The influencing factors of digital health passport adoption and acceptance during COVID-19 in Saudi Arabia

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Abstract

Background: The COVID-19 outbreak has left a destructive trail around the world in terms of deaths, travel restrictions, trade deficits, and an economy that is collapsing, including job losses, real estate, health benefit loss, and a decrease in the quality of access to care and services in almost all sectors, as well as generally in the overall quality of life. The successful development of COVID-19 vaccines may hasten the acceleration of global post-pandemic recovery by vaccinating residents, with a particular focus on important groups, in order to decrease secondary transmission. This will facilitate the easing of enforced restrictions on global and local travel, the tourism industry, education sectors, and other aspects of social life. Vaccinating residents may also help reduce the risk of secondary transmission. The efforts that Saudi Arabia made to control the epidemic were outstanding on all fronts and in all spheres, including the health, education, commerce, and tourism industries, among others.

Objective: The purpose of this research was to investigate the elements that influence a traveler's decision to acquire and use a digital health passport (DHP), which was introduced by the Tawakkalna application in Saudi Arabia at the COVID-19 conference.

Methods: The technology acceptance model (TAM) and the information system success model (ISSM) were the primary theoretical frameworks that guided this investigation. The terms "perceived ease of use" (PEOU), "perceived usefulness" (PU), "information quality" (IQ), "service quality" (SQ), and "net benefit" (NB) were applied in order to investigate the user's acceptance and use of the DHP, as well as how it contributes to the facilitation of traveling and public perception toward using the DHP.

Results: In order to assess the validity of the proposed model and its four assumptions, a survey was sent through social media platforms to get responses from nationals and residents of Saudi Arabia. The SPSS program was used to evaluate a total of 103 replies that were considered valid. Following the completion of the study, the findings revealed that PEOU, PU, IQ, SQ, and NB all had favorable impacts on the use of DHP.

Conclusion: PEOU, PU, IQ, and SQ have a significant relationship with NB that affects the public's acceptance and use of DHP. This study has established validity and reliability while testing the relationship between the variables suggested in the research model.

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Introduction

The Coronavirus disease 2019 (COVID-19) has had a significant effect on the lives of billions of people worldwide, with substantial health, societal, and economic implications. Tourism and travel are one of the world's major economic sectors, accounting for 7% of global trade in 2019, and corresponding to more than 20% of the Gross Domestic Product in some countries.[1] A remarkable 73% reduction in international tourism in 2020 because of the COVID-19 pandemic, and the demand for international travel remained low at the beginning of 2021. In January 2021, international visitor arrivals decreased by 87%.[2] Governments must be confident that they have effectively mitigated the possibility of importing COVID-19 to re-open borders without quarantine and restart flights. This confidence requires having correct COVID-19 health status information on travelers. The traditional certificates can be modified and difficult to validate, leading to the illegal selling of forged negative COVID-19 test certificates.[3] The procedure of notifying passengers on what tests, vaccines, and other procedures they need before travel, details on where they can take the test, and giving them the capability to share their tests and vaccination results in a verifiable, secure, and privacy-protecting method are the keys to providing governments with the confidence to open borders.[4] With the development of the digital health passport (DHP) service by Tawakkalna application, Saudi Arabia has achieved great work with international travel. The DHP allows for the collection of data in one place and facilitates the traveling procedures for citizens and residents to contribute to the gradual return to everyday life. This paper contributes to the literature by being the first study to explore the factors influencing the adoption and acceptance of DHP during the COVID-19 pandemic in Saudi Arabia, describe how DHP facilitates traveling procedures during the pandemic for both citizens and residents, and how to activate the use of DHP in a more efficient way.

Applications of telemedicine might be used as an alternate method of providing medical care during the COVID-19 crisis. Because COVID-19 is both infectious and lethal, taking preventative measures is the only way to preserve an individual's life from it. It has been observed that healthy persons are infected during the COVID-19 epidemic when they are visiting the hospital.[5] Due to the highly infectious nature of COVID-19, it was recently reported by Healthline[6] that medical professionals, including physicians and paramedical workers, are becoming ill with the virus. Because of this, the present study directs the attention of researchers toward the usage of a telemedicine application that is based on a wireless sensor network for the consultation of health-related issues. Applications of telemedicine have been proven to be effective in the delivery, reporting, and monitoring of patient health care services in Africa.[7,8] This success was observed in the fight against Malaria and Ebola. In addition to this, the World Health Organization

(WHO) has affirmed that the utilization of e-health apps for health monitoring is both effective and cost-efficient.[9] Previous research[7–10] has shown that integrating internet of things (IoT) technology into smart hospital systems was successful. [SHS] stands for "smart hospital system." Applications that employ the IoT have shown promise in terms of their ability to manage patient records, perform monitoring in real-time, identify the appropriate drug-to-patient relationships, and spot early signs of clinical deterioration.[10] The implementation of telemedicine applications (e-Health) is found to be less effective,[2,11] despite the fact that there are various benefits to doing so. It has been stated by a number of authors, including Alaboudi et al.,[11] that the primary impediments to the effective deployment of telemedicine applications include uneven financial support, hazy telemedicine services, and unclear vision and missions. Similar to what was said earlier, Pavli and Maltezou[2] hypothesized that medical professionals in underdeveloped nations had less awareness of the uses of telemedicine. Therefore, it is essential to investigate the elements that have an influence on the behavior of users in order to embrace telemedicine applications.

Patients have been hesitant to accept telemedicine health apps since the introduction of IoT applications.[12] A lack of understanding of the new technology available in the form of telemedicine applications[2,13] is one possible explanation for this phenomenon. According to the research that was conducted on the e-health system, the global failure rate for telemedicine projects was 75%.[14,15] Although wireless sensor networks do make a contribution to the health care system, there is still a significant obstacle to overcome in terms of their adoption and operationalization.[10] Utilizing wireless sensor networks offers a cost-effective solution for health monitoring and overall health and wellness.[2] Therefore, the purpose of the present study is to address a gap in the existing research by examining the factors that impact human behavior to use telemedicine apps based on wireless sensor network applications to monitor patient health during the COVID-19 pandemic. In order to investigate individual behavior in regard to the adoption of a telemedicine application that is based on wireless sensor networks, the research model for this study includes factors that underpin a unified theory of acceptance and use of technology, task technology fit, awareness, and self-efficacy. This study is important because it provides physicians, health advisors, and software developers with unique guidelines for designing a compatible wireless sensor network-based telemedicine application. These guidelines will boost patient confidence and encourage them to adopt wireless sensor network applications for health care.

In this paper, we investigate the factors that determine the traveler's adoption and acceptance of a DHP launched by Tawakkalna application in Saudi Arabia during the

COVID-19. This study relied on the technology acceptance model (TAM) and information system success model (ISSM), which include the constructs of perceived ease of use (PEOU), perceived usefulness (PU), information quality (IQ), service quality (SQ), and net benefit (NB). Thus, the aim of the study presented here is to analyse whether the acceptance of the health passport as a measure to revive travel ultimately improves the general population's intention to travel.

Thus, the remainder of the paper is organized as follows. The literature review is discussed in the Literature review section. Then, the research methodology is described in the Methodology section. Research analysis and results are explained in the Analysis and results section, and the discussion is considered in the Discussion section. Finally, we discuss the future work in the Future work section and conclude this paper in the Conclusion section.

Literature review

This study will describe and discuss the DHP, which was used globally during the COVID-19 pandemic to ensure privacy and overcome the associated issues, and the limitations of digital contact-tracing (DCT) applications. This paper will focus on the factors influencing the adoption and acceptance of DHP by travelers during COVID-19 in Saudi Arabia. Several studies have attempted to address the DCT applications for COVID-19 and the processes of DHP in different aspects.

Digital contact-tracing applications

The efforts of all countries to contain the pandemic and reduce the spread of disease through the development of DCT applications and protocols have been introduced with success. In the past, according to Sekalala et al.,[5] manual contact-tracing methods (e.g. interviewing an infected individual or tracking down recent connections that they could recall) to advise persons to self-isolate were used. However, it was argued that manual contact tracing would be too slow to stop the spread of infection across the population, given the large proportion of pre-symptomatic transmission for COVID-19 and the size of national and worldwide infections. As a result, digital solutions for faster contact tracing were developed, which mostly employed mobile telephones or other wearable devices with geolocation capabilities.[5]

Troncoso et al.[6] reported that contact-tracing apps use smartphone apps developed to stop the spread of the disease. The goal of these apps is to keep track of where their users are in relation to other users or locations.[6] It would be feasible to tell everyone who had been in close vicinity to a site or user linked to an outbreak. To ease of lockdown measures, a contact-tracing technique was deemed necessary to contain the spread of COVID-19.[7]

This method attempted to improve diagnostic testing effectiveness by detecting asymptomatic patients early and isolating them from the general population through self-quarantine. According to empirical evidence, countries that implemented this technique were successful in controlling the pandemic in its early stages.[8] In Saudi Arabia, for example, the Saudi Data and Artificial Intelligence Authority published the Tabaud application on June 14, 2020 (Okaz, 2020) to notify users of their interaction with those infected with COVID-19 (SDAIA, 2020).[9,16] In European countries, Italy launched Immuno, an app chosen by an ad hoc task committee of the Italian Ministry of Health, on June 15, 2020, six weeks after the primary lockdown in Italy ended (May 4, 2020). Despite considerable reverses that paused the application deployment, Italy was among the first European nations to proceed with a contact-tracing solution, evidence of this matter's broad-based complication. However, the number of app downloads (4.3 million) for Immuno has been disappointingly low so far and is inadequate to ensure the efficacy of the tool.[10]

According to Angelopoulos et al.,[11] DCT is a reactive approach that tries to interrupt existing disease transmission chains in a population. However, reactive methods worldwide do not permit international travel to continue, leaving economies with considerable international tourism exposure extremely vulnerable to losses.[11] Sharma et al.[12] argued that the DCT raises significant limitations and issues. Among these issues is their dependency on public perception and adoption. Due to the use of personal devices, DCT applications raise several problems regarding their users' privacy. Second, its reactive nature has also been an issue because it assumes that the disease is already prevalent in the community. Third, interoperability among different DCT applications and protocols has also been an issue.[12] Angelopoulos et al.[11] argued that DCT is incompatible as a means for international travel because it does not allow for seamless data interchange.[11]

Digital health passport, technology used, and its global applications

While domestic travel has recovered in many nations, international connectivity remains seriously affected in many parts of the world. Along with the desire of individuals to travel, pressure on airlines and governments to re-establish international economic linkages has been increasing.[13] The latest survey of recent travelers by the International Air Transport Association (IATA) revealed growing confidence in a return to air travel, accompanied by frustration with current travel restrictions and approval of DHPs (April 2021). In addition, more than half of the respondents (57%) expect to be traveling within two months of the pandemic being contained, representing an increase of 8% since September 2020. These data are supported by the vaccine rollout, which implies that (81%) will be more

likely to travel once vaccinated.[14] The main area where certification has been in active use is international travel. The EU has recently announced a 'digital green certificate' scheme, enabling those vaccinated, having a recent negative antigen test, or recovered from COVID-19 to travel freely. The IATA has also been developing a digital health pass to manage and verify the secure flow of necessary testing or vaccine information among governments, airlines, laboratories, and travelers.[4] Therefore, a number of airlines are using DHPs, including British Airways, Virgin Atlantic, and American Airlines.[4]

Given the necessity to restart travel and economies following the significant effects of COVID-19, several initiatives for developing digital health certification have been studied.[13] Brown et al.[15] stated that most initiatives were centered on digital certificates that consumers can carry on their smartphones (such as the QR code). Border officials or airlines will not need to through phones or emails manually to verify the health facility's identities or the type of vaccine administered.[15] From the travelers' perspective, the vaccine passport would allow them to learn about a particular country's vaccination requirements quickly. It could help in the long-term control of the COVID-19 pandemic.[17] Osama et al.[18] illustrated that the vaccination passport can be utilized in the context of COVID-19 to enable international business travel and trade or for any other cause that does not threaten personal safety or public health.

Pavli and Maltezou[2] demonstrated that vaccine passports are designed to make travel easier for individuals, and should be utilized primarily as a standardized and interoperable form of vaccination confirmation for travelers with verified credentials. This passport was based on technologies that enable secure data access or exchange through international collaboration, open interoperability criteria, and system harmonization.[19] Angelopoulos et al.[11] showed that in contrast to how the reactive method of testing, tracking, and isolation affected people, this was a proactive approach aimed at preventing infected people from entering the country. The Vaccination Credential Initiative (VCI) is an example of the global efforts to overcome the significant effects of COVID-19 and is a collaboration between 12 technology and health service providers, including Microsoft, Oracle, the Mayo Clinic, and others that was launched in May 2021. According to Wilford et al.,[20] the goal is to use an application programming interface to enable open-licensed, safe, and dispersed solutions to guarantee that the solution is interoperable and widely approved within numerous platforms and stakeholders. In addition, the technology will enable exchanging of verifiable clinical information such as COVID-19 laboratory results, immunization, and other pertinent data in the form of a smart health card or digital health wallet.[20]

There are several new innovative solutions for standardizing COVID-19 immunization status data and presentation. CommonPass Application is a health data app created by The Commons Project and the World Economic Forum to make cross-border travel more accessible.[13] Common Pass is defined by Mithani et al. [21] as a DHP app, which you can use to show proof that you were vaccinated or tested negative for COVID-19; it is one example offered to over 37 governments. In addition, it has been tried by United Airlines and Cathay Pacific Airlines to demonstrate how easy it is to retrieve your test results and vaccination records and show your COVID-19 health status when needed.[21] Particularly, Barbara[22] highlighted that CommonPass is a new DHP that appears to be reliable for validating people's COVID-19 free status globally.

Khatib et al.[23] illustrated CommonPass' capabilities as an extensible secure platform that allows travelers to electronically register their COVID-19 status, which can then be submitted at boarding or border crossings. The pass could be used to validate test results or immunization status while safeguarding patient privacy.[23] The IATA has created a digital health pass to help with border reopening safety. According to IATA, the Travel Pass will allow travelers to remain in control of their data and ease the sharing of their tests with airlines and travel authorities.[16] Mbunge et al.[24] claimed that traditional certificates have major issues, such as being altered and difficult to validate, leading to the illegal selling of forged negative COVID-19 test certificates. Therefore, the IATA[16] launched the IATA travel pass app, which has yet to be adopted by many governments. The app allows passengers to make a digital passport to confirm that their test/vaccination satisfies the regulations and share test or vaccination certifications with authorities to make travel easier. Additionally, travelers can utilize it to maintain their documentation digitally and effortlessly throughout their trip.[16]

Cosgrove[25] argued that this approach posed several issues and the increased privacy concerns are attributed to numerous health platforms mandating patients to share their personal protected health information, including but not limited to the patient's name, phone number, email, race, country of birth, social security number, residential address, and even travel history. The challenge with digital certificates, according to Angelopoulos et al.,[11] is how the information will be communicated effortlessly and timely across multiple stakeholders (e.g. airlines, border agencies, etc.) in different countries while maintaining traveler privacy.

Consequently, designing vaccination passports on a global scale poses significant challenges and demands on technology infrastructure, especially given that a wide range of people may use these passports. The decision of whether to use a centralized or decentralized infrastructure and how to manage vaccination data are also critical considerations. Several scholars have advocated a blockchain-based strategy in this context.[11,26,27] For example, several airlines are now adopting the IATA travel pass initiative as a worldwide solution to check and verify laws and rules addressing passenger travel prerequisites during

COVID-19. This system as explained by Wilford et al.[20] is built on four open-source elements that can communicate with one another utilizing blockchain technology and be merged to create an end-to-end solution. These include (1) a global health requirements registry that delivers data on testing, vaccine status, and travel requirements; (2) a testing vaccination centers registry that identifies laboratories and testing centers near departure points; (3) a lab app that permits labs and testing centers to send test results or vaccination certifications to passengers; and (4) a digital passport module which allow passengers to complete, verify and share their certifications.[20]

Gandhi et al.[1] stated that decentralized systems of credentials deployed at a broad scale suggest the privacy-protecting model of immunity certificates. Due to the decentralized and trustworthy framework, blockchains have come across as a solution to deliver critical information securely and in a privacy-preserving manner. In addition, blockchain-based solutions can help reduce some of these difficulties because data ownership remains with the particular individual (or hospital), which increases the security and reliability.[1] Khubrani and Alam[28] added that blockchain technology is a cutting-edge and secure system for tamper-proof record storage that is still evolving and has been used and suggested in various contexts, primarily where trust and reliability are crucial.

In the recent study by Mithani et al.,[21] the initiatives such as CommonPass, Digital Health Pass, Vaccify (part of COVID-19 Credentials Initiative), and DigiLocker are innovative solutions that use blockchain technology to provide a secure platform and ensure the traveler's privacy. The data privacy and security of the digital platforms recognized were based on the basics of blockchain, all personally identifiable data is held encrypted and cannot disclose without the user's approval. All solutions permit the verifier of the vaccine certification to check the QR code showing the existence or absence of a vaccine certificate, date, and other details of the vaccination without revealing other personally identifiable information.[21] The coordinated and integrated travel and health rules are essential to restoring confidence and restart travel and tourism, contributing to economic growth globally. However, given the current situation, immediate regulations are required to provide appropriate means to balance public health protection with a partial return to normalcy before the epidemic.

Emirates airlines have teamed up with the Dubai Health Authority (DHA) to create a digital health pass. It positioned Dubai as one of the first cities to digitally verify travelers' medical records associated with COVID-19 testing and vaccination. Emirates and the DHA collaborated to integrate DHA-approved laboratories' IT systems into Emirates' reservations and check-in systems. The aim is to effectively share, store, and verify passenger health information related to COVID-19 infection, testing, and vaccinations in a secure and legally compliant manner (DHA, April 2021). The Emirates have adopted the IATA travel pass solution on six continents in September 2021 as part of its rollout of digital health passes to consumers at all its destinations. Emirates developed the IATA travel pass pilot to clients on 12 routes in June after a successful trial on certain routes from its Dubai hub in April 2021. The airline has now agreed to engage with IATA to develop the solution across its global network. Emirates' customers are currently traveling from 50 cities; the rollout across all 120+ Emirates destinations is expected to be achieved by October 2021. Emirates' Chief Operating Officer (AlRedha, 2021) stated that the airlines continue to invest in technology solutions, such as the IATA travel pass, to provide customers with smooth trips and contactless experiences while allowing airport teams to efficiently handle document checks in accordance with regulatory prerequisites.[29]

Digital health passport service in Saudi Arabia

During the COVID-19 pandemic, Saudi Arabia developed various applications to facilitate the citizens' lives and reduce the effect of the pandemic in different sectors. One of these measures is the Tawakkalna application, which provides many services, such as Permit Feature of Umrah, Digital identification, Test COVID-19, and DHP.[30] The General Authority of Civil Aviation (GACA) and the Saudi Authority for Data and Artificial Intelligence (SDAIA) signed an operating protocol agreement that aims to establish a general framework for areas of cooperation between the two parties, including assisting in the facilitation of travel procedures and verifying the eligibility of health travelers, which follows the best practices of civil aviation legislation internationally to protect traveler's and stakeholder's rights (GACA, 2021).[31]

SDAIA and GACA (Al-Ghamdi and Al-Duailej, 2021) also signed a memorandum of cooperation and assistance with the IATA to associate the health passport in the "Tawakklna" application with the IATA. This agreement aims to facilitate travel procedures according to international best practices and accept the passport platform as an initiative to digitalize health certificates from reliable sources and accredited laboratories through cooperation with airlines and associations on linking the "Tawakklna" application with the IATA application. In mid-November 2021, "Tawakklna" added a new feature, called Health Travel Requirements. This feature allows travelers to recognize the conditions of their destination country. Saudi Arabia is one of the first countries globally to connect a government platform with an international platform. Furthermore, the GACA aims to support the "Tawakklna" system and strengthen its collaboration with the IATA to develop integrated digital solutions that reflect the Kingdom's position in the field of digital transformation and encourage air traffic and travel to and from the Kingdom. Aside from its role in the speedy recovery of air transportation in Saudi Arabia and worldwide, this program has several other benefits.[31]

There are four stages in the development of the DHP in the Tawakklna app. The first stage started in January 2021 and included the release of the DHP service. The SDAIA revealed that the updated version of the second phase of the DHP provides many benefits, including displaying a polymerase chain reaction test report, a travel insurance policy for the risks of COVID-19, and allowing family members to review the health passport. In addition, to associate the passport to border systems, they were enabling the Tawakklna application in more than 75 countries and allowing verification of the passenger's health eligibility when the boarding pass is issued (SDAIA, 2021). SDAIA explained that the third phase included integration with the IATA systems to display travel requirements and integration with the IATA travel pass application. The SDAIA clarified that through the fourth stage of developing the DHP, it aspires to generalize the activation of the passport internationally and its adoption as an official document to prove the data of COVID-19 vaccine doses.[32]

By integrating border systems into the Tawakkalna application, it can improve the travel experience in collaboration with the necessary authorities by automating and facilitating travel procedures. Additionally, when issuing boarding passes, it allows for real-time verification of travelers' health status, which contributes to confirming the status of the health passport for travelers with high reliability, ensuring passenger safety, preventing congestion, and reducing crowding at the airport. Moreover, it allows for the availability of all information related to travel in the health passport as a unified electronic document to facilitate the traveler's journey.[31]

Adequate research has focused on the issues related to contact-tracing apps and DHP, such as privacy and security. However, the factors influencing the acceptance and usage of DHP in Saudi Arabia have not yet been examined. To solve this gap in research, this paper aims to study and highlight the factors influencing the acceptance and use of DHP by travelers during the COVID-19 pandemic concerning PEOU, perceived usefulness, IQ, SQ, and NB in facilitating traveling procedures.

Methodology

This study highlights the TAM that was developed by Davis in 1989 to understand why a user accepts or rejects new technology. Thus, this study examines the adoption and acceptance of the DHP by travelers during the COVID-19 pandemic in Saudi Arabia in relation to PEOU, PU, IQ, SQ, as well as NB in facilitating traveling procedures. The research is descriptive research, which uses primary sources to acquire data from the target population to test the hypotheses. Descriptive research is one that is intended to characterize the distribution of one or more variables without respect to any causal or another hypothesis. This kind of study is also known as a "statistical characterization." Case reports, case series, cross-sectional studies, ecological studies, and other kinds of

research may all fall under the umbrella of the descriptive study category. The first three of these involve the collection of data on individuals, whereas the fourth makes use of data that have been aggregated for groups. The study employs a quantitative data analysis approach, a survey research strategy, and questionnaires for data collection.

Research hypotheses

This research relied on two theories: the TAM and the ISSM. The TAM mechanism was developed by Davis in 1989 to understand the reasons that a user accepts or rejects new technology. In TAM theory, the researcher focuses on PU, which determines the rate of people who believes that the use of a particular system would boost job performance, and PEOU, which determines the rate of people who confirm that using a particular system would be free of effort.[33] The most important constructs in TAM are PEOU and PU, as these two constructs have the greatest influence on users' acceptance or rejection of technology.[34]

The ISSM was developed by DeLone and McLean in 1992. In the ISSM mechanism, the researcher will focus on (a) IQ, which is used to measure the quality of the information produced by the system, (b) SQ, which refers to the effect that influences users to continue using the information system and to obtain satisfaction,[35] and (c) NB, which is defined as the contribution of information systems to the development of individuals, groups, organizations, industries, and countries.[36] NBs affect the intention to use the system and user satisfaction. They consider a high-quality system will be more functional and satisfactory and provide multiple benefits.[37] The NB is an outcome of the use of DHP in facilitating traveling procedures and improving traveling experiences. This study deals with an individual's NB from using the DHP service.

The PU and PEOU influence users' intention to use a system. Both factors have significantly influenced users' interaction with IS.[38] In the study by Ahn et al.,[39] IQ has a significant effect on user perception of PU.[39] IQ is a critical element affecting PU according to Chen and Hsiao[40], as shown in Figure (1).
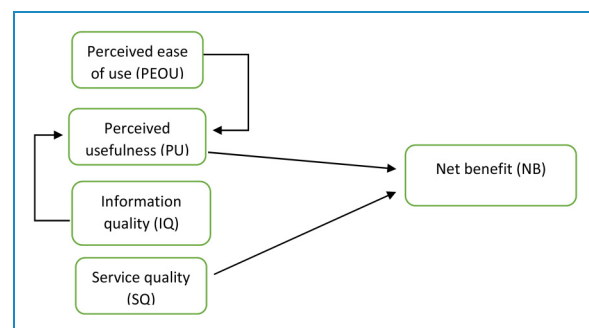

Figure 1. Structural model.

The study has four hypotheses as follows[41,42]:

H1: Perceived ease of use will have a positive effect on PU of the acceptance and use of DHP.
H2: Perceived usefulness will have a positive effect on NB of the acceptance and use of DHP.
H3: Information quality will have a positive effect on PU of the acceptance and use of DHP.
H4: Service quality will have a positive effect on NB of the acceptance and use of DHP.

Data collection

The public's level of agreement with the survey items is measured using a five-point Likert scale ranging from 1 to 5, with 1 indicating strong disagreement and 5 indicating strong agreement. The questionnaire included demographic questions, such as gender and age, and was distributed online in Arabic languages. The participants were selected randomly based on two criteria: age above 18 years and may or may not have experience using the DHP service when traveling during the COVID-19 pandemic in Saudi Arabia. The survey strategy was selected to describe the characteristics of a large population and ensure a more accurate sample to gather targeted responses and results to interpret the data and draw conclusions. The researcher needs around 10 days to distribute the questionnaires and collect responses. The data for this research were gathered by publicly sending a survey over social media in Saudi Arabia, including WhatsApp, Twitter, and Telegram, along with a summary of the study in Arabic. In Saudi Arabia, the survey was sampled over two weeks in December 2021. The number of respondents is 103 travelers (citizens and residents) during the COVID-19 pandemic in Saudi Arabia.

Description of the questionnaire. The questionnaire consists of 35 validated questions and is divided into six sections. The first section pertains to the respondents' general demographic information, such as age, gender, region, level of education, and employment status. The second section consists of four questions related to the perceived ease of use of the DHP by the participants. The third section deals with perceived usefulness of using DHP in traveling and contains six questions. The fourth part consists of seven questions and involves the information quality of DHP. The fifth considers the service quality of the DHP when using it and includes seven questions. The final section deals with the NB of DHP and how it facilitates the traveling procedure and consists of five questions.

Analysis and results

Reliability analysis

The examination of the internal consistency between several components of a construct often makes use of a technique known as reliability analysis. Analyzing a measurement's reliability involves determining whether or not it can be trusted to provide accurate results by determining whether or not participants can consistently provide the same responses to the same questions. As a result, Cronbach's alpha is the judgment that is used by the vast majority of people to describe how closely connected a set of things are to each other. The reliability of a questionnaire may be determined based on its alpha value.[43] According to the findings of Hair et al. (2010), a questionnaire may be considered acceptable if its alpha value is more than 0.6, and it can be considered adequately trustworthy if its alpha value is greater than 0.7.[43] A scale of 0.929 indicates excellent fitting between all questions in the overall questionnaire. It also represents the good reality of the sample community and the ability of the questionnaire to obtain the same results if the same questionnaire is applied multiple times. This is done by calculating all variables in all parts of the questionnaire, and a scale of this value indicates excellent fitting (Table 1).

Validity test

In this research, we considered the Pearson Product Moment Correlation analysis to validate the instrument test This test was carried out with a significance level of 0.01 (1%) using SPSS. The correlations between each item of the instrument and the whole instrument were calculated. Table 2 shows the values of the correlation coefficients for the items in the total ranges between (0.635) and (0.852), which means a high degree of internal consistency exists, thereby reflecting the high degree of validity for the paragraphs of the statements. As shown in Table 2, all correlation coefficients for all expressions are positively signified.

Demographic characteristics

- Females represent 61.2% of the sample population, while males represent 38.8%, indicating that the respondents were more predominantly females.

Table 1. Reliability analysis for model constructs.

Constructs	Cronbach's alpha for reliability
Perceived ease of use	0.818
Perceived usefulness	0.899
Information quality	0.889
Service quality	0.890
Net benefits	0.897
Reliability of the overall questionnaire	0.929

Table 2. Correlation coefficient for model constructs.

Constructs	Perceived ease of use		Perceived usefulness		Information quality		Service quality		Net benefits	
Items and correlation coefficient	PEOU1	0.704**	PU1	0.720**	IQ1	0.747**	SQ1	0.635**	NB1	0.820**
	PEOU2	0.822**	PU2	0.741**	IQ2	0.713**	SQ2	0.756**	NB2	0.834**
			PU3	0.804**	IQ3	0.801**	SQ3	0.876**	NB3	0.852**
	PEOU3	0.820**	PU4	0.768**	IQ4	0.738**	SQ4	0.789**	NB4	0.796**
			PU5	0.747**	IQ5	0.811**	SQ5	0.736**		
	PEOU4	0.791**	PU6	0.743**	IQ6	0.749**	SQ6	0.796**	NB5	0.763**
					IQ7	0.845**	SQ7	0.848**		

** Correlation is significant at the 0.01 level.

- About 44.7% of the sample population had ages ranging from 31 to 40 years, 25.2% had ages ranging between 18 and 30 years, and 8.7% had ages ranging from 51 to 60 years.
- About 50.5% of participants are from the central region, 20.4% are from the eastern region, 19.4% are from the western region, 2.9% are from the southern region, and 6.8% are from the northern region.
- About 56.3% of the participants have a bachelor's degree and 25.2% have a master's degree whereas only 6.8% have a doctorate.
- About 37.8% of the sample population are working within the public sector, while 27.2% are working within private sector, and 35.0% are not employed.
- About 67.0% of participants travel using DHP (Table 3).

Demographic characteristics

Perceived ease of use. The participants' opinions on the perceived ease of use, which refers to the extent to which an individual thinks that using the DHP would be free of effort, were measured (Table 4).

Participants agreed with all the statements including that learning to use the DHP has been easy for them, the interaction has been clear, the interaction has been understandable, and it is easy to become skillful at using the DHP. Overall, the participants' opinions were positive with a mean of 4.00 ± 0.555, which reflects the ease of use of DHP by participants.

Perceived usefulness. The participants' opinions on the perceived usefulness of DHP, which refers to the ratio of people who believe that the use of DHP would boost job performance, were measured. Perceived usefulness is the most common and significant determinants of technology acceptance (Table 5).[42]

Participants agree with all the statements, including that using the DHP enables them to accomplish their tasks more quickly, improves the quality of services in providing faster movement in the airport, increases productivity, and enhances the effectiveness of services, and the services were easier to perform and give them greater control over the service's schedule. The participants' opinions on the perceived usefulness of DHP had a mean of 3.84 ± 0.671, which reflects that the use of DHP boosts job performance.[42]

Information quality. Participants' opinions on the information quality of DHP, which refers to the desirable characteristics of the DHP service output to provide relevant, understandable, complete, and up-to-date information to users, were measured (Table 6).

Participants agreed with all the statements including that the DHP service provides sufficient and needed information at the right time. They also found the information to be easy to understand, up-to-date, and on time. Additionally, the information that appears in DHP is readable, clear, and well-formed information that is suitably concise. Overall, the participants' opinions on the information quality of DHP had a mean of 3.98 ± 0.533, which reflects the high quality of the information provided by DHP.

Service quality. The participants' opinions on the service quality of DHP, which refers to the quality of service or support that the DHP service users received from the information technology department or the technical competency of the service, were also measured (Table 7).

Participants agreed with all the statements including the DHP service is easy to access anytime with all requirements

Table 3. Demographic items.

	Variable	Frequency	Percent	Mode	Direction	Standard deviation
Gender	Male	40	38.8%	2	Female	0.489
	Female	63	61.2%			
Age	18–30 years	26	25.2%	2	31–40 years	0.897
	31–40 years	46	44.7%			
	41–50 years	22	21.4%			
	51–60 years	9	8.7%			
	Over 60 years	0	0.0%			
Location	Central region	52	50.5%	1	Central region	1.199
	Eastern region	21	20.4%			
	Western region	20	19.4%			
	Southern region	3	2.9%			
	Northern region	7	6.8%			
Highest degree	High school or less	4	3.9%	3	Bachelor's degree	1.191
	Intermediate diploma	2	2.0%			
	Bachelor's degree	58	56.3%			
	Diploma degree	6	5.8%			
	Master's degree	26	25.2%			
	Doctorate	7	6.8%			
Employment status	Employee in public sector	39	37.8%	1	Employee in public sector	0.857
	Employee in private sector	28	27.2%			
	Not employed	36	35.0%			
Did you travel using DHP	Yes	69	67.0%	1	Yes	0.472
	No	34	33.0%			

for travel during COVID-19. They also agreed that the DHP service provides accurate and trustworthy information. Most participants said that they faced no problems while using DHP and could entirely rely on it while traveling. Additionally, they agreed that the DHP service provides security and privacy for their health information. Overall, the participants' opinions on the service quality of DHP had a mean of 3.91 ± 0.571, which reflects the high service quality of the DHP.

Net benefits. The participants' opinions on the NBs of DHP, which refers to the extent to which the DHP service contributed to facilitating travel procedures during the COVID-19 pandemic, were measured.

Participants agreed with all the statements, which indicated that the use of DHP contributes to reducing the crowding at check-in points by making airport check-in quicker and smoother during travel in the COVID-19 pandemic. It also facilitates their travel procedure, such as

Table 4. Perceived ease of use.

Question	Scale	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation	Direction
Q1: Learning to use the DHP has been easy for me	Frequency	0	1	9	74	19	4.07	0.554	Agree
	Percent	0.0%	1.0%	8.7%	71.8%	18.5%			
Q2: My interaction with the DHP has been clear	Frequency	2	0	21	63	17	3.90	0.734	Agree
	Percent	1.9%	0.0%	20.4%	61.2%	16.5%			
Q3: My interaction with the DHP has been understandable	Frequency	1	1	22	60	19	3.92	0.723	Agree
	Percent	1.0%	1.0%	21.4%	58.2%	18.4%			
Q4: It is easy to become skillful at using the DHP	Frequency	0	0	23	47	33	4.09	0.734	Agree
	Percent	0.0%	0.0%	22.3%	45.6%	32.1%			
Total	Frequency	3	2	75	244	88	4.00	0.555	Agree
	Percent	0.7%	0.5%	18.2%	59.2%	21.4%			

Table 5. Perceived usefulness.

Question	Scale	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation	Direction
Q1: Using the DHP enables me to accomplish tasks more quickly	Frequency	1	3	14	61	24	4.01	0.760	Agree
	Percent	1.0%	2.9%	13.6%	59.2%	23.3%			
Q2: Using the DHP has improved the quality of services by providing faster movement in the airport	Frequency	2	1	31	46	23	3.84	0.849	Agree
	Percent	1.9%	1.0%	30.1%	44.7%	22.3%			
Q3: Using the DHP has increased productivity	Frequency	3	1	25	53	21	3.85	0.856	Agree
	Percent	2.9%	1.0%	24.3%	51.4%	20.4%			
Q4: Using the DHP has enhanced the effectiveness of services	Frequency	3	0	31	49	20	3.80	0.852	Agree
	Percent	2.9%	0.0%	30.1%	47.6%	19.4%			
Q5: Using the DHP has made services easier to perform tasks	Frequency	1	3	16	64	19	3.94	0.738	Agree
	Percent	1.0%	2.9%	15.5%	62.1%	18.5%			
Q6: Using the DHP has given me greater control over the service's schedule	Frequency	3	4	35	47	14	3.63	0.874	Agree
	Percent	2.9%	3.9%	34.0%	45.6%	13.6%			
Total	Frequency	13	12	152	320	121	3.84	0.671	Agree
	Percent	2.1%	1.9%	24.6%	51.8%	19.6%			

Table 6. Information quality.

Question	Scale	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation	Direction
Q1: The DHP service provides the information you need at the right time (Availability)	Frequency	0	3	17	64	19	3.96	0.685	Agree
	Percent	0.0%	2.9%	16.5%	62.1%	18.5%			
Q2: The DHP service provides sufficient information for your purposes (Quality of Information)	Frequency	0	2	23	57	21	3.94	0.711	Agree
	Percent	0.0%	2.0%	22.3%	55.3%	20.4%			
Q3: The DHP service provides information that is easy to understand (Understandability)	Frequency	0	3	23	56	21	3.92	0.737	Agree
	Percent	0.0%	2.9%	22.3%	54.4%	20.4%			
Q4: The DHP service provides up-to-date information (Current)	Frequency	0	1	14	62	26	4.09	0.649	Agree
	Percent	0.0%	1.0%	13.6%	60.2%	25.2%			
Q5: The DHP service provides the required information on time (Timeless)	Frequency	0	1	15	64	23	4.06	0.639	Agree
	Percent	0.0%	1.0%	14.6%	62.1%	22.3%			
Q6: The DHP service provides information that appears readable, clear, and well-formed (User Interface)	Frequency	0	1	21	62	19	3.96	0.655	Agree
	Percent	0.0%	1.0%	20.4%	60.2%	18.4%			
Q7: The DHP service provides information that is suitable concise	Frequency	0	0	30	47	26	3.96	0.740	Agree
	Percent	0.0%	0.0%	29.1%	45.6%	25.3%			
Total	Frequency	0	11	143	412	155	3.98	0.533	Agree
	Percent	0.0%	1.5%	19.9%	57.1%	21.5%			

displaying the PCR test results in the departure and/or arrival destination. Additionally, it allows for real-time verification of their health status, thereby improving their traveling experience. Overall, the participants' opinions on the NBs of DHP indicated that they found it beneficial, with a mean of 3.87 ± 0.626,[44] reflecting the high NB of the DHP and its contribution to facilitating traveling procedures during COVID-19 (Table 8).

Test of structural model

The standardized coefficient beta values (β) are used to compare the effects of the independent variables. To consider a determent to be significant, its coefficient β should be around 0.20 and $P < 0.05$.[45] In this paper, hypothesis testing was applied based on the P-value. Table 9 shows that all the hypotheses were supported.

The results demonstrated that PEOU positively affects the public's perceived usefulness to use DHP (β = 0.714, $P < 0.000$) for the first hypothesis, which aimed to test whether PEOU influences the acceptance and adoption of DHP in Saudi Arabia. Thus, H1 was strongly supported. The results for the second hypothesis, which aimed to test influence of PU on NB, showed that PU positively affects the NB of using DHP (β = 0.637, $P < 0.000$). Thus, H2 was strongly supported. The third hypothesis aimed to test whether IQ influences the use of DHP by travelers in Saudi Arabia. The finding showed that IQ has a positive effect on the public's perception of DHP's usefulness (β = 0.773, $P < 0.000$). Thus, H3 was strongly supported. The fourth hypothesis aimed to test whether the SQ influenced the use of DHP by travelers in Saudi Arabia. The results showed that SQ positively affects the NB of using DHP (β = 0.821, $P < 0.000$). Thus, H4 was strongly supported, as shown in Figure (2).

Table 7. Service quality.

Question	Scale	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean	Standard deviation	Direction
Q1: The DHP provides services that are easy to access anytime during day hours	Frequency	0	1	11	71	20	4.07	0.582	Agree
	Percent	0.0%	1.0%	10.7%	68.9%	19.4%			
Q2: The DHP service provides all requirements for travel during Covid-19 (such as displaying the type of vaccine) (service content)	Frequency	0	0	18	60	25	4.07	0.645	Agree
	Percent	0.0%	0.0%	17.5%	58.2%	24.3%			
Q3: The DHP service provides accurate information (Service Content)	Frequency	0	2	34	43	24	3.86	0.793	Agree
	Percent	0.0%	1.9%	33.0%	41.8%	23.3%			
Q4: The DHP service provides information that trust (Service Content)	Frequency	0	0	32	48	23	3.91	0.729	Agree
	Percent	0.0%	0.0%	31.1%	46.6%	22.3%			
Q5: No problems while using the DHP service (service security)	Frequency	0	5	38	42	18	3.71	0.812	Agree
	Percent	0.0%	4.9%	36.9%	40.8%	17.4%			
Q6: I can fully rely on the DHP service while traveling (I do not need a paper document)	Frequency	0	6	31	47	19	3.76	0.819	Agree
	Percent	0.0%	5.8%	30.1%	45.6%	18.5%			
Q7: DHP service provides security for my health information and privacy (Service Security)	Frequency	0	1	26	50	26	3.98	0.740	Agree
	Percent	0.0%	1.0%	25.2%	48.6%	25.2%			
Total	Frequency	0	15	190	361	155	3.91	0.571	Agree
	Percent	0.0%	2.1%	26.3%	50.1%	21.5%			

Table 8. Hypothesis testing.

| Hyp.	Description	Path coefficient (β)	Standard error	*T*- value	*P*-value	Decision
H1	PEOU → PU	0.714	0.097	7.378	0.000	Supported
H2	PU → NB	0.637	0.068	9.369	0.000	Supported
H3	IQ → PU	0.773	0.099	7.836	0.000	Supported
H4	SQ → NB	0.821	0.072	11.340	0.000	Supported

Discussion

The successful creation of COVID-19 vaccinations has sped up the process of worldwide post-pandemic recovery. This has made it possible to relax the limitations that had been imposed on international and domestic travel, tourism, education, and other elements of social life. This study aims to identify the factors that influence the adoption and acceptance of DHP when traveling during the COVID-19 pandemic in Saudi Arabia, as well as how it contributes to making travel procedures easier. The purpose of this study is to identify the factors that influence

Table 9. Total variance explained.

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.428	46.302	46.302	13.428	46.302	46.302
2	2.250	7.759	54.062			
3	1.504	5.187	59.248			
...	...	...	...			
29	0.079	0.272	100.00			
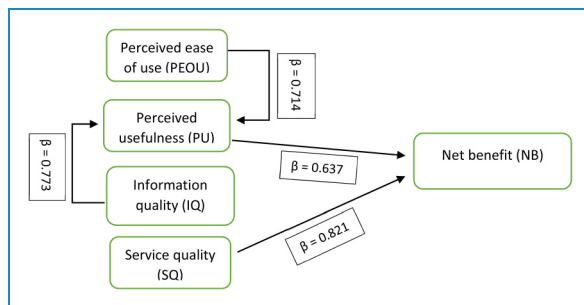
Figure 2. Results of the structural model.

the adoption and acceptance of DHP. PEOU, PU, IQ, SQ, and NB are the criteria that were taken into consideration for this analysis. The findings have shown that PEOU and IQ are major variables that influence the perceived utility of utilizing DHP services while traveling in Saudi Arabia during the COVID-19 epidemic.[41,42] Because of this, travelers will find the DHP service in the Tawakkalna application helpful if they believe that it is simple to use and improves their learning results for them. In prior research, a correlation between PEOU and PU was investigated and shown to be present. For instance, Or et al.[46] corroborated the PEOU and PU link by demonstrating that patients' judgments of the utility of client health information technology were reliant on the ease with which the system could be used. Users will also think that the DHP is helpful and valuable if the information quality that is supplied is accurate, timely, exact, and relevant to the present state of affairs. According to the findings of the research that investigated the relationship between IQ and PU,[47] the quality of the information has a beneficial impact on PU. In addition, it has been shown by these findings that there is a substantial connection between PU and NB. Due to the fact that the DHP is beneficial, it boosts productivity and improves the efficiency of services provided to consumers; hence, it will contribute to the NB of the DHP. In addition, SQ has an important connection

with NB regarding the use of DHP when traveling due to the fact that DHP allows for convenient access to services at any time throughout daytime hours. As a result, consumers are able to place their complete trust in the DHP service when they are traveling and thus ensure that their personal health information and privacy are protected. As a result, it makes the process of traveling easier and enhances the enjoyment that folks get out of their trips. Ideally, this study can contribute to the development of theory and the advancement of practices in the adoption and acceptance of DHP that will be internationally standardized with verifiable credentials and based on interoperable technologies. In addition, forgery and personal data security are dominant concerns, but such problems are routinely solved for financial and other sensitive transactions.

Although the small sample consisted exclusively of Saudi citizens and residents, Harman's Single Factor Test shows that there is no common method variance between the dependent and independent variables. This test introduces the risk of common method bias (CMB).[44,48] CMB, among other causes, occurs because of the similarities in the structure and wording of questionnaire items that generate similar responses. Another cause is due to applying uniformly across measures leading to specific response tendencies that raters can do. Therefore, it is necessary to inspect the data for the above-mentioned risk, and for that, the Harman Single Factor Test was used. Harman Single Factor Test is actually running the principal component analysis by choosing one factor only and testing if the resultant % of the variance is less than 50%. Indeed, the outcome shows a value of 46.302% as shown in Table 9, and then we conclude that there is no CMB and data are ready for further analysis.

Future work

This paper developed a research model for the adoption and acceptance of the DHP by travelers (citizens and residents) during the COVID-19 pandemic in Saudi Arabia. Despite

the study's contributions, its limitations would create new chances for future development. First, the sample consisted exclusively of Saudi citizens and residents who used DHP services. Therefore, disparities may be found if the study were performed in other nations. Second, the study was performed before fully completing the development and adoption of the DHP by travelers, such as relating the DHP in the Tawakkalna application with the IATA travel pass. As a result, new steps could be used in future research to investigate in-depth, collect more detailed responses, and use qualitative approaches, such as interviews to gather additional information from travelers. Finally, the small sample consisted exclusively of Saudi citizens and residents who used DHP services. Therefore, disparities may be led to case of bias, such as non-response, which occurs when some subjects do not have the opportunity to participate in the survey.

Conclusion

This study examined the factors that influence the adoption and acceptance of DHP for travel during the COVID-19 pandemic in Saudi Arabia. The study focused on the factors from the TAM and ISSM models to explore their effects on DHP services. Travelers benefit from using such technologies in a variety of ways, such as facilitating their travel procedures and improving their experience. In this research, four hypotheses were investigated, and all were found to have a substantial effect on the adoption and use of DHP. Based on the results and data analysis, PEOU, PU, IQ, and SQ have a significant relationship with NB that affects the public's acceptance and use of DHP. The study has established validity and reliability while testing the relationship between the variables suggested in the research model. Finally, the same models can provide different results in different contexts.

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