system quality; IQ, information quality; PE, performance expectancy; FC, facilitating conditions; SI, social influence; US, user satisfaction; Comm, communication; Compa, compatibility; SU, system use; BI, behaviour intention; Trial, trialability; CoU, context of use; ImpSCT, implementation of smart card.

**FIGURE 1:** Structural model of smart card technology implementation.

The study extracted factors using the principal component analysis (PCA) method. The goal of PCA is to find a sequence of orthogonal factors that represent the directions of the greatest variance (Liu et al. 2018). Principal component analysis was used because it can form uncorrelated linear combinations of observed variables. It is also used to obtain the initial factor solution and can be used when a correlation matrix is singular. As a factor rotation method, a direct Oblimin method was used because the literature suggested some theoretical grounds that imply that the factors in this study are related or correlated during theory development. The study chose to display the coefficients in order of size and suppress coefficients with absolute values smaller than 0.4 (Rashied 2019). In this study, the following output was extracted and explained: correlation matrix, Kaiser-Meyer-Olkin and Bartlett's test, factor extraction, and rotated pattern matrix.

## Study analysis

To determine the relationship between observable indicators and latent components and to assess the precision of the measurement model, a confirmatory factor analysis (CFA)

was conducted. The most popular analysis tool for testing causal links between latent variables is SEM (Tran et al. 2019). For this reason, SEM was used to investigate the relationships between latent factors, which are measured by several construct items. AMOS software was used to accomplish the CFA and SEM procedures.

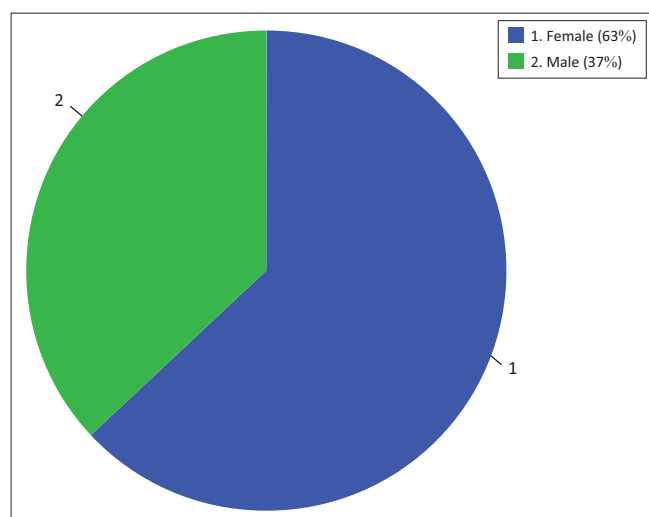
## Knowledge factors and smart card technology implementation

Regarding SCT interactions, the results in Table 2 show that every individual has experienced or used SCT in some way or the other. About 24.6% of the respondents indicated that they have used it for patient data, while 20.7% have used it for clinical data. A total of 18% of respondents have used it for data regarding radiology, and 13.1% and 12.8% of the sample have used SCT for laboratory and administration data, respectively. About 10.8% of the respondents indicated that they used SCT for pharmacy data. To further understand the knowledge about SCT that respondents possess, the study requested the respondents to rate their knowledge of SCT. The results in Table 2 indicate that even though they have interacted with SCT at some stage, a good number of respondents (61.8%) have little knowledge about SCT.

**TABLE 2:** Level of knowledge of technology and smart card technology.

Knowledge factor	Items	Frequency	%
SCT interactions	Patient data	100	24.6
	Clinical data	84	20.7
	Laboratory data	53	13.1
	Radiology data	73	18.0
	Pharmacy data	44	10.8
	Administration data	52	12.8
Computer literacy level	Little	117	28.8
	Fair	51	12.6
	Good	99	24.4
	Very good	20	4.9
	Excellent	119	29.3
SCT knowledge	Little	251	61.8
	Fair	10	2.5
	Good	136	33.5
	Very good	9	2.2

SCT, smart card technology.

**FIGURE 2:** Representation of gender.

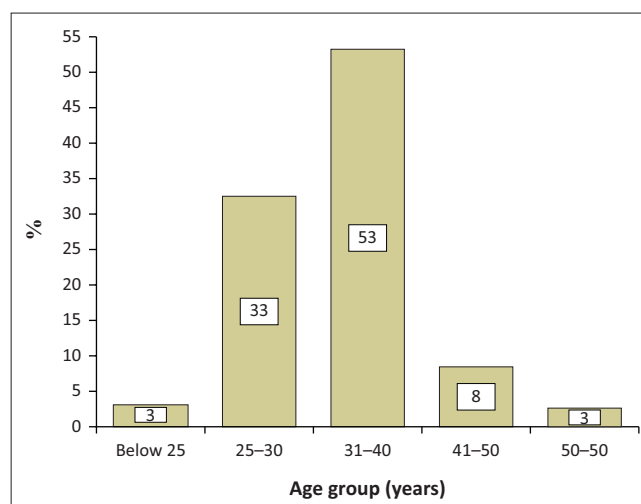
This is followed by 33% who have a good knowledge of SCT. A total of 2.2% and 2.5% of respondents, respectively, have very good and fair knowledge of SCT. Regarding computer literacy, 29.3% of the respondents have excellent computer skills, followed by 28.8% who have little knowledge about computers. A total of 24.4% have good knowledge of computers, while 12.6% and 4.9% have fair and very good knowledge of computers, respectively.

## Descriptive analysis

A total of 406 respondents participated in the study. The analysis included the following demographic variables, namely, gender, age, department, and level of education.

### Gender

The gender representation in terms of frequency is shown in Figure 2. The figure shows that females had the highest, that is, 63%, while their male counterparts were 37% of the total sample. Generally, it is difficult to obtain an equal representation of both genders; this phenomenon is common in many research studies.

**FIGURE 3:** Representation of age group.**TABLE 3:** Respondents' work departments.

Department	Frequency	%
Emergency	82	20.2
Midwifery	128	31.5
Paediatric	43	10.6
Neonatal	20	4.9
Support services	132	33.0
Others (oncology or medical care)	1	0.2
<b>Total</b>	<b>406</b>	<b>100</b>

### Age group

The study investigated the age groups of participants. The percentage representation of each age group is shown in Figure 3. The figure shows that the age group with the highest representation is 31 years–40 years with a total of 53% of the sample, followed by the age group 25 years–30 years with a total representation of 33%. A total of 8% of the respondents belonged to the age group 41–50 years, while the age groups below 25 years and above 50 years have an equal representation of 3% of the sample used in this study. Generally, most of the respondents are middle-aged, which is the age group that previous studies have classified as the technology age group (31 years–40 years). Therefore, it can be argued that most respondents were technophiles.

### Department

Table 3 indicates that 33% of the respondents work in the support services department, which is the most represented.

### Level of education

The majority of the respondents (52.5%) had a degree qualification, followed by 32.5% with a diploma. Those with a postgraduate qualification were 9.4%, while 4.7% of the respondents had at most a Grade 12 certificate. A negligible percentage (1.0%) of the sample had other qualifications. It can be argued that most respondents understood emerging technologies such as SCT. The level of education frequency is summarised in Table 4.

## Evaluation of influential factors for smart card technology implementation

This research was underpinned by three theories which are as follows: the HUTAUT Model (2018), DeLone and McLean IS Success Model (2003), and the DOI (2003).

### Information quality

The data in Table 5 demonstrate that healthcare professionals substantially disagree about whether the loaded information in the SCT is accurate for the IQ competencies of the SCT, with a maximum of 220 (54.2%) for item IQ1 (information loaded in the SCT is accurate). Item IQ2 (SCT information is credible and relevant for reporting) had 204 votes as well (50.2%). This indicates that respondents believe SCT is untrustworthy when it comes to reporting. Item 4 agrees that the SCT is simple to comprehend. Respondents are unsure about patients supplying appropriate quality information to be fed into SCT with 64 in item 3 (15.8%). Respondents disagree with 151 on item IQ2 (SCT information is credible and valuable for reporting) (37.2%).

### System quality

The data presented in Table 6 show that among the four questionnaire items for this construct, a maximum of 182 (44.8%) respondents disagree with Information and Communications Technology (ICT)'s willingness to solve problems related to connectivity (SQ3). Similarly, most respondents disagree with item SQ1 (the response time

offered by ICT is available) – a total of 178 (43.8%). This implies that respondents think there is poor support from ICT in maintaining the system. The results showed that most respondents disagreed with the question relating to whether there is enough knowledge and understanding about SCT (item SQ4). A total of 152 (37.4%) of the respondents completely disagreed about there being enough knowledge and understanding of SCT. The lowest percentage 1.5% (6 respondents) under item SQ3 strongly agreed that ICT is willing to solve connectivity issues with healthcare.

### Effort expectancy

The results in Table 7 address the EE variable adopted from the HUTAUT model. The data presented reflected four items of EE. In item EE2, a maximum of 208 (51.2%) strongly disagreed that it would be easy for them to use the SCT. Similarly, item EE3 showed that 263 (64.8%) respondents also disagreed with whether they believed that they would find the SCT easy to use. Item EE4 had 197 (48.6%) respondents confirming that healthcare professionals were uncertain about whether it is easy for them to learn to operate the SCT. This implies that respondents are uncertain about how the SCT is going to operate. Item EE1 had the lowest number who agreed, 4 (1%), that their interaction with the SCT would likely be clear and understandable. Item EE2 with a total of 4 (1%) and EE3 with a total of 4 (1%), respectively, for strongly disagree, highlighted the frustration regarding the usability or understanding of the SCT in both items.

## Discussion

The findings of the study are based on the respondents' understanding of SCT and implementing SCT in a healthcare institution. The findings have shown that 33% of the respondents have a good knowledge of SCT while 2.2% and 2.5%, respectively, have a very good and fair knowledge of SCT. Regarding computer literacy, 29.3% of the respondents

**TABLE 4:** Respondents' level of education.

Education level	Frequency	%
Grade 12 or below	19	4.7
Diploma	132	32.5
Degree	213	52.5
Postgraduate	38	9.4
Other qualifications	4	1.0
<b>Total</b>	<b>406</b>	<b>100</b>

**TABLE 5:** Information quality.

Item number	Items	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree	
		<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
IQ1	Information loaded in the SCT is accurate.	1	2	29	7.1	54	13.3	220	54.2	102	25.1
IQ2	The SCT information is reliable and useful for reporting.	1	2	3	7.0	47	11.6	151	37.2	204	50.2
IQ3	Patients provide relevant quality information to be loaded in SCT.	1	2	29	7.1	64	15.8	203	50.0	109	26.8
IQ4	SCT is easy to understand.	1	2	7	7.0	57	14.0	192	47.3	153	37.7

SCT, smart card technology; *f*, frequency; IQ, information quality.

**TABLE 6:** System quality.

Item number	Items	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree	
		<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
SQ1	Response time on faulty systems	8	2.0	73	18.0	74	18.2	178	43.8	73	18.0
SQ2	Do the ICT department keep the users/ healthcare professionals informed of downtime?	27	6.7	115	28.3	109	26.8	96	23.6	59	14.5
SQ3	ICT is willing to solve problems related to connectivity.	6	1.5	65	16.0	79	19.5	182	44.8	74	18.2
SQ4	There is enough knowledge and understanding about SCT.	24	5.9	75	18.5	70	17.2	152	37.4	85	20.9

ICT, Information and Communications Technology; SCT, smart card technology; *f*, frequency; SQ, system quality.

TABLE 7: Effort expectancy.

Item number	Items	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree	
		<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
EE1	My interaction with the SCT would likely be clear and understandable.	7	1.7	4	1.0	37	9.1	188	46.3	170	41.9
EE2	I believe it would be easy for me to become skilful at using the SCT.	4	1.0	61	15.0	22	5.4	111	27.3	208	51.2
EE3	I believe I would find the SCT easy to use.	4	1.0	5	1.2	26	6.4	263	64.8	108	26.6
EE4	Learning to operate the SCT is easy for me.	28	6.9	27	6.7	197	48.6	154	37.9	28	6.9

EE, Effort expectancy; SCT, smart card technology; *f*, frequency; EE, effort expectancy.

have excellent computer skills, followed by 28.8% who have little knowledge about computers. About 24.4% of the respondents have good knowledge of computers, while 12.6% and 4.9%, respectively, have fair and very good knowledge of computers.

Respondents were asked to identify the departments in which they are working. The results indicated that 33% of the respondents work in the support services department, which is the most represented. This was followed by the casualty department with a total of 32% of the sample. Admission and pharmacy departments have a representation of 20% and 11%, respectively. The least represented departments are the IT department and other departments that were not explicitly mentioned in the questionnaire, each with 5% and 0.2%, respectively. Although health IT has many advantages, it still has shortcomings too, such as a lack of transparency in the management of medication errors, hence the inclusion of all the departments that are affected by the delivery of healthcare (Howell et al. 2016). Patients' medication documentation errors can be a significant springboard for adverse drug events (Rohm & Milne 2004). Delivering quality healthcare and access to data for smart card technology implementation, when manual files become misplaced, lost, or stolen, it becomes a major problem to replace them. With the Department of Health's six fast-track schemes, addressing the quality issues of healthcare has been identified as one of the key issues that need to be addressed to improve it. This framework aims to address these issues through a series of actions and initiatives. Prior researchers found that electronic management records are useful for storing citizen data in Taiwan (Sethia et al. 2019). The study will seek to investigate other factors that influence the use of SC by healthcare professionals to improve technology-supported healthcare delivery services.

The results of this study found that healthcare professionals influence the implementation of SCT. These results may also be influenced by a strong relationship between the implementation of SCT and EE. The results of this study agree that the EE construct is associated with the use of a technology that is to be implemented or that has been implemented (Ejiobih et al. 2019). Furthermore, the effect of EE on behavioural intention is moderated by gender and age such that the effect is strongest for older women in the early stages of experience with the system (Vanneste, Vermeulen & Declercq 2013). Effort expectancy has to do with SCT usability, which aims to improve the quality of service in the delivery of healthcare. Effort expectancy

positively influences the implementation of SCT. This construct has a significant effect on the implementation of SCT in the public healthcare sphere.

Information quality is a measure of how well the information is presented to a healthcare professional (Shim & Jo 2020). The results of the study further confirm that IQ is pertinent to the content available on the site regarding aspects such as accuracy, completeness, and recency (Shim & Jo 2020). It also indicates how well the information is formatted and presented. To improve the quality of healthcare services, the Department of Health created policies that guide the private and government sectors in implementing computerised systems. This system should allow hospitals and clinics to seamlessly integrate business processes. The concept of IQ refers to the integration of various factors such as human factors, organisational factors, and technical factors into a solid health IS's implementation (Kilsdonk, Peute & Jaspers 2017). Information quality is effective in reducing health information overload, and 'training interventions' have been devised to combat information overload. Thus, a suggestion was made that there is a need for assessing more interventions that concentrate on the ability of consumers to manage health information overload. However, for the benefit of this study, IQ did not carry any weight and it was not fully supported in the implementation of the SCT.

System quality refers to the component of an IS dimension and, thus, subsumes various measures of the system itself. Although SQ is perceived as contributing to convenience, technology adaptability, system accuracy, response time, and ease of use are all factors (Lau & Kuziemsky 2016). System quality was equally referred to as the technical aspects and has three categories of measures, that is, system functionality, performance, and security. Functionality covers the type and level of SCT features present such as order entry with decision support for reminders and alerts (Sellappans et al. 2013). System quality covers the technical behaviour of SCT in terms of its accessibility, reliability, and response time (Shim & Jo 2020). However, SQ is frequently regarded in terms of the security component of the system, which protects the integrity of the information or data recorded and ensures correct permission.

Finally, the EE provided in the study significantly influences the implementation of SCT in public healthcare. This result revealed that EE was significant for the implementation of SCT with existing values and needs. Hence, EE plays an

important role in the implementation of SCT and should be considered important.

## Conclusion

The state of e-health in public healthcare institutions resorting under the Department of Health is at best unsatisfactory. E-health systems are focused mainly on selected central hospitals, thus neglecting other hospitals. The state of e-health in public hospitals can therefore be described as nascent. For this reason, the need for guidelines that help promote the implementation of SCT in public healthcare institutions cannot be ignored. It can be concluded that EE, IQ, and systems quality have an impact on the implementation of SCT.

This study has revealed the factors that influence the implementation of SCT in South African public hospitals. Also results of this study will assist the healthcare professionals and the Department of Health in how to implement the SCT successfully. In addition, the study has the potential to contribute to the eradication of the lack of a healthcare framework to support healthcare professionals. The study shows that the success of an SCT depends on several factors. These include government policy, ICT skills and knowledge, ICT and e-health infrastructure, funding, medical facilities, and IT technical support, among others. Furthermore, the findings reveal that doctors in public hospitals are facing the same challenges in the implementation of SCT. The potential for implementing e-health in South Africa is enormous when the mentioned factors are considered.

Information is extremely important for the appropriate treatment of all patients. The true cost of producing information to assist hospitals is not always quantifiable, and its value in this case is not measurable. The advantages associated with possessing medical records cannot be overemphasised. The medical record is an important primary tool in the practice of medicine and hospitals; the goal is to provide better care to the patient by diligently recording every detail about his or her case. As a result, medical records are essential for ensuring that patient information is kept and used consistently.

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## Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

## Authors' contributions

L. Malungana wrote the entire article and L. Motsi assisted in completing the article as a supervisor by offering advice and support, including directing, instructing, and encouraging the research efforts.

## Ethical considerations

Ethical approval was granted by the National Health Research Council (NHRC) and the University of South Africa Ethical Clearance Committee (2020/CAES\_HREC/081).

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## Data availability

The data that support the findings of this study are available from the corresponding author, L.M. on request.

## Disclaimer

The views and opinions expressed in this article are those of the authors and are the product of professional research. It does not necessarily reflect the official policy or position of any affiliated institution, funder, agency, or that of the publisher. The authors are responsible for this article's results, findings, and content.

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