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ORIGINAL RESEARCH

Towards a quantified-self technology conceptual framework for monitoring diabetes

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Introduction: The objective of this paper is to identify the factors that influence the adoption of Quantified Self Technology (QST) in monitoring diabetes. QST facilitates the tracking by oneself, their biological or physical elements, environmental data, individual mental states or behavioural elements using either wearable technology or mobile health apps. The benefits of QST have not been properly realised in the health sector despite their potential in monitoring life-threatening chronic diseases such as diabetes. This study identified factors that influence the adoption of QST in monitoring diabetes.

Methods: This is a systematic literature review study that analysed peer-reviewed published papers between 2018 to 2023. The papers were extracted from five scholarly databases, EBSCO, Web of Science, Science Direct, Proquest and Scopus. A total of 42 papers were analysed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).

Results: This study proposes a conceptual framework for the adoption of QST for monitoring diabetes. The main factors that influence the adoption of QST by diabetic patients were identified as technology awareness, technology preparedness of the diabetic patient, service quality of medical applications, social norms, and security concerns related to medical applications. These factors constituted the main constructs of the proposed conceptual framework of this study.

Conclusion: The literature analysis uncovered the main factors that influence the adoption of QST for monitoring diabetes. The proposed conceptual framework situates QST within its multiple intersecting components that together influence its adoption in monitoring diabetes.
Contribution: This paper contributes literature in the field of technology adoption, focusing on the use of QST in monitoring diabetes. This is a new niche area and understanding adoption patterns of QST in monitoring diabetes is valuable in providing resources for primary health care for people with diabetes.

Keywords: quantified self technology, self tracking, diabetes, self monitoring, mobile health apps, remote health monitoring, wearable devices, lifelogging, personal analytics

Ontwikkeling van 'n gekwantifiseerdeself-tegnologie-konseptuele raamwerk vir die monitering van diabetes:

Inleiding: Die doel van hierdie artikel is om die faktore te identifiseer wat die aanvaarding van gekwantifiseerdeself-tegnologie (GST) vir die monitering van diabetes beïnvloed. GST is tegnologie wat die selfnasporing van biologiese of fisieke elemente, omgewingsdata, individuele geestestoestande of gedragselemente vergemaklik deur gebruik te maak van draagbare tegnologie of mobiele gesondheidstoepassings. Die voordele van GST is nog nie behoorlik in die gesondheidsektor gerealiseer nie, ondanks die potensiaal daarvan om lewensbedreigende chroniese siektes soos diabetes te moniteer. Hierdie studie het faktore geïdentifiseer wat die aanvaarding van GST vir die monitering van diabetes beïnvloed.

Metodes: Hierdie studie is 'n sistematiese literatuuroorsigstudie wat ewekniegeëvalueerde gepubliseerde artikels en referate tussen 2018 en 2023 ontleed het. Die artikels en referate is uit vyf wetenskaplike databasisse, EBSCO, Web of Science, Science Direct, Proquest en Scopus, onttrek. Altesaam 42 artikels en referate is met gebruik van die Voorkeurverslagdoeningsitems vir Sistematiese Oorsigte en Meta-ontledings (Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)) ontleed.

Resultate: Hierdie studie stel 'n konseptuele raamwerk voor vir die aanvaarding van GST vir die monitering van diabetes. Die belangrikste faktore wat die aanvaarding van GST deur diabetiese pasiënte beïnvloed, is geïdentifiseer as tegnologiebewustheid, tegnologievoorbereidheid van die diabetiese pasiënt, diensgehalte van mediese toepassings, sosiale norme, en veiligheidskwessies wat met mediese toepassings verband hou. Hierdie faktore was die hoofkonstrukte van die voorgestelde konseptuele raamwerk van hierdie studie.

Gevolgtrekking: Die literatuurontleding het die belangrikste faktore aan die lig gebring wat die aanvaarding van GST vir die monitering van diabetes beïnvloed. Die voorgestelde konseptuele raamwerk plaas GST binne die veelvuldige oorvleuelende komponente daarvan wat saam die aanvaarding van GST vir die monitering van diabetes beïnvloed.

Bydrae: Hierdie artikel dra literatuur by op die gebied van tegnologieaanvaarding, met die fokus op die gebruik van GST vir die monitering van diabetes. Dié is 'n nuwe nisarea en die begrip van aanvaardingspatrone van GST vir die monitering van diabetes is waardevol vir die verskaffing van hulpbronne vir primêre gesondheidsorg vir mense met diabetes.

Sleutelwoorde: gekwantifiseerde-self-tegnologie, selfnasporing, diabetes, selfmonitering, mobiele gesondheidstoepassings, afstandgesondheid monitering, drabare toestelle, lewenstyl, persoonlike analise

Introduction

The World Health Organization (WHO) has provided the guiding principle for managing communicable and non-communicable diseases (World Health Organization 2019). One such disease is diabetes, an incurable non-communicable lifestyle disease that affects millions of people worldwide (Zimmermann et al. 2018). The management of diabetes requires regular monitoring of blood glucose levels, dietary intake, physical activity and medication adherence. Research has shown that the weaknesses of traditional methods of monitoring diabetes can be overcome by exploiting the capabilities of QST (Lupton 2017; Heyen 2020).

QST has also been referred to as self-tracking (Ajana 2020; Heyen 2020; Riggare et al. 2019), self-monitoring (Brohi et al. 2020), lifelogging (Wilkwoska 2021; Kim et al. 2019) and personal informatics/analytics (Lupton 2017; Kooiman et al. 2018; Maltseva & Lutz 2018; Dulaud et al. 2020; Heyen 2020; Feng et al. 2021). QST is used to collect, analyse and maintain data that is used by self-quantifiers to carry out and achieve their long-term goals of tracking weight loss, sound sleep, healthy behaviours, wellness, and, most importantly, a better understanding of their bodies (Calvard 2019). It is a selfhood activity that adheres to sociocultural norms regarding the importance of self-awareness, introspection and embracing responsibilities for managing, governing and improving one's livelihood in life. The QST era has stimulated in people the will to improve themselves beyond the limitations of nature, age and diseases, enabling them to function beyond the scope of their normal and physical capabilities (Lupton 2019). QST uses technological tools such as wearable devices, mobile applications and other digital tools (Heyen 2021; Feng et al. 2021). QST can help reduce healthcare costs, manage diabetes, promote medication adherence, provide motivational support, monitor diabetes as it progresses, assist elders and promote activity and diet tracking, thus improving the quality of life of diabetics (Almegbel & Aloud 2021; Felipe et al. 2022).

The systematic reviews focusing on the adoption patterns and the factors that influence the adoption of QST are lagging. Little is known about how members of marginalised or stigmatised groups, such as those in Africa, engage in self-tracking, oppose it or even re-invent it (Lupton 2017). A thorough analysis of a wide range of recent literature that helps us understand the motivations behind the effects of Quantified Self (QS) behaviour in monitoring diabetes is required. Hence, this review aims to investigate the factors that influence the adoption of QST by diabetic patients. This corresponds to the study's main research question: "What are the factors that influence the adoption of QST in monitoring diabetes?". To identify these factors, the inquiry was conducted as a systematic literature analysis.

The remainder of this article is organised as follows: Section 2 presents the background of the study, Section 3 presents the methods, Section 4 presents the results, Section 5 presents the discussion, Section 6 presents the proposed conceptual framework, and Section 7 presents the conclusion and future direction for research.

Background to the study

This study reviewed 11 systematic literature review articles to understand the Quantified Self Technology phenomenon. The number of studies covered by these systematic reviews is a minimum of 26 studies (Almalki et al. 2016) and a maximum of 523 studies (Epstein et al. 2020), whilst one review did not specify the number of studies covered (Swann et al. 2021). The industrialised nations, namely the United States of America and those on the European continent, have produced the majority of the studies on QS. Further analysis of the papers reveals that the domain of the QS phenomenon is interdisciplinary, as evidenced by different publishing fields, which include the medical field, medical informatics, information systems and computer science (Epstein et al. 2020; Yfantidou et al. 2023). The findings reveal that the QS phenomenon in the medical field dates back to the 1990s (Mogre et al. 2019). Nevertheless, the information systems field has revealed that this is an emerging field gaining dominance around 2014, especially in research focusing on leveraging QS in monitoring chronic diseases (Mogre et al. 2019; Feng et al. 2021). Consequently, most published papers on QS began to appear and significantly rose in the period 2014 to 2017.

Researchers reviewing the QS phenomenon state that self quantification is mainly practised by people who want to leverage technology to have a better understanding of their own bodies (Jiang & Cameron 2020; Tabaei-Aghdaei et al. 2023; Yfantidou et al. 2023). To achieve this, they must engage in self-quantification activities, such as data collection and analysis. Thus, health self-quantification is data-driven as well as objective-oriented mediated by QS tools (Almalki et al. 2016). These QS tools have been identified by the reviewed articles as mobile apps, web-based tracking programs, medical devices (glucometers) and wearable technologies (smartwatches) that enable self-monitoring of chronic diseases (Jiang & Cameron 2020;De Moya et al. 2019). Indeed, mobile phone applications are the most used QS tools (Lentferink et al. 2017). These tools allow individuals to collect data in real-time, effortlessly and seamlessly, and provide self-trackers with detailed insights into their daily habits and routines. In the medical field, the most

cited reasons for self-quantification are behaviour change, awareness, habit and chronic disease management (Epstein et al. 2020; Tabaei-Aghdaei et al. 2023). Moreover, the information systems domain also reveals that self-quantification presents key affordances, such as preparedness, data collection, user reflection and action, and social connections (Jiang & Cameron 2020).

The medical field has focused on the clinical experience of QST in improving health outcomes and managing chronic diseases. Reviews in this field mainly focus on applying the goal setting theory in measuring physical activity to understand what a goal is, how to classify goals, how to set goals, and the implications of setting goals for one's health (Swann et al. 2021; Ogbeiwi 2021; Tabaei-Aghdaei et al. 2023). The findings of these aforementioned reviews reveal that setting goals has both positive and negative implications. The positive health-related outcomes are satisfaction, improved quality of life and disease management (Tabaei-Aghdaei et al. 2023). As a result, goals can aid as a motivator or incentive to help self-quantifiers continue in self-tracking activities until they achieve the intended outcomes. On the other hand, prior research has shown that activity-tracking tools for self-quantification can produce false information, which could compromise users' performance and confidence in these methods (Almalki et al. 2016). Similarly, other research state that inappropriately set goals to measure one's health can have negative repercussions, such as stress, pressure, unethical behaviours and perceptions of failure, leading to persons not tracking their health (Swann et al. 2021; Ogbeiwi 2021).

Other reviews in the medical field have focused on adherence behaviours (Mogre et al. 2019). Their findings reveal that diabetic patients in middle to low-income studies do not adhere to diabetes self-care behaviours such as diet and exercise, which is a cause of concern given the health outcomes associated with poor diabetes management.

Reviews in the computer science domain have focused on design considerations for evaluating self-quantification technological interventions (Yfantidou et al. 2023). These studies advocate the necessity of developing standardised, reliable and extensible frameworks for health behaviour change (HBC) and user engagement (UE). To achieve this, machine learning libraries and pre-built Application Programming Interfaces need to be leveraged.

A review and synthesis of the literature on the QS in information systems reveals that this field of study is still in its infancy, as very few studies have investigated the self-quantification phenomenon. Hence, reviews in this field are very scant and have no common focus (Almalki et al. 2016; De Moya et al. 2019; Jin et al., 2020). An early review in this field by Almalki et al. (2016), focusing on studies solely based on the Activity Theory, reveals that achieving a useful health outcome is difficult because one needs to manage the data and reflect on it. Nevertheless, De Moya et al. (2019) focused on the adoption and utilisation of self-tracking technologies. Their findings reveal that the main factors influencing self-tracking adoption are social norms and hedonic motivation. In addition, a review that focuses on the drivers of fitness-tracking technologies has revealed that the main driver categories that influence adoption are user characteristics, device characteristics, perceived benefits/risks and external drivers, social factors and health factors (Jin et al. 2020). Jiang and Cameron (2020) solely focused on the self-monitoring of chronic diseases by delivering an organising framework on the current status of IT-based self-monitoring (ITSM). They reveal that ITSM can transform multiple aspects of chronic care.

In terms of scope, reviews in the medical field have mainly concentrated on medical intervention designs and medical methodologies, such as random control experimental trials and non-random experimental trials, to monitor adherence (Lentferink et al. 2017; Mogre et al. 2019; Earle et al. 2021; Yfantidou et al. 2023; Tabaei-Aghdaei et al. 2023). In the information systems domain, the most commonly used methodology in studies reviewed is the quantitative method (De Moya et al. 2019; Feng et al. 2021). This methodology has been used for description and prediction rather than explanation of QS. Despite the relevance of quantitative studies, which only provide statistical meanings that are not explanatory, it is necessary to investigate these factors using other research methodologies, such as qualitative or mixed methods, as they may reveal additional relevant factors and give us a deeper understanding of the QS phenomenon.

In terms of theoretical foundations, most studies did not base their research on theory. Those that did, leveraged the Technology Acceptance Model (TAM); Self Determination Theory (SDT) (Feng et al. 2021; Yfantidou et al. 2023); Social Cognitive Theory (Jiang & Cameron 2020; Lentferink et al. 2017); Activity Theory (Almalki et al. 2016); Extended TAM (UTAUT) (De Moya et al. 2019); and Goal Setting Theory (Ogbeiwi 2021). These theories, specifically the Social Cognitive Theory, TAM and UTAUT, have mainly been used to inform overall intervention design or to interpret study results rather than to support hypotheses (Jiang & Cameron 2020). Consequently, most of these studies cite theory to inform interventions and tool design or to measure development but do not use theory to explain the relationships under investigation. Thus, these theoretical underpinnings were prevalent in research focusing on self-monitoring, use continuance, motives and goals (Lentferink et al. 2017; Jiang & Cameron 2020; Feng et al. 2021; Yfantidou et al. 2023). These findings reveal that there is no common theoretical framework for self-quantification intervention and adoption. Hence, the lack of theoretical foundations grounding the research leaves a lot of unanswered questions. Hence there is a need to develop new substantive research theories that may contextualise the QS phenomena to relate better to context-specific demands. A review of the body of literature demonstrates that a new framework can deliver more and offer comprehensive solutions. Given these considerations, further theory-focused research is still needed to strengthen the theoretical and conceptual underpinnings and broaden our understanding of QST (Feng et al. 2021).

Nonetheless, the QS movement continues to evolve and inspire individuals to take an active role in their own self-improvement. By harnessing the power of technology and personal data, it offers new possibilities for understanding and optimising human behaviour, health and performance.

Several common future research directions are suggested by these reviews, despite emanating from varied disciplines. These include the need to focus on privacy and trust issues associated with the QS phenomenon (De Moya et al. 2019; Epstein et al. 2020); the need to underpin research through theoretical lenses (Almalki et al. 2016; Jiang & Cameron 2020; De Moya et al. 2019; Epstein et al. 2020); the need to understand patients' attitudes toward QST adoption, as well as towards the barriers and facilitators of self-tracking (De Moya et al. 2019; Feng et al. 2021); and the need to contextualise studies because different socio-cultural contexts, especially those emanating from developing nations, can reveal significant factors influencing QST adoption (De Moya et al. 2019).

Considering these constraints in terms of the scope of preceding reviews and the growing body of research on QS, there is a need for a current and comprehensive literature review. It is against this background that this study conducts a systematic literature review with the aim of investigating the factors influencing the adoption of QST. If the role of QST in managing chronic diseases is misunderstood, it may lead to missed opportunities both in terms of practice and research (Jiang & Cameron 2020).

Methods

A systematic literature analysis (SLR) methodology was employed to answer the research question, "What are the factors that influence the adoption of QST in monitoring diabetes?". The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) steps included identification, screening and eligibility, and structured the literature analysis of this study (Rethlefsen & Page 2022).

Identification

The peer-reviewed and published papers analysed in this study were sourced from five scientific databases, namely ProQuest, EBSCO, Web of Science, Science Direct and Scopus research. A search term was constructed to query the above databases, and it had some variations to suit the syntax of the database. The structure of the search term was as follows: (TITLE ("Seltrack*" OR selftrack* OR "QuantifiedSelf*" OR "selmonitor*" OR selfmonitor* OR "lifelog*" OR lifelog* OR "personalanalytic*" OR "personalinformatic*") AND TITLE (diabet*)). Execution of the search query yielded 1 536 articles distributed as follows: EBSCO n = 25 articles, Proquest n = 698 articles, Web of Science n = 150 articles, Science Direct n = 343 and Scopus n=320.

Screening

The papers included for analysis were published between 2018 and 2023. Excluded papers were from medical journals not focusing on the applications of QST. Hence, from the 1 536 papers identified, a total of 1 101 papers were eliminated by reviewing the title and abstract of the paper.

Eligibility

All the papers retrieved were written in the English language and the subjects of the papers were information technology, information systems or health informatics. The papers were peer-reviewed and published in journals or conference papers. The included papers focused on the application or adoption of QS to monitor diabetes, lifestyle or self-improvement. Hence 155 papers remained.

Included

A total of 155 papers were screened and thematically reviewed. Two rounds of reviews were done. The first review was done to scan through the paper and determine if each paper did address the research question of the paper. After the first round, 113 papers were excluded. The remaining 42 papers went into the second round and were analysed to identify factors that affect the adoption of QST by diabetic patients in monitoring diabetes or any other illness or as a lifestyle habit tool. The factors identified were then grouped into themes and were used in the development of a QST conceptual framework.

Results

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used, as proposed by Moher et al. (2009). The flow diagram for this study using PRISMA is depicted in Figure 1.

Studies analysed and corresponding factors influencing adoption

This study reviewed 42 papers. The complete list of publications and corresponding factors are presented in Table I.

These papers identified a total of 12 factors influencing the adoption of QST. Figure 2 presents these factors and their frequency in the publications listed in Table I.

The potential advantages and prospects offered by QST were noted by all research studies (42 out of 42 publications) as a factor influencing the adoption of the technology. Tracking, self-monitoring, patient engagement and physician communication, cost-effective outcomes, chronic disease management, medication adherence, knowledge of the diseases, task motivation, data collection and assisting elders are the 10 primary opportunities that were found.

Another significant influence was the technology's perceived usefulness (30 articles out of 42). The reviewed articles noted that for the QST to be valuable to users, it must offer services that are advantageous to them, such as the capability to consistently monitor their diabetes (Kimura et al. 2022).

Social norms also emerged as a prominent factor (20 out of 42 articles). These results suggest that the adoption of QST is significantly influenced by the social-cultural milieu.

Experience with the technology is also a significant factor (19 articles). The likelihood of users using the technology is higher for individuals who have used it before than for non-users.

The perceived ease of use of the technology was another factor that was found to be important. It was cited in 17 publications and was shown to be both a tremendous enabler of and a deterrent to technology adoption, as users tend to examine the complexity of technology before adopting it.

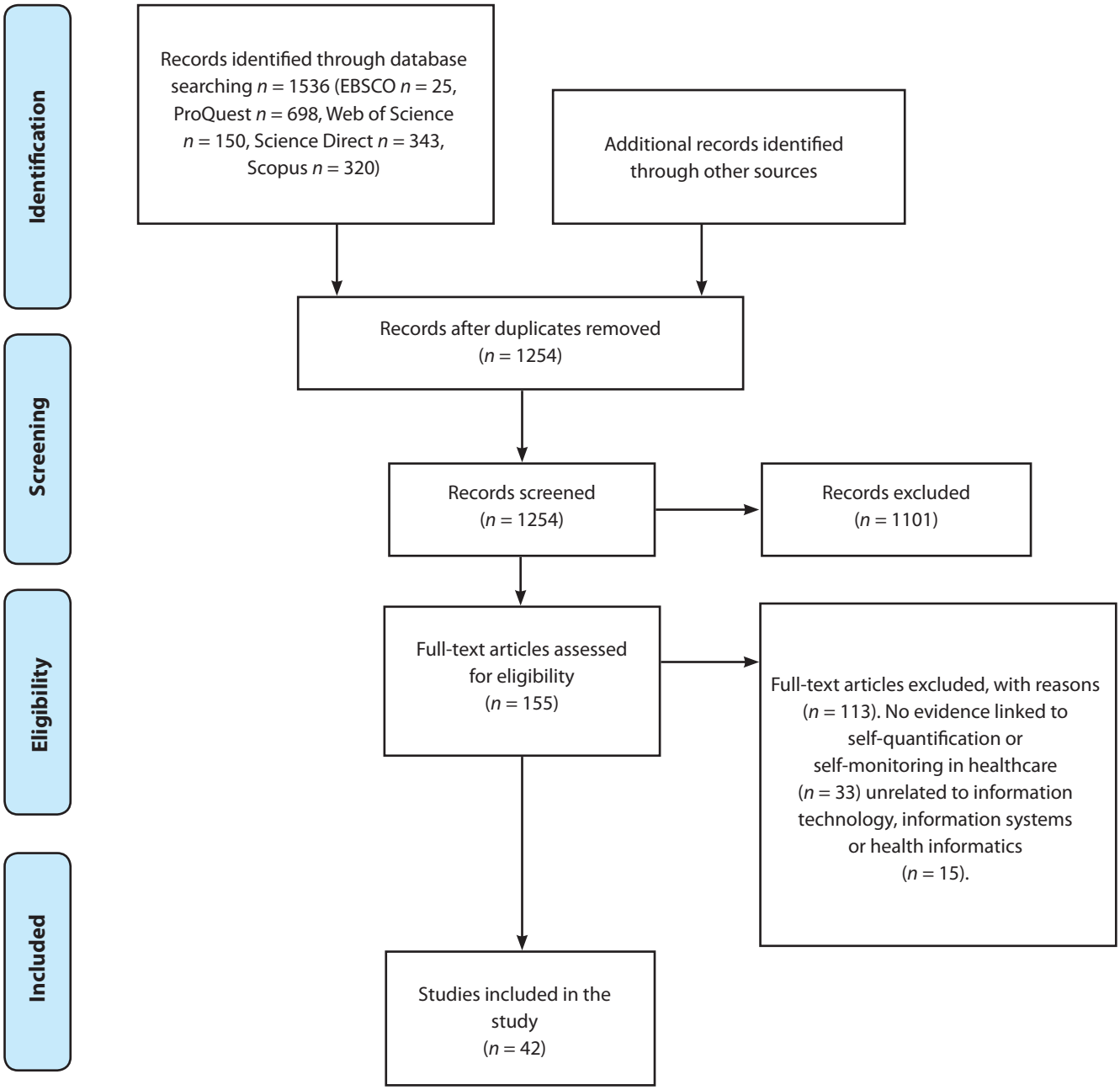

Figure 1: The search process with inclusion and exclusion criteria

Table 1: Factors Influencing the Adoption of QST Identified in Literature

Author & Year	Perceived usefulness of the technology	Perceived ease of use	Social influence	Perceived enjoyment	Perceived reliability	Affordability of the technology	Data privacy	Access to resources	Experience	Awareness	Trust	Perceived benefit
Zhang & Mao 2023	✓	✓	✓			✓						✓
Zhang et al.2023	✓		✓								✓	
Martínez-Ibáñez												
et al. 2022	✓					✓			✓	✓		✓
Jakowski 2022	✓											✓
Kimura et al. 2022	✓	✓	✓			✓			✓			✓
Grosová et al. 2022	✓	✓	✓	✓		✓		✓				✓
Schretzlmaier et al. 2022	✓	✓	✓	✓		✓		✓				✓
Chittem et al. 2022			✓			✓		✓	✓	✓		✓
Jin et al. 2020	✓			✓	✓	✓	✓		✓			✓
Findeis et al. 2021						✓	✓	✓			✓	✓
Mak et al. 2021	✓		✓	✓		✓		✓	✓			✓
Zhao et al.2021	✓			✓								✓
Chen et al. 2021	✓	✓	✓			✓	✓		✓			✓
De Moya et al. 2021	✓	✓	✓		✓		✓					✓
Lv et al. 2021			✓					✓	✓	✓		✓
Almegbel & Aloud 2021	✓	✓	✓		✓	✓		✓				✓
Chebolu 2021			✓				✓		✓		✓	✓
Wilkowska et al. 2021	✓	✓							✓			✓
Lee & Lee 2020			✓						✓	✓		✓
Liu et al. 2020	✓											✓
Dulaud et al. 2020	✓											✓
Ajana 2020	✓						✓	✓			✓	✓
Heyen 2020	✓											✓
Brohi et al. 2020			✓			✓			✓	✓		✓
Gangadharbatla 2020	✓	✓					✓	✓	✓			✓
Pentikäinen, 2019							✓	✓	✓			✓
Breil et al. 2019	✓	✓	✓						✓			✓
Lupton 2019	✓			✓						✓		✓
Zhang et al. 2019						✓		✓		✓	✓	✓
Zhang et al. 2019					✓		✓	✓	✓		✓	
Riggare et al. 2019	✓											✓
Khakurel et al. 2019							✓					✓
Kim et al. 2019	✓	✓										✓
Mishra et al. 2019	✓											✓

Table 1: Factors Influencing the Adoption of QST Identified in Literature *(continued)*

Author & Year	Perceived usefulness of the technology	Perceived ease of use	Social influence	Perceived enjoyment	Perceived reliability	Affordability of the technology	Data privacy	Access to resources	Experience	Awareness	Trust	Perceived benefit
Jeffrey et al. 2019	✓	✓			✓				✓	✓		✓
Yu et al. 2019	✓	✓										✓
Apolinário-Hagen et al. 2018												
	✓	✓	✓						✓			✓
Schroeder et al. 2018	✓		✓									✓
Rupp et al. 2018	✓	✓	✓						✓		✓	✓
Kooiman et al. 2018	✓		✓									✓
Zhao et al. 2018	✓	✓	✓							✓		✓
Lee & Lee 2018		✓			✓			✓	✓		✓	
Maltseva & Lutz 2018							✓				✓	✓

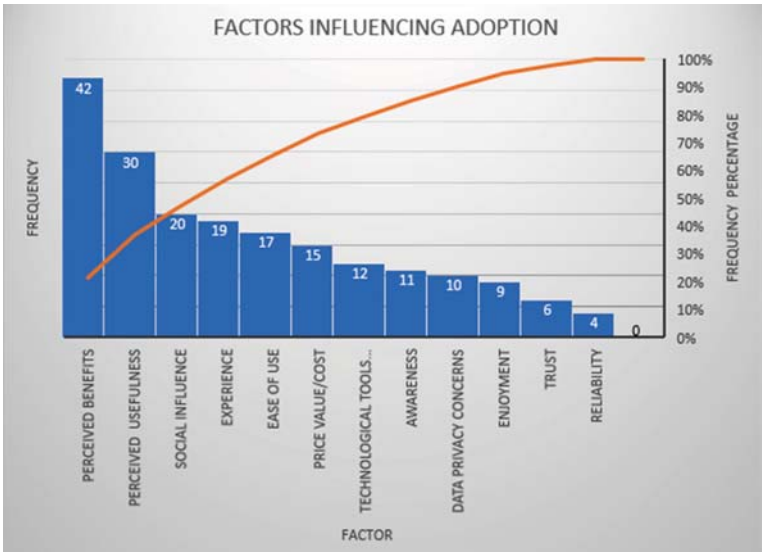

Figure 2: Factors Influencing QST Adoption

Other factors that emerged included the cost factor, which in this study is termed affordability of the technology. This includes the price of purchasing smartphone technology and the cost of downloading and using the QS app, because it needs broadband. Another factor that was mentioned as a potential barrier to adoption was the Access to Resources (12 articles). Resources identified in this review encompass the availability of networks, internet, the self-quantification application and smartphones.

Data privacy concerns and trust issues were also highly prevalent (10 articles). The prevalence of data privacy concerns and trust issues suggests that users consider the risks associated with a technology before implementing it and these need to be identified and assessed before technology adoption.

Although the majority of the studies (31 out of 42 publications) did not discuss or investigate the awareness state for the QS (sufficient knowledge), the 11 studies that did, did not provide a thorough explanation of the awareness component. According to the findings, there hasn't been much comprehensive research done on how much is known about diabetes monitoring using QST. Given that the awareness stage has extremely important and major implications for the adoption of QST based on the Diffusion of Innovations theory, research on diabetics' awareness of the prospects and challenges it presents is necessary.

Discussion

This study aimed to determine the factors influencing the adoption of QST in monitoring diabetes. A review of the literature revealed that the factors influencing the adoption of QST are usually affected by five main themes: Technology Awareness, Technology Preparedness, Service Quality, Social Norms and Security Concerns (Chen et al. 2021; Jeffrey et al. 2019; Kavandi & Jaana 2020). These themes and consequent factors are discussed below.

Technology preparedness of the diabetic patient

Technology Preparedness of the diabetic patient is the capability of individuals to use new technology effectively and efficiently (Hero 2020; Machaba & Bedada 2022). Users who are technology-prepared through experience with the technology or similar technologies, who have access to resources and who can afford the costs associated with the technology have

higher chances of adopting technology (Almegbel & Aloud, 2021; Schretzlmaier et al. 2022; Grosová et al. 2022; Jeffrey et al. 2019; Zhao et al. 2021). Table II presents the factors associated with technology preparedness and where they have been referenced in the literature.

Technological experience

Technological Experience refers to familiarity with the technology through previous practical use of similar applications or observing the technology in use over a period of time (Ayaz & Yanartas 2020; Wilkowska et al. 2021). This construct is a moderating factor in models such as the TAM, UTAUT and UTAUT (2) (Venkatesh et al. 2003). Prior research indicates that people with a high level of experience are more optimistic about utilising the technology and hence adopting it compared to those who do not have such experience (Jeffrey et al. 2019; Gangadharbatla 2020; Breil et al. 2019; Apolinário-Hagen et al. 2018; Wilkowska et al. 2021).

Access to resources

Access to Resources is the accessibility of all technological tools that are required to support an individual in using the technology (Teye & Duah 2022). In theoretical models like UTAUT(2) and TAM, these may be known as facilitating conditions (Venkatesh et al. 2003). The adoption of QST can be positively or negatively impacted by the access to resources (Schretzlmaier et al. 2022). A study in Czech shows that the access to QST resources such as smartphones has no impact on the adoption of QST since the majority of the population are owners and users of smartphones (Grosová et al. 2022). Contrary to this, other studies indicate that the lack of resources such as internet access results in individuals not tracking their health and hence not adopting QST (Zhang et al. 2019; Mishra et al. 2019).

Affordability of the technology

The UTAUT model has explored the affordability component known as cost and noted that it relates to the perceived benefits of the apps and the financial cost of employing them (Venkatesh et al. 2003). QST has affordability costs associated with its acquisition, updating and maintenance. Affordability is a crucial concern for Saudi and Chinese consumers because health-related applications themselves are freely provided for by their health ministries (Almegbel & Aloud 2021; Zhang et al. 2019). The findings of Schretzlmaier et al. (2022) on 88 percent of their research population show that if self-management software is affordable for patients, they will utilise it. However, if the cost is high, it will have an impact on uptake and hamper acceptance. In light of this, researchers support that affordability of the technology should be assessed first before any QS adoption as it has different implications for individuals based on their employment status, family income and country (Almegbel & Aloud 2021; Zhao et al. 2021; May et al. 2021).

Technology awareness

Table III presents the Technology Awareness factor and where it has been referenced in the literature.

Technology awareness can significantly impact the adoption of QST as consumers who are unaware of the technology will not utilise it even if it has advantages (Almegbel & Aloud 2021). Being aware means knowing and understanding that something is happening or exists. Zhang et al. (2019) note that the most prominent barrier to the use of QS applications is people's lack of awareness of these applications as potential medical tools. According to an interview, study participants were unaware of health-related applications and had never thought about using a self-tracking app for self-monitoring.

Table II: Technology preparedness

Main theme	Sub-factors	References
Technology preparedness of the diabetic patient	Technology experience	Gangadharbatla 2020; Wilkowska et al. 2021; Apolinário-Hagen et al. 2018; Martínez-Ibáñez et al. 2022; Kimura et al. 2022; Chittem et al. 2022; Jin et al. 2020; Mak 2021; Chen et al. 2021; Brohi et al. 2020; Zhang et al. 2019; Jeffrey et al. 2019; Rupp et al. 2018; Lee & Lee 2018; Breil et al. 2019; Pentikäinen 2019
	Technological costs	Jin et al. 2020; Almegbel & Aloud 2021; Findeis et al. 2021; Schretzlmaier et al. 2022; Grosová et al. 2022; Kimura et al. 2022; Pleus et al. 2022; Mak 2021; Zhang & Mao 2023; Chittem et al. 2022; Chen et al. 2021; Brohi et al. 2020)
	Access to resources	Almegbel & Aloud 2021; Findeis et al. 2021; Jeffrey et al. 2019; Zhao et al. 2021; Mak 2021; Schretzlmaier et al. 2022; Apolinário-Hagen et al. 2018; Zhang et al. 2019; Chittem et al. 2022; Pentikäinen 2019

Similarly, in another study, the participants were unaware that mobile apps for tracking pulmonary disease (PD) symptoms existed at all (Mishra et al. 2019). In a study conducted in China, the greater population, especially young adults, was also unaware of diabetes mellitus apps and of self-monitoring of blood glucose (SMBG). By raising awareness, people will better comprehend their conditions and continue using diabetes management tools (Zhang et al. 2019; Lv et al. 2021; Zhang et al. 2019). Additionally, another study in India emphasised the importance of raising awareness of self-monitoring of diabetes so that Indians do not perceive this practice as uncultured but as beneficial to their health (Chittem et al. 2022).

Service quality of medical applications

Delone and McLean's information system success model defines service quality as customers being satisfied if they get good service or service as expected (DeLone & McLean 2003). The Servqual model elaborates that servqual (service quality) is designed to measure the difference between what people want and how they feel about the service they actually receive (Singh & Khanduja 2010; Ali et al. 2018). Service Quality as a factor is crucial to QST adoption because it affects consumers' willingness to utilise the technology going forward. In the context of this study, perceived ease of use of the technology, perceived usefulness of the technology, perceived benefits of the technology and enjoyability affect the Service Quality. Table 4 presents these factors and where they have been referenced in the literature.

Perceived ease of use of the technology

A user's perception that technology is simple to use, as measured by TAM, UTAUT and HITAM, is necessary for a positive service quality perception for QST adoption. Adoption rates can be considerably increased by an intuitive and user-friendly interface that employs clear and simple language, is convenient, offers helpful instructions, and needs minimal training (De Moya et al. 2021; Gangadharbatla 2020; Zhao et al. 2018; Zhao et al. 2021). Similarly, a qualitative study conducted in Germany and Austria demonstrates people's long-term usage of diabetes self-management devices depends on their usability and perceived ease of use without causing physical impairment (Schretzlmaier et al. 2022). Other researchers have also confirmed the importance of perceived ease of use for older individuals with particular needs, noting that older persons prefer tailored programs that are simple to use and have a larger font size that can be adjusted for vision (Apolinário-Hagen et al. 2018; Jeffrey et al. 2019; Zhao et al. 2018). To the contrary, other researchers like Zhang et al.(2019) and Rupp et

Table III: Technology Awareness

Main theme	Sub-factors	References
Tegnology awareness		Jeffrey 2019; Apolinário-Hagen et al. 2018; Zhang et al. 2019; Pleus et al. 2022; Chittem et al. 2022; Brohi et al. 2020; Martínez-Ibáñez et al. 2022; Lv et al. 2021; Lee & Lee 2020; Lupton 2019; Zhang et al. 2019; Zhao et al. 2018; Lee & Lee 2018

Table IV: Service Quality of Medical Applications

Main theme	Sub-factors	References
Service quality of medical applications	Perceived ease of use of the technology	Almegbel & Aloud 2021; Jeffrey 2019; De Moya et al. 2021; Zhao et al. 2018; Gangadharbatla, 2020; Wilkowska et al. 2021; Apolinário-Hagen et al. 2018; Schretzlmaier et al. 2022; Rupp et al. 2018; Zhang & Mao 2023; Zhang et al. 2023; Chen et al. 2021; Kim et al. 2019; Breil et al. 2019; Yu et al. 2019
	Perceived usefulness of the technology	Jeffrey et al. 2019; De Moya et al. 2021; Zhao et al. 2018; Gangadharbatla 2020; Jin et al. 2020; Zhao et al. 2021; Wilkowska et al. 2021; Almegbel & Aloud 2021; Apolinário-Hagen et al. 2018; Zhang et al., 2019; Schretzlmaier et al., 2022; Grosová et al. 2022; Zhang & Mao 2023; Chen et al. 2021; Heyen 2020; Riggare et al. 2019; Kim et al. 2019; Kooiman et al. 2018; Dulaud et al. 2020; Breil et al. 2019; Yu et al. 2019
	Perceived reliability	Jeffrey 2019; Almegbel & Aloud, 2021; Jin et al. 2020
	Perceived benefits	Mishra et al. 2019; Allouch & Van Velsen 2018; Lee et al. 2022; Liu et al. 2020; Breil et al. 2020; Abbaspur-behbahani et al. 2022; Kim et al., 2019; Jakowski 2022; Utesch et al. 2022; Kooiman et al. 2018; Almegbel & Aloud, 2021; Jeffrey 2019; De Moya et al. 2021; Zhao et al. 2018; Gangadharbatla 2020; Wilkowska et al., 2021; Apolinário-Hagen et al. 2018; Schretzlmaier et al. 2022; Rupp et al. 2018; Zhang & Mao, 2023; Q. Zhang et al. 2023; Chen et al. 2021; Maltseva & Lutz 2018; Zhang et al. 2019; Ajana 2020; Chebolu 2021; Findeis et al. 2021; Heyen 2020; Riggare et al. 2019; Kim et al. 2019; Dulaud et al., 2020; Breil et al. 2019; Yu et al. 2019
	Perceived enjoyment	Jin et al. 2020;Mak 2021; Schretzlmaier et al. 2022; Grosová et al. 2022; Zhang et al. 2023; Lupton 2019

al. (2018) did not find perceived ease of use to be an important influencing factor in the usefulness of apps for diabetes management.

Perceived usefulness of the technology

The perceived usefulness of the technology is a user's evaluation of how valuable a technology is to them, which in turn influences QST adoption (Davis 1986). This is an attitudinal factor influencing QST adoption emanating from the TAM, UTAUT and HITAM models. Clear advantages of the technology, the ability to solve problems, personalisation and relevance to the user's needs can lead to the adoption of the technology. According to studies on diabetes self-tracking apps, patients are more likely to use diabetes management apps if they believe they can benefit from them (Jeffrey et al. 2019; Zhang et al. 2019; Zhao et al. 2021; Apolinário-Hagen et al. 2018). In particular, Zhao et al. (2021) demonstrate that QST can be viewed as valuable, provided it is perceived as useful and offers users new services. According to a different Saudi Arabian study, technology is seen as useful and more likely to be accepted if there is an emotional benefit associated with utilising it (Almegbel & Aloud 2021). In addition, for the technology to be helpful, the information gathered by QST ought to be precise and trustworthy. The technology should also encourage consumers to use it by offering feedback, setting goals, and making it easy to share data with others.

Enjoyability

Users' perception of how much they enjoy using a product or service is known as perceived enjoyment (Venkatesh, Morris, et al. 2003). As the enjoyment and entertainment value associated with QST adoption grows, the greater the acceptance of the use of the technology by diabetic patients (Grosová et al. 2022; Schretzlmaier et al.2022). This construct is from the UTAUT2 model and the Cognitive-Motivational-relational theory (Venkatesh et al. 2003). In a study by Schretzlmaier et al.(2022) all the mHealth users expressed joy at having an app that aids in managing their disease. Consequently, 63% of the mHealth users noted that if an app is fun to use it prompts them to check their blood glucose regularly, thus leading them to accept and adopt the technology. Contrary to these findings, a study in Czech revealed that enjoyability was an insignificant factor in QST adoption but the users did not see any fun nor find the devices used, such as fitness watches, interesting and fashionable (Grosová et al. 2022). More so, in a study conducted by Lupton (2019), one of the research participants reported that self-tracking was not fun but rather a burden, thus not motivating them to track their diabetes.

Benefits of medical technology

QST is expanding quickly and has the potential to transform healthcare. QST tracks and measures a variety of personal health data, such as sleep patterns, blood sugar levels, physical activity and more, using wearable technology and mobile health apps. Then, with the aid of this information, individuals can become more self-aware, manage chronic conditions, make better health decisions, enhance communication, improve quality of life by tracking the progression of diseases, assess the effects of treatment, promote medication adherence and assist the elderly (Jeffrey et al. 2019; Zhang et al. 2019; De Moya et al. 2021). Patients will adopt QST if they recognise these benefits.

QST can be used to monitor vital signs like blood pressure and sugar levels. Once this information is used to modify medication dosages and other lifestyle choices one can adopt a positive attitude toward using the technology, and thus improve health outcomes (Fan & Zhao 2022). According to a different study, QST can assist multiple sclerosis patients in managing their symptoms and adjusting to the disease's unpredictability (Apolinário-Hagen et al.2018).

Additionally, QST can aid in enhancing communication (Kim et al. 2019; Almegbel & Aloud 2021; Fan & Zhao 2022). Doctors may have a better understanding of the patient's condition and how they respond to treatment when patients share their QST data with them. Thus, better treatment plan decisions may result from this.

QST can also be used to track the progression of diseases (Mishra et al. 2019; Allouch & Van Velsen 2018; Lee et al. 2022). Early warning signs of disease progression can be detected using this information, and treatment plans can be adjusted accordingly.

The effectiveness of treatment can also be monitored using QST. This data can be used to assess the efficacy of the treatment and to make necessary adjustments (Schroeder et al. 2018; Riggare et al. 2019; Jeffrey et al. 2019; Breil et al. 2019; Zhang et al. 2019; Felipe et al. 2022; Kimura et al. 2022). For people with chronic illnesses and other medical conditions, QST has the potential to enhance health outcomes whilst alleviating costs. To fully comprehend the long-term effects of this technology, however, more research is required

Perceived reliability

Users' perception of the accuracy and consistency of new technology is known as perceived reliability (Barua et al. 2018). This construct is from the UTAUT model. Reliability is a crucial component in promoting users' acceptance of technology-based services because it increases customer satisfaction in adopting QST (Jeffrey et al. 2019; Almegbel and Aloud 2021). The findings of Almegbel and Aloud (2021) support the idea that mHealth uptake is influenced by perceived reliability. According to their research, Saudi consumers anticipate comprehensive and reliable mHealth app functionality. Counter to this, another study discovered that the uptake of mHealth apps is not greatly influenced by perceived reliability (Jeffrey et al.2019).

Social norms

Table V presents literature that has referenced social norms as an influential factor in technology adoption.

The unspoken guidelines that control how people act in a particular society are known as social norms (McDonald & Crandall 2015). Social Norms, a UTAUT construct, reflect how users' behaviour toward technology might be influenced by the opinions of their friends, family and superiors (Venkatesh et al. 2003). Social influence plays a major role in the behavioural intention to embrace QST since people's perceptions of new technology are crucial in persuading others to adopt such technology (De Moya et al. 2021; Jeffrey et al. 2019; Almegbel & Aloud 2021; Schretzlmaier et al. 2022; Apolinário-Hagen et al. 2018; Fan & Zhao 2022; Chen et al. 2021; Felipe et al. 2022). Social sanctions like rejection or ostracism can play a role in the adoption of technology.

Saudi users exhibit favourable behavioural intentions to use QST in chronic disease monitoring because social media, recommendations and referrals from friends and family have an impact on them (Almegbel & Aloud 2021). Similarly, quantitative studies reveal that social norms are crucial in the diffusion of QST innovations since patients rely on advice from medical experts, friends and family when deciding on the use of QST (Rupp et al. 2018; Zhao et al. 2021; Almegbel and Aloud 2021). This is in accord with studies focusing on QST adoption by multiple sclerosis sufferers, which reveal that although sufferers frequently turn to the internet for health-related information, their doctors continue to be the most dependable and influential people in their lives (Zhang et al. 2019; Apolinário-Hagen et al. 2018).

Security concerns

Security concerns can constrain the adoption of QST negatively if some aspects are not clarified (De Moya et al. 2021; Zhang et al. 2019; Zhao et al. 2018; Chen et al. 2021; Pentikäinen 2019). Security concerns include users' perceptions of ambiguity, unclear information and the detrimental effects of participating in an activity. Security concerns are high in QST adoption since the data is hosted in the cloud. In this study data privacy concerns and trust are the major security concerns in QST adoption. Table 6 presents these security concerns.

Data privacy concerns

The type of private information that QST obtains about a person's body might be quite delicate and disclose details that the person would not want others to know about (De Moya et al., 2021). If consumers feel the QST exposes their data they will not adopt it (Ajana 2020; Hutton et al. 2018; Pentikäinen,2019; Chen et al. 2021; Schretzlmaier et al. 2022). For this reason, in a study that examined 64 well-known self-tracking services, the applications did not satisfy the requirements for privacy (Hutton et al. 2018).

The research of Gangadharbatla (2020) found that if data privacy concerns are not addressed, they negatively impact people's views of and desire to use QST. Studies vary, nonetheless, in their assessment of the detrimental effect privacy concerns have on m-health app adoption. On the other hand, a study found that data privacy concerns have a marginally negative impact on QST adoption since the participants are aware of privacy protection acts, whilst a quantitative study conducted in the USA and the UK reveals that participants are unconcerned about security and data protection (Zhang et al. 2019; Ajana 2020). Effective privacy protection mechanisms are crucial, even if the latter studies indicated that perceived privacy risk had no impact on the intention to use monitoring apps.

Trust

The Extended Valence Framework now includes the trust variable as a factor (Kim et al. 2019). Regarding data security, confidentiality and processing, health apps guarantee the reliability of the information they collect (De Moya et al. 2021; Chebolu 2021). Should this be compromised, it could hamper the uptake of QST. When analysing QST, trust has been called into question on multiple occasions, primarily because the developers of the technology are obscure and rarely provide an explanation of how they detect and measure physical activity. Users who contribute data to QS systems must have faith in the provider, particularly in the latter's ability to ensure data

Table V: Social Norms

Main Theme	Sub-factors	References
Social norms		(Rupp et al. 2018; Gangadharbatla 2020; Zhao et al. 2021; Almegbel & Aloud 2021; De Moya et al. 2021; Apolinário-Hagen et al. 2018; Zhang et al. 2019; Schretzlmaier et al. 2022; Mak 2021; Zhang & Mao 2023; Chen et al. 2021; Brohi et al. 2020; Kooiman et al. 2018; Breil et al. 2019)

Table VI: Security Concerns

Main theme	Sub-factors	References
Security concerns	Data privacy concerns	De Moya et al. 2021; Gangadharbatla 2020; Hutton et al. 2018; Chen et al. 2021; Ajana 2020; Jin et al. 2020; Findeis et al. 2021; Pentikäinen 2019
	Trust	Rupp et al. 2018; Maltseva & Lutz 2018; De Moya et al. 2021; Zhao et al. 2018; Zhang et al. 2019; Ajana 2020; Chebolu 2021; Findeis et al. 2021

security. Additionally, research on the attitudes and viewpoints of diabetologists and patients with diabetes towards diabetes QS apps reveals that diabetes users typically reject the technology and prefer hospital diagnosis when they do not trust the technology (Schretzlmaier et al. 2022; Zhang et al. 2019). This is supported by a study that claims that consumers who do not trust the QST will not use it (De Moya et al. 2021). Conversely, a quantitative study conducted in the UK and the USA reveals that participants' views toward the adoption of QST were unaffected by the sharing of life-logging data with third parties, indicating that trust is not a key consideration (Ajana 2020). All things considered, QST is a promising technology that could enhance health and well-being. It is imperative to be cognisant of any potential security problems before using QST.

Proposed QST conceptual framework

The conceptual framework was developed by establishing the relationships between the identified factors. A logical framework eventually evolved after an iterative process that involved repetitive synthesis and re-synthesis. This was done by four independent researchers. The literature reveals that a diabetic patient's awareness of QST has an impact on its adoption. QST-aware diabetic patients are more likely to be technology-prepared to employ this technology. Their social norms influence how they perceive QST. However, the service quality and security concerns must be addressed as they may hamper adoption. Figure 3 depicts this framework.

Technology awareness: Awareness, i.e., to be aware of QST, someone would probably have mentioned the technology to the diabetic patient. People who are unaware of the existence of technology cannot accept or utilise it. Awareness can be generated by verbal suggestions, which are thoughts presented orally rather than in writing, or through actions such as app reviews and referrals. As a result, verbal knowledge such as app evaluations, support from others and ideas may impact patients' willingness to adopt this technology. To promote the concept of self-quantification and its adoption, awareness of the topic must be increased because this will, among other things, forefront transparency, responsibility and accessibility. Diabetic patients would not be aware of certain mobile phone services (self-monitoring apps) unless someone tells them about it. A diabetic patient cannot adopt QST if they are unaware of it. Patients with diabetes may become aware of QST through hospitals, care facilities, newspapers, radio, television, advertisements or word-of-mouth campaigns.

Technology preparedness: The influence of technology preparedness needs to be investigated before the adoption of QST can take place. Discrepancies arise from the fact that diabetic patients have varying degrees of technological expertise and socioeconomic standing. Diabetic patients would only adopt QST if they were technology-prepared. Availability and affordability of technological tools can lead to one forming a positive attitude toward adoption. In some environments, certain mobile phones are unavailable, certain features are disabled and certain applications are prohibited, which hampers uptake. Any technology user's desire is to embrace a solution that reduces operating costs as well as healthcare expenses. They will not use an application if it offers these services but is expensive. If all these concerns are addressed, the diabetic person may adopt a more optimistic mindset and be more receptive to using the technology. Thus technology preparedness can determine the disparities in attitudes and ideas that exist between different diabetic patients.

Service quality: This refers to how users engage with the QST. Users are more likely to keep using QST if they find it easy to use, it is useful to them, it brings about convenience, and they enjoy using it. The purpose of QST is to gather information about the environment, one's activity, and the physical and mental health of the user. Then, with the help of this information, one can monitor one's progress, spot trends and decide on a healthy lifestyle. Satisfying service quality can result in higher levels of productivity, engagement and pleasure with the technology. Technology is more likely to be adopted if it is fun to use. Users are more likely to stick with and recommend a technology if they enjoy using it. This can be accomplished by creating captivating images and giving insightful feedback. The technology provider may benefit from enhanced word-of-mouth, referrals and increased revenue because of increased loyalty to the technology. On the other hand, if the service quality is subpar, it may be challenging to use the technology, comprehend the data and act on the data. Frustration, abandonment, a lack of rewards, dissatisfaction and lower productivity might result from this.

In addition, the perceived benefits also contribute to the service quality. Perceived benefits refer to the possible advantages that people believe they may gain from using the technology. QST can be used to track and monitor certain health parameters, thereby improving chronic disease management. People may adopt QST more readily if they see benefits like cost-effective outcomes or better healthcare management.

Social norms: Diabetes patients' social environment also has an impact on their ability to accept QST. Individual actors, like friends, family and doctors, make up society. Therefore, societal attitudes of diabetic patients toward the use of this technology could be influenced in either a favourable or negative way. A person who lives with people using QST may be more inclined to do so in a group of people who also engage in self-quantification practices. This is due to the groups' social norm of tracking their parameters. A person may be more likely to employ this technology in their own life if they were raised in a society that values better health management through the usage of QST. This is so because their social norms have influenced them.

Security concerns: Users may be less likely to adopt QST if they anticipate security concerns like data privacy or trust issues. The diabetic patient must trust the technology before they will use it. Furthermore, all data privacy concerns must be addressed so that the patient can decide if the benefits outweigh the risks.

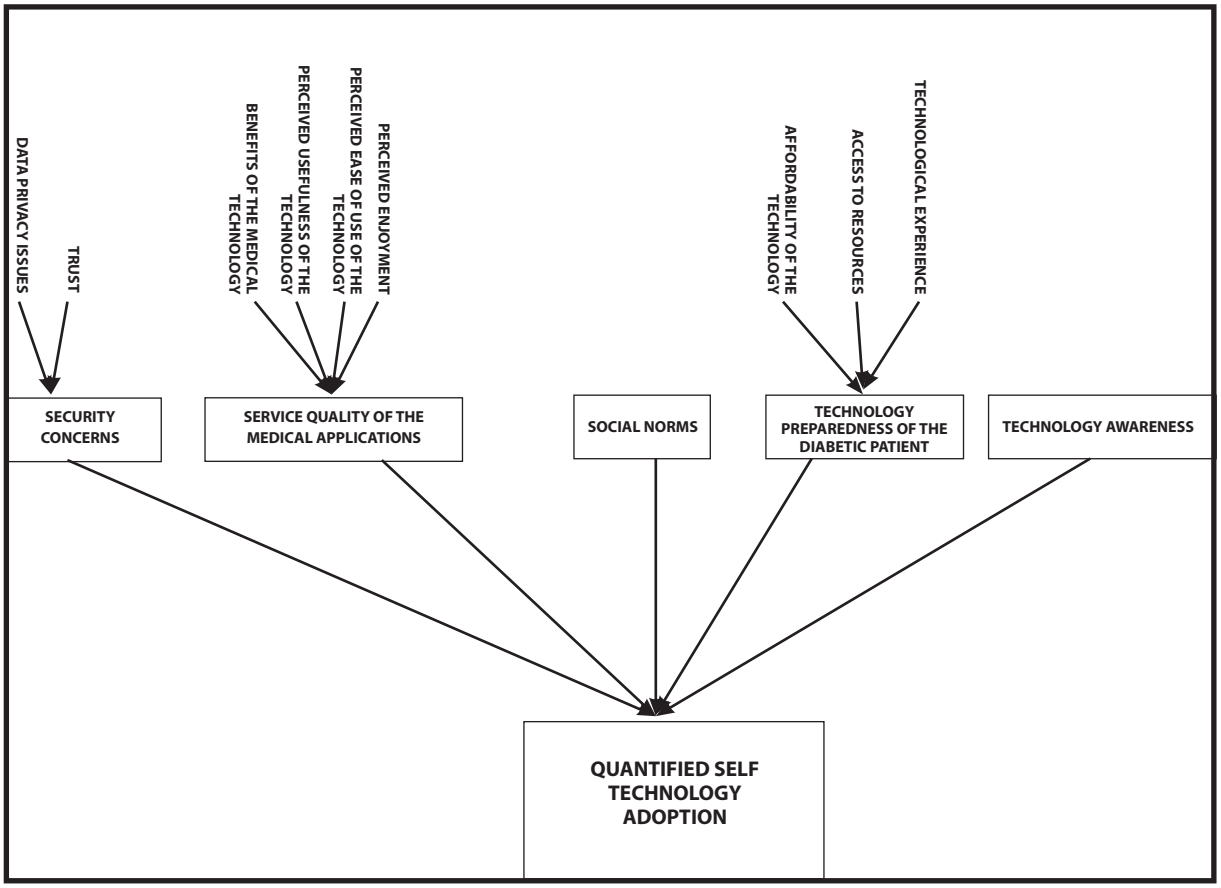

Figure 3: Proposed QST Conceptual Framework For Monitoring Diabetes

However, since every country has its own set of laws, policies, financial incentives and regulations pertaining to the use of technology, security policies and regulations cannot be universally applied (Gupta et al. 2018; Kruse et al. 2016). There is therefore a need for data privacy concerns to be addressed in the relevant context.

Practical Implications

In this review, the majority of the research studies have focused on people of affluent social groups in developed nations (including the United States, China, Germany and Australia) who track their health indicators (Fan & Zhao 2022). The analysis also found that research in Africa, particularly in developing countries, is lagging behind that in developed countries. We know very little about how Africans do self-tracking (Lupton 2017). Consequently, there is still a gap in the literature that requires scholarly attention. Given the comparatively low-level adoption of QST among patients, more thorough qualitative research is needed in this area to better understand the perspectives and preferences of this population, taking into account the attitudes toward self-tracking of the collective environment of the diabetic community, patients and doctors (Feng et al. 2021). Considering these constraints, it is possible that some important and legitimate factors were overlooked. Furthermore, as referred to before, because every country has different policies, financial incentives, rules and laws when it comes to implementing technology, security measures for all nations cannot be generalised (Gupta et al. 2018; Kruse et al. 2016). Policymakers must fill in the knowledge gaps about the effects of awareness, privacy and security concerns to evaluate the factors influencing the adoption of QST in resource-constrained contexts, where the QST adoption framework may be implemented differently than in other countries (Alkhudairi 2016; Nord et al. 2019; Selvaraj & Sundaravaradhan 2020).

Limitations of the study

The systematic review has certain limitations, which the authors have acknowledged. Some publications meeting the inclusion criteria were likely overlooked, although five databases, including those containing conference proceedings and the references of included studies, were searched. Only English-language articles were reviewed for this study. Language prejudice could result from this because studies written in other languages may have included some valid adoption factors not included in this review. This review, utilising five academic databases, was conducted in August 2023. Some academic papers may have been published after this date and therefore will not have been included in this review. In addition to the limitations, it is also worth noting that certain research lacked precise and comprehensive information regarding the research design, methodologies employed and explicit factors influencing adoption. These issues made it challenging to satisfactorily extract certain information.

Conclusion

The literature review identified factors influencing QST adoption. The most prevalent drivers and obstacles to adoption, as identified by the literature, include technology preparedness of the diabetic patient, technology awareness of the diabetic patient, social norms, and service quality as well as security concerns related to the medical applications. A conceptual framework was developed and, if tested and found relevant, could provide a comprehensive understanding of the factors that exist and that may limit the adoption of QST within the setting of a developing nation.

Future research direction

Future research may look at an African emerging country that is resource-constrained because the infrastructure there may not be that well established and the access to resources may be different from that in developed countries, yet where there is a rising prevalence of diabetes (Mutunhu et al. 2023). Additionally, patterns in African user behaviour toward technology adoption suggest that the continent is prepared to adopt any technology that might prove useful and reduce healthcare costs (Asongu 2018). Furthermore, since there are disparities in culture, economic status, demographics and the technologies used, the adoption patterns seen in European countries differ from those in Africa. Therefore there is a need for each study to be referenced within a specific context (Chipangura 2019). More so, owing to the short history of QST and the scant number of pertinent research outputs, it is possible that other significant factors have not been considered in the study.

Competing interest

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