Clinical Decision Support Systems' Usage Continuance Intentions by Health Care Providers in Jordan: Toward an Integrated Model

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Jehad Imlawi(✉)
Information Systems Department, Faculty of Prince Hussein bin Abdullah for Information Technology, Al al-Bayt University, Mafraq, Jordan
imlawi@aabu.edu.jo

Abstract—Health organizations in Jordan has just started adopting a nation-wide health information system [Hakeem] including useful tools such as the clinical decision support system [CDSS]. Adopting CDSS by health care providers is not mandatory; However, the fruitful results of these tools can only be gained after adopted by the health care providers, and when they have the intentions to continue use it in the future. The current study proposes a model that integrates factors from tow important theories of technology acceptance; Technology Acceptance Model [TAM], and Information Systems Success Model [ISSM] to predict the health care providers' usage continuance intentions of CDSS in future. The study also checks if gender, experience, and CDSS alerts' frequency has any moderation effects on the proposed research model. To assess the research model, data were collected from 218 participants via an online survey. The proposed model has strongly predicted the CDSS usage continuance intentions [R^2=0.486]. However, the moderators; gender, experience, and CDSS alerts' frequency, partially moderate the proposed relationships. Conclusions: This research extends the growing literature on health information systems' adoption by building an integrated model that integrates factors from two well-established technology acceptance models, TAM and ISSM. The findings proved a significant impact of ISSM's factors [system quality, information quality, and satisfaction] on CDSS usage continuance intentions.

Keywords—clinical decision support systems, information quality, system quality, decision-making satisfaction, alerts' fatigue

1 Introduction

The implementation of health information systems [HISs] was driven by the health-care providers' willingness to provide patient-centric, high quality health services. Prior research showed the positive impacts of HISs' adoption to healthcare, and public health [1,2].

HISs include useful tools, such as electronic medical record [EMR], computer-ized provider order entry [CPOE], and clinical decision support system [CDSS]. CDSS is a component of HISs that provides health care providers with a clinical decision support [3]. CDSS integrates patient's health information with the relevant health rules, to assist clinicians as they make clinical decisions. CDSS is useful for health care providers as it reduces medical errors and risks without compromising patients' care.

Although CDSS has a positive effect on health-care quality, and reduction of medication costs, rates of CDSS utilization and adoption are still low [4,5]. Prior studies explained this low adoption by the alerts' fatigue caused by CDSS [6,7,8]. Prior studies have also reported conflicting results regarding CDSS effects [9]. Thus, further research is required to investigate CDSS adoption intentions.

Prior research proposed numerous theories to investigate the HISs' usage continuance intentions. Technology Acceptance Model [TAM] [10], and Information System Success Model [ISSM] [11] are among the most cited theories in the field of information systems adoption. Adoption one of these models has mostly depended on the relevance of its factors. However, few studies have integrated factors from multiple models [12]. The current study has adopted several factors, from TAM [perceived usefulness, and perceived ease of use], and ISSM [information quality, system quality, and satisfaction], to enhance our understanding of the health care providers' behavior toward CDSS usage continuance intentions.

Prior research has mainly focused on the adoption and acceptance of health information systems. Few studies have investigated the health care providers' adoption of CDSS specifically. Prior studies have also adopted one of the established models of technology acceptance. Few studies have employed an integrated model that integrates factors from different models. Moreover, few prior studies have been conducted in developing countries, like Jordan, where HISs, and CDSS have just started to be implemented.

The following section presents the discussions of prior studies on CDSS usage continuance intentions by health care providers, followed by the hypotheses building section that proposes the research model, and then the study's methodology section. The next section presents the data analyses and the study's results. The last section presents the discussion, implications, limitations, and the study's conclusions.

2 Literature review

2.1 Modeling continuance intention

Many studies have investigated the antecedents of users' intention to adopt new IS and its usage continuance intention. Many research models were proposed by researchers, such as technology acceptance model [TAM] [10], and Information System success model [ISSM] [11]. Prior research has affirmed these two models' simplicity, significance, and prediction strength.

TAM theory is widely recognized as the most popular model of technology adoption, due to its simplicity and significance. The model proposed two main factors to predict the new technologies adoption: perceived usefulness [PU], and perceived ease of use [PEOU]. PU is "the degree to which a person believes that using a particular system would enhance his or her job performance" [10. P, 320], whereas PEOU is "the degree to which a person believes that using a particular system would be free of effort" [10. P, 320]. The two factors have shown a strong predictive power of technology adoption [13,14].

ISSM theory is also one of the most cited models in the technology adoption research. The model was first introduced by Delone and McLean [11] to propose two factors, system quality and information quality, as predictors of technology adoption. A decade later, Delone and McLean [11] proposed the modified version of ISSM, to add service quality and users' satisfaction to the original factors.

System quality relates to several dimensions such as ease of use, usability, availability, and reliability. Information quality is related to the effectiveness of input/output process; how a system captures input and present relevant and useful output. It is also related to the attractiveness of the interface design. Service quality is related to the maintenance and end-user support. Prior research has proved that technology rejection can be caused by the low-quality service, such as lack of user's training [15]. ISSM factors have shown a strong predictive power of the technology adoption [16].

2.2 Health information systems adoption in developing countries

Developing countries face many challenges related to the adoption of HISs. Lack of infrastructure, security, and privacy concerns could be factors that caused the low adoption rate in the developing countries. Developed countries have preceded other countries in adopting HISs, motivated by HISs' role in lowering the cost of healthcare, and improving healthcare quality [17].

Some developing countries started to adopt HISs, to improve healthcare quality, accessibility, and affordability [18]. However, the ongoing challenge is to motivate health care providers, to continue use HISs in the future.

Jordan has launched a nationwide electronic health record called "Hakeem". The promising HIS is utilized in the public hospitals and medical centers, and it aims to improve the efficiency and quality of health care in Jordan. However, the private health providers adopted different health information systems in their facilities.

Hakeem provides health care providers with patients' periodic reports, in addition to building a set of real-time reports that assist health care providers in the clinician decision-making process. However, the fruitful benefits of HIS can only be gained when adopted by the health care providers. There are some reasons that prevent this adoption, such as users' resistance, and alerts' fatigue.

2.3 Clinical decision support systems

Clinical decision support system [CDSS] is a component of HIS that integrates and presents intelligently filtered, situation-specific and patient-specific heath information, to the health providers, in a consistent manner, at the appropriate time, to assist them in making their clinician decisions [19].

CDSS have been designed to support health care provider's decisions, such as diagnoses and medicine prescribing. CDSS provides a variety of interventions to enhance the quality of patient care, decrease medical errors, and increase health efficiencies [19]. CDSS sends alerts to focus the health care providers' attention, provide them with patient-specific recommendations, provide them with an access to scholarly health publications, and provide them with tools, like specialized medical calculators, that help health care provider in their clinicians' decision-making.

Prior studies indicated that HISs would fail to improve health-care quality when they are not completely and continuously adopted by health care providers [20]. Accordingly, healthcare organizations are increasingly adopting CDSS, to provide the health care providers with patient-specific assessments and recommendations to promote health efficiency and support the health care providers' decisions [21,22].

However, the effective implementation of CDSS can be challenging because of the alerts' fatigue. Alerting systems can improve performance. However, if there are too many alerts being triggered, especially when some of these alerts are irrelevant, or when alerts are being triggered in instances when it is not necessary, then alerts' fatigue is expected to negatively affect the CDSS adoption. Alternatively, alerts should be effectively generated and displayed to the user. Alerts' timing is also critical to support the clinical decision makers. In addition to the mode of presented advice, which should be event-driven, like when an order is placed or a result is posted, and not only upon the physician's request.

3 Hypotheses building

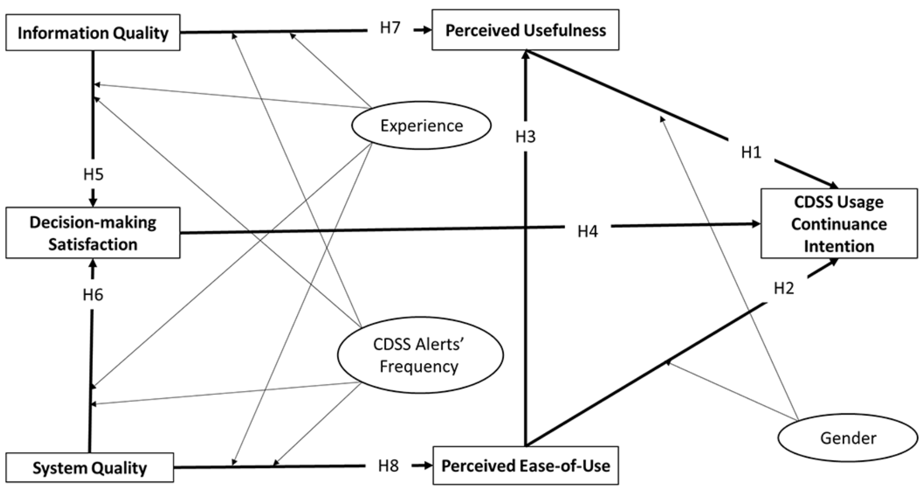

Fig. 1. The research model

The current study aimed to build a model that predict the Jordanian health care providers' intention to continue use the CDSS in the future. The proposed model collects factors from well-established models that have been employed in the prior studies of technology acceptance. The study also checks if gender, experience, and CDSS alerts' frequency have any moderation effect on the proposed research model. Figure 1 shows the research model.

3.1 TAM factors

TAM [10] is the most widely adopted model to anticipate users' intentions to adopt and continue to use information systems. The model has proposed perceived usefulness [PU], and perceived ease-of-use [PEOU]. Both factors were proved to affect the intention to adopt new information systems in a variety of contexts [23]. PU is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" [10. P, 320]. PEOU refers to "the degree to which a person believes that using a particular system would be free of effort" [10. P, 320]. TAM theory hypothesized that users' perceived usefulness and perceived ease of use predict their attitude toward adopting an information system. The theory also posits that users' perceived ease of use affect their perceived usefulness of an information system. Thus, we hypothesize:

H1: Health care providers' perceived usefulness of CDSS has a positive influence on their intentions to continue use CDSS in the future.
H2: Health care providers' perceived ease of use of CDSS has a positive influence on their intentions to continue use CDSS in the future.
H3: Health care providers' perceived ease of use of CDSS has a positive influence on their perceived usefulness of CDSS.

3.2 ISSM factors

TAM has been widely used to investigate users' adoption intentions. Yet, some previous studies showed that TAM has a limited explanatory and predictive power [24]. Huang & Haried [25] argued that TAM assumes the users' reasoning relies merely on cognition, while in the reality, humans are complex, and often do not act logically and reasonably. Therefore, to strengthen the model of technology usage continuance intentions, many other factors and characteristics should be added to the proposed model.

Decision-making satisfaction represents the IS ability to support the users in their decision-making process. Prior research has confirmed that the performance of an information system influences the decision-making satisfaction [26]. Users should be more satisfied when the system supports them in recognizing the problem, and making better decisions related to their goals [27]. The impact of information quality and system quality on decision-making satisfaction is well established in the prior studies [28,29]. However, little research has investigated the impact of decision-making satisfaction on system usage intentions [30], and usage continuance intentions.

User satisfaction with a decision-making process is associated with a confirmation of users' expectations [31]. Users' satisfaction with CDSS happens when it meets their expectations of supporting them in making better decisions. Almeida et al. [32], and Wibowo & Deng [33] argue that using methods and procedures, for modeling the decision-making process, makes the process rational, transparent, and effective, which render greater satisfaction, and hence, greater intentions to continue use the system in the future. While the shortage of decision's support leads to lower levels of satisfaction [34].

When there is a commitment to provide support to solve the health care providers' problems, they are expected to be more satisfied and have more intentions to adopt CDSS [11]. CDSS can be difficult to use without a serious support, provided by a robust system. Therefore, quality of CDSS is expected to positively influence its users' satisfaction and their intentions to continue use CDSS in the future.

User's satisfaction is presented by the IS success model [11,35] as a predictor of IS usage intention. User's satisfaction is also widely admitted by many other subsequent studies, as a strong predictor of IS usage continuance intention [36]. Thus, we hypothesize:

H4: Health care providers' perceived satisfaction with CDSS supported decision-making has a positive influence on their CDSS usage continuance intentions.
H5: Health care providers' perceived information quality has a positive influence on their perceived satisfaction with CDSS supported decision-making.
H6: Health care providers' perceived system quality has a positive influence on their perceived satisfaction with CDSS supported decision-making.

DeLone & McLean [11] presented the Information Systems Success Model [ISSM] to predict the users' intentions to adopt new information systems. The model proposed information quality and system quality as predictors of IS adoption intention. Many studies adopted ISSM model in a variety of contexts [37].

Information quality reflects characteristics such as relevance, accuracy, timeliness, completeness, understanding, and accessibility of the system outputs [37–42]. Prior research has affirmed that usefulness represents a utilitarian benefit of information services, and it shapes the attitude toward information technology implementation [43]. Information quality affects users' satisfaction [44–46]. Satisfied health care providers are more likely to adopt health information systems [47]. Satisfaction affects perceived usefulness, and perceived ease of use [48]. Zhou [37] found that information system that does not offer high-quality information would be more difficult to use by users.

Quality of information provided by CDSS is essential to adopt it. High-quality information assists health care providers to provide useful healthcare services. While low-quality information would complicate the physician's decision-making. Many prior studies have confirmed the impact of information quality on perceived usefulness [49–55]. Accordingly, CDSS information quality is expected to positively influence its perceived usefulness.

System quality represents the system's ease of use, usability, and reliability [37,41]. When the system provides its users with a better performance, it will lead to their satisfaction [55]. Delone and McLean [11] argued that system quality decreases the difficulty of using systems. Many prior studies have confirmed the impact of system quality on perceived ease of use [51,52,54,56,57]. Accordingly, CDSS quality is expected to indirectly influence the health care providers' intentions to continue use it in the future, by influencing PU and PEOU:

H7: Health care providers' perceived CDSS information quality has a positive influence on their perceived usefulness of CDSS.
H8: Health care providers' perceived CDS system quality has a positive influence on their perceived ease-of-use of CDSS.

3.3 The moderating effects of gender, experience, and CDSS alerts' frequency

The current study has investigated the moderation effect of gender, experience, and CDSS alerts' frequency on the proposed research model. The moderation effect of gender on technology adoption is well established in the literature [58]. There is a difference between males and females in terms of perceptions and attitudes toward adopting new technologies [59]. Tarhini et al. [60] found that adding gender as a moderator to TAM has increased its prediction power to 52%. Prior research has shown that males are highly task-oriented, therefore, they value the system usefulness more than females do [60]. However, females value the easiness of system usage more than males do [61]. Thus, we hypothesize:

H-G1: The relationship between perceived usefulness and CDSS usage continuance intention is moderated by gender, such that the effect will be greater for male health care providers.
H-G2: The relationship between perceived ease of use and CDSS usage continuance intention is moderated by gender, such that the effect will be greater for female health care providers.

CDSSs were found to assist health care providers as they make their clinical decisions. However, less experienced health care providers might seek CDSS assistance more than highly experienced health care providers. Information quality could be more appreciated by less experienced health care providers to be satisfied with their decisions, and to find the system more useful. Similarly, system quality might be more appreciated by less experienced health care providers to be satisfied with their decisions, and to find the system easier to use. The less experienced the health care providers are, the more uncertain when making clinical decisions. Therefore, for less experienced health care providers, the impact of information quality on PU, and on decision making satisfaction is higher. Similarly, for less experienced health care providers, the impact of system quality on PEOU, and on decision making satisfaction is higher. Thus, we hypothesize:

H-EX1: The relationship between information quality and perceived usefulness of CDSS is moderated by health care provider's experience, such that the effect will be greater for less experienced health care providers.
H-EX2: The relationship between information quality and decision-making satisfaction is moderated by health care provider's experience, such that the effect will be greater for less experienced health care providers.
H-EX3: The relationship between system quality and decision-making satisfaction is moderated by health care provider's experience, such that the effect will be greater for less experienced health care providers.
H-EX4: The relationship between system quality and perceived ease of use of CDSS is moderated by health care provider's experience, such that the effect will be greater for less experienced health care providers.

Prior studies have shown that alerts' fatigue is a potential problem with CDSS. When CDSS users receive many alerts, they start to silence, disable, or ignore incoming alerts, thereby undermining patient's safety. Therefore, Information quality might make CDSS more useful, and more satisfactory to health care providers, when there are less CDSS alerts. Similarly, system quality might make CDSS easier to use, and more satisfactory to health care providers, when there are less CDSS alerts. Thus, we hypothesize:

H-AF1: The relationship between information quality and perceived usefulness of CDSS is moderated by CDSS alerts' frequency, such that the effect will be greater when there are less CDSS alerts.
H-AF2: The relationship between information quality and decision-making satisfaction is moderated by CDSS alerts' frequency, such that the effect will be greater when there are less CDSS alerts.
H-AF3: The relationship between system quality and decision-making satisfaction is moderated by CDSS alerts' frequency, such that the effect will be greater when there are less CDSS alerts.
H-AF4: The relationship between system quality and perceived ease of use of CDSS is moderated by CDSS alerts' frequency, such that the effect will be greater when there are less CDSS alerts.

4 Research methodology

The current study's objective is to investigate health care providers' intentions of CDSS usage continuance in the future. The study has adopted an integrated model that integrates factors from two technology-acceptance theories: TAM, and ISSM. Th study also investigated the moderation effect of gender, experience, and CDSS alerts' frequency. The study is motivated by the negative attitude of some health care providers toward CDSS in Jordan. Reasons for this negative attitude could be the large number of alerts sent by CDSS, in addition to the alerts sent in unnecessary situations.

Toward this objective, the current study utilized a survey to collect health care providers' opinions about their intentions to continue use the CDSS in the future. A statistical analysis was also used to analyze the collected data and validate the research model.

4.1 Measurement development

The study's survey starts with explaining the study's purpose, and the anonymity assurance. The next section of the survey collects information related to the participants' demographic background, and their CDSS usage statistics. The last section includes the study's measurement scales. The survey uses a seven-points Likert scales ranging from 1 = "strongly disagree" to 7 = "strongly agree", to measure the study constructs.

Perceived ease of use measurement focuses on exploring the health care providers' opinions regarding the ease of CDSS usage to get assistance to make clinical decisions. Perceived usefulness measurement focuses on exploring the health care providers' opinions regarding the CDSS usefulness to make better clinical decisions. Usage continuance intention [CI] measurement reflects the health care providers' intention to continue use the CDSS in the future.

System quality measurement focuses on exploring the health care providers' opinions regarding the CDSS characteristics. These characteristics are related to CDSS usability, response time, user interface, reliability, and stability. Information quality measurement focuses on exploring the health care providers' opinions regarding the characteristics of information provided by CDSS. These characteristics are related to the CDSS outputs quality. Decision-making satisfaction measurement focuses on exploring the health care providers' opinions regarding their satisfaction toward the CDSS support to make better clinical decisions.

The survey items were adopted from previously established measurements. However, the measurement items were reworded reviewed, and pretested using a pilot study [N=25]. Consequently, the final survey included 36 items as illustrated in Table A1, in the appendix.

4.2 The sampling methods and procedure

The current study has employed a convenience sampling method. The study has targeted health care providers who work in health-care organizations that adopted CDSS. Health care providers from different specialties were welcomed if they have any access to CDSS. An invitation was sent via email to health care providers in selected health-care organizations in Jordan. The email included a link to an online survey. The survey lasted for three months until a sufficient sample size was reached for the statistical analyses. The study has targeted 200 valid responses to achieve a sufficient sample size according to Hair, Black, Babin, Anderson, and Tatham [62] recommendations of sample size. The collected data were finally organized and prepared for the statistical analysis.

5 Data analysis and results

The authors have sent the survey link to 538 health care providers in Jordan. 218 health care providers have returned the survey, yielding a response rate of 40.5%, 42.2% females [n=92], and 57.8% males [n=126]. Table 1 explains the sample's demographics. All the participants have reported using CDSS as part of the health information systems in their health organizations. The participants have received no compensation for their participation.

Table 1. Sample demographics

Variable	Frequency (N)%	Variable	Frequency (N)%
Gender		**CDS access frequency**	
Male	(126) 57.8%	Not every day	(11) 5%
Female	(92) 42.2%	Once a day	(85) 39%.
		Twice a day	(67) 30.7%
		Three or more times a day	(55) 25.3%
Age		**Health professionals' classification**	
Less than 40	(6) 2.75%	General doctor	(129) 59.17%
40–44	(42) 19.27%	Specialist	(89) 40.83%
45–49	(54) 24.77%		
50–54	(66) 30.28%		
55 and older	(50) 22.93%		
Work experience		**Alerts' Frequency**	
Less than 2 years	(27) 14.1%	Too many alerts	(133) 61%
2–5 years	(70) 30.34%	Little alerts	(85) 39%
6–9 years	(74) 33.3%		
10–13 years	(43) 19.66%		
More than 13 years	(4) 2.6%		

The current study has employed a partial least squares structural equation modeling [PLS-SEM] method. PLS-SEM is the most appropriate method for the current study because it focuses on prediction, instead of testing whether data fit a predefined model [63]. The authors followed two procedures in the statistical analysis: measurement model assessment, and structural model assessment.

5.1 Measurement model assessment

Items loading values of above 0.6 are deemed desirable [64]. Table 2 shows that each item in the study has surpassed this threshold. Internal consistency requires all the constructs to have composite reliability values of at least 0.7 [65]. Table 3 shows that each construct has surpassed this threshold.

Table 2. Items loading and cross loading

	PEOU	PU	SQ	IQ	SAT	UCI
PEOU1	0.51	0.31	0.47	0.27	0.45	0.4
PEOU2	0.57	0.36	0.38	0.42	0.45	0.35
PEOU3	0.56	0.4	0.47	0.46	0.27	0.42
PEOU4	0.69	0.44	0.47	0.46	0.4	0.35
PEOU5	0.68	0.37	0.37	0.26	0.38	0.45
PEOU6	0.84	0.36	0.32	0.28	0.44	0.36
PU1	0.29	0.76	0.35	0.48	0.47	0.49
PU2	0.34	0.76	0.26	0.47	0.37	0.34
PU3	0.48	0.54	0.26	0.4	0.35	0.49
PU4	0.4	0.82	0.47	0.36	0.34	0.34
PU5	0.46	0.52	0.4	0.43	0.32	0.46
SQ1	0.41	0.4	0.51	0.3	0.4	0.45
SQ2	0.47	0.32	0.75	0.42	0.41	0.49
SQ3	0.33	0.47	0.57	0.37	0.44	0.42
SQ4	0.4	0.26	0.78	0.3	0.38	0.48
SQ5	0.43	0.43	0.82	0.33	0.43	0.42
SQ6	0.26	0.41	0.5	0.29	0.42	0.35
IQ1	0.42	0.4	0.49	0.69	0.35	0.38
IQ2	0.28	0.29	0.43	0.84	0.38	0.35
IQ3	0.4	0.4	0.49	0.76	0.43	0.47
IQ4	0.43	0.26	0.45	0.65	0.28	0.39
IQ5	0.34	0.34	0.36	0.64	0.33	0.36
IQ6	0.43	0.29	0.35	0.64	0.31	0.44
IQ7	0.39	0.32	0.33	0.76	0.47	0.39
IQ8	0.46	0.49	0.28	0.74	0.38	0.4
IQ9	0.28	0.45	0.32	0.74	0.44	0.38

(Continued)

Table 2. Items loading and cross loading *(Continued)*

	PEOU	PU	SQ	IQ	SAT	UCI
SAT1	0.28	0.38	0.46	0.31	0.78	0.37
SAT2	0.4	0.41	0.4	0.43	0.76	0.44
SAT3	0.32	0.49	0.3	0.43	0.6	0.49
SAT4	0.41	0.49	0.36	0.34	0.63	0.42
SAT5	0.31	0.31	0.46	0.36	0.59	0.49
UCI1	0.38	0.4	0.35	0.46	0.33	0.65
UCI2	0.42	0.29	0.41	0.38	0.35	0.6
UCI3	0.42	0.49	0.42	0.42	0.45	0.54

Table 3. Internal consistency and discriminant validity

		Square Root of AVE and Inter-Construct Correlations					
Composite Reliability		**PEOU**	**PU**	**SQ**	**IQ**	**SAT**	**UCI**
0.83	**PEOU**	0.57					
0.85	**PU**	0.48	0.68				
0.81	**SQ**	0.39	0.42	0.63			
0.76	**IQ**	0.48	0.35	0.42	0.63		
0.73	**SAT**	0.47	0.39	0.49	0.35	0.79	
0.77	**UCI**	0.43	0.37	0.39	0.43	0.44	0.53

To ensure the discriminant validity, the study applied two methods. First, the loading of each item on its respective construct should be higher than the item's cross loading on other constructs. Second, the square root of the average variance extracted [AVE] for each construct should be higher than the correlations among the other constructs [66]. Tables 2 and 3 show that the study results meet these conditions; thus, the criterion of discriminant validity was satisfied.

Finally, the current study used Harman's single factor to check for the common method bias. Firstly, the test was performed with all the study's variables, resulting in 29.34% of the variance explained by the first factor. Secondly, the test was performed with the independent variables, resulting in 33.04% of the variance explained by the first factor. Accordingly, the results of Harman's single factor suggest that common method bias is not an issue in the current study, considering the threshold recommended by Greene and Organ [67].

In summary, the assessment of the measurement model indicates that the model has met all the required conditions that confirm the model's validity and reliability.

5.2 Structural model assessment

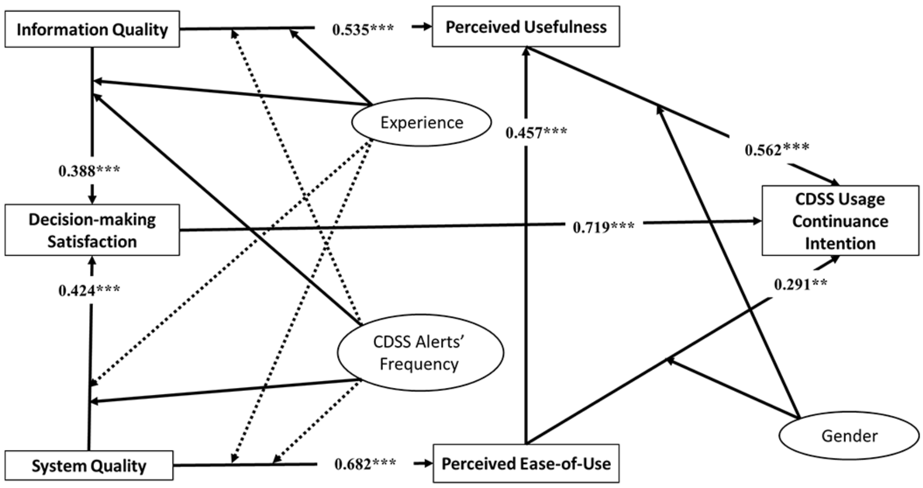

Fig. 2. Structural model assessment

Notes: *P < 0.05, **P < 0.01, ***P < 0.001. T-values in parentheses. Dashed paths are not significant.

The outcomes of the structural model assessment are presented in Figure 2. The CDSS usage continuance intention has an R^2 of 0.486. Accordingly, the factors PU, PEOU, and decision-making satisfaction have collectively explained 48.6% of the variance in the CDSS usage continuance intention. This percent represents an adequate share of variance explained by the study's factors. Perceived usefulness had an R^2 of 0.667. Accordingly, information quality and PEOU have collectively explained 66.7% of the variance in PU. Perceived ease-of-use had an R^2 of 0.633. Accordingly, system quality has explained 63.3% of the variance in PEOU. Decision-making satisfaction had an R^2 of 0.615. Accordingly, information quality and system quality have collectively explained 61.5% of the variance in decision-making satisfaction.

The study's results show that the constructs PU [β = 0.562, t-value = 6.281, $p < 0.001$], PEOU [β = 0.291, t-value = 1.658, $p < 0.01$], and decision-making satisfaction [β = 0.719, t-value = 11.492, $p < 0.001$], have a significant influence on CDSS usage continuance intention. However, the strongest predictor of the continuance intention was the decision-making satisfaction. PEOU has a significant influence on PU [β = 0.457, t-value = 3.534, $p < 0.001$]. Information quality has a significant influence on decision-making satisfaction [β = 0.388, t-value = 3.405, $p < 0.001$], and on PU [β = 0.535, t-value = 4.387, $p < 0.001$]. System quality has a significant influence on decision-making satisfaction [0.424, t-value = 3.613, $p < 0.001$], and on PEOU [β = 0.682, t-value = 4.942, $p < 0.001$]. Table 4, and Figure 2 demonstrate these results.

Table 4. Results of hypotheses testing

Hypothesis	Beta (β)	t-value	p-value
H1: PU → UCI	0.562	6.281	0.001
H2: PEOU → UCI	0.291	1.658	0.01
H3: PEOU → PU	0.457	3.534	0.001
H4: Sat → UCI	0.719	11.492	0.001
H5: IQ → Sat	0.388	3.405	0.001
H6: SQ → Sat	0.424	3.613	0.001
H7: IQ → PU	0.535	4.387	0.001
H8: SQ → PEOU	0.682	4.942	0.001

The study tested for the moderation effect by performing a multi-group path analysis [68]. The multi-group path analysis results for the different groups of moderators are provided in Tables 5 and 6.

Table 5. Chi-square difference test results (moderation results)

Hypothesis	Structural Relationships	Group 1 Estimate	Group 2 Estimate	Comparison Among Groups (Chi-Square Test for Difference) Δc^2
H-G1	Perceived Usefulness → CDSS Usage Continuance Intention	Female (N=92) 0.313**	Male (N=126) 0.741***	5.127**
H-G2	Perceived Ease of Use → CDSS Usage Continuance Intention	Female 0.414**	Male 0.217*	3.184*
H-EX1	Information Quality → Perceived Usefulness	No Experience (N=97) 0.712***	Experience (N=121) 0.334**	5.11**
H-EX2	Information Quality → Decision-making Satisfaction	No Experience 0.548***	Experience 0.257*	3.954*
H-EX3	System Quality → Decision-making Satisfaction	No Experience 0.319**	Experience 0.568***	3.742*
H-EX4	System Quality → Perceived Ease of Use	No Experience 0.691***	Experience 0.668***	0.009
H-AF1	Information Quality → Perceived Usefulness	Lower Alerts (N=) 0.439***	Higher Alerts (N=) 0.651***	3.685*
H-AF2	Information Quality → Decision-making Satisfaction	Lower Alerts 0.678***	Higher Alerts 0.154	8.657***
H-AF3	System Quality → Decision-making Satisfaction	Lower Alerts 0.654***	Higher Alerts 0.176	8.356***
H-AF4	System Quality → Perceived Ease of Use	Lower Alerts 0.688***	Higher Alerts 0.667***	0.007

Note: ***p < 001; **p < 01; *p < 05.

Table 6. Summary of moderation hypotheses results

Hypothesis	Result	Explanation
H-G1	Supported	Significant difference as hypothesized. The relationship is stronger for males.
H-G2	Supported	Significant difference as hypothesized. The relationship is stronger for females.
H-EX1	Supported	Significant difference as hypothesized. The relationship is stronger for unexperienced health professionals.
H-EX2	Supported	Significant difference as hypothesized. The relationship is stronger for unexperienced health professionals.
H-EX3	Not supported	Significant difference, but contrary to what hypothesized. The relationship is stronger for experienced health professionals.
H-EX4	Not supported	No significant difference in the strength of the relationship between unexperienced and experienced health professionals.
H-AF1	Not supported	Significant difference, but contrary to what hypothesized. The relationship is stronger for higher alerts' frequency.
H-AF2	Supported	Significant difference as hypothesized. The relationship is stronger for lower alerts' frequency.
H-AF3	Supported	Significant difference as hypothesized. The relationship is stronger for lower alerts' frequency.
H-AF4	Not supported	No significant difference in the strength of the relationship between lower and higher alerts' frequency.

For the relationship between PU and CDSS continuance intention [H1], the results indicate that there is a significant difference between males and females [$\Delta\chi^2 = 5.127$, $p < 0.01$], and the effect is greater for males as hypothesized in H-G1. For the relationship between PEOU and CDSS continuance intention [H2], the results indicate that there is a significant difference between males and females [$\Delta\chi^2 = 3.184$, $p < 0.05$], and the effect is greater for females as hypothesized in H-G2.

For the relationship between information quality and PU [H7], the results indicate that there is a significant difference between unexperienced and experienced health care providers [$\Delta\chi^2 = 5.11$, $p < 0.01$], and the effect is greater for unexperienced health care providers as hypothesized in H-EX1.

For the relationship between information quality and decision-making satisfaction [H5], the results indicate that there is a significant difference between unexperienced and experienced health care providers [$\Delta\chi^2 = 3.954$, $p < 0.05$], and the effect is greater for unexperienced health care providers as hypothesized in H_EX2.

For the relationship between system quality and decision-making satisfaction [H6], the results indicate that there is a significant difference between unexperienced and experienced health care providers [$\Delta\chi^2 = 3.742$, $p < 0.05$]; however, the effect is greater for experienced health care providers, contrary to the proposed hypothesis H-EX3.

For the relationship between system quality and PEOU [H8], the results indicate that there is no significant difference between unexperienced and experienced health care providers [$\Delta\chi^2 = 0.009$, $p > 0.05$], contrary to the proposed hypothesis H-EX4.

For the relationship between information quality and PU [H7], the results indicate that there is a significant difference between lower and higher alerts' frequency [$\Delta\chi^2 = 3.685$, $p < 0.05$]; however, the effect is greater for the higher alerts' frequency, contrary to the proposed hypothesis H-AF1.

For the relationship between information quality and decision-making satisfaction [H5], the results indicate that there is a significant difference between lower and higher alerts' frequency [$\Delta\chi^2 = 8.657$, $p < 0.001$], and the effect is greater for the lower alerts' frequency, as hypothesized in H_AF2.

For the relationship between system quality and decision-making satisfaction [H6], the results indicate that there is a significant difference between lower and higher alerts' frequency [$\Delta\chi^2 = 8.356$, $p < 0.001$]; and the effect is greater for the lower alerts' frequency, as hypothesized in H_AF3.

Finally, For the relationship between system quality and PEOU [H8], the results indicate that there is not a significant difference between lower and higher alerts' frequency [$\Delta\chi^2 = 0.009$, $p > 0.05$], contrary to the proposed hypothesis H-AF4.

6 Discussion

The current study has employed two of the most prevalent models of technology acceptance, TAM and ISSM, to propose an integrated model to predict the health care providers' intentions to continue use the CDSS in the future. The results have led to several key findings.

The integrated model has strongly predicted the CDSS usage continuance intentions [R^2=0.486]. Decision making satisfaction was the strongest predictor of the CDSS usage continuance intention. TAM's factors [perceived usefulness, and perceived ease of use] had a smaller, yet significant, influence on the CDSS usage continuance intentions. The findings also highlight the significant of the ISSM model's factors; system quality, information quality, and satisfaction, in predicting CDSS usage continuance intentions by health care provider in Jordan.

Many reasons may explain the ISSM superiority, in predicting the CDSS usage continuance intentions. This should be related to the factors proposed by this theory, system quality, information quality, and satisfaction. The ISSM model has already received a lot of attention and contributed significantly to investigate and predict the technology acceptance. However, some other models, especially TAM, has received more attention. Researchers have extensively relied on TAM. Our findings indicate that ISSM model could be more accurate in this study's context.

Information quality dimensions are accuracy, objectivity, believability, availability, relevance, timeliness, completeness, concise representation, consistent representation, reliability, and verifiability [69,70]. However, researchers have affirmed that the best assessment for information quality is its usefulness in a particular task [71]. Health information quality can be assessed by its usefulness in assisting health care providers to make better clinical decisions.

Obviously, low-quality health information, such as inaccurate, unavailable, irrelevant, outdated, incomplete and unreliable health information, has less ability to assist health care providers in their clinical decision making. Consequently, it does not motivate them to adopt CDSS that offer such low-quality health information, and this is consistent with the current study's results.

System quality represents ease of use, response time, user interface and reliability and stability [37,41]. These characteristics are crucial to the health care providers to be satisfied with their clinical decisions.

Ease of use has proved to influence the health care providers' intention to adopt health information systems [72]. CDSS is not an easy-to-use system, because of the complexity of health workflows. In some cases, health care providers need to interrupt their current work, switch to the CDSS, and enter the required data, so they can get the assistance they need. Accordingly, ease of CDSS usage motivates the health care providers to adopt it, and to continue this adoption in the future.

Response time refers to the time the CDSS takes to return responses to the health care providers. Response time is evaluated as a task-related characteristic [69]. Meaning that, applications are supposed to offer a fast response rate to the users, however, users evaluate the response time based on the nature of tasks that they are working on. What seems to be tolerant by users when using a particular application might not be tolerant when using another application. Users might be more sensitive to response time in the case of clinical decision support systems, where health care providers need to make serious decision in a limited time.

The usability of user interfaces is an important dimension of system quality. Usability can be a multi-dimensions factor, it is related to the degree the system is easy to learn, remember, understand, find, and effective to use [73,74]. These characteristics of system quality are critical to the health care providers when they use CDSS.

Reliability is how dependable the system is over time [69]. CDSS must be reliable so that health care providers can decide to adopt it and continue use it in the future. CDSS assists health care providers as they made critical clinical decisions. Unreliable CDSS would lead to health errors that prohibit the users from adopting it. System reliability can be measured by metrics such as system's downtime. CDSS downtime prevent health care providers from getting assistance as they make clinical decisions, affecting their adoption CDSS.

The findings partially support our proposed hypotheses regarding the moderation effects of gender, experience, and CDSS alerts' frequency. The results showed that gender moderates the relationship between PU and usage continuance intentions, and the relationship between PEOU and usage continuance intentions. Experience moderates the relationship between information quality and PU, and the relationship between information quality and decision-making satisfaction. CDSS alerts' frequency moderates the relationship between information quality and decision-making satisfaction, and the relationship between system quality and decision-making satisfaction. These findings are consistent with the prior studies [60,75].

6.1 Contributions to theory and practice

The current study aimed to investigate health care providers' intentions to continue use CDSS in the future in Jordan. This research extends the growing literature on health information systems' adoption by building an integrated model that integrates factors from two well-established technology acceptance models, TAM and ISSM. The findings proved a significant impact of ISSM's factors [system quality, information quality, and satisfaction] on CDSS usage continuance intentions.

Health organizations in Jordan have started to implement health information systems to improve the healthcare services quality. Health organizations rely on CDSS to assist health care providers in their clinical decision-making process. CDSS implementation does not guarantee its adoption, and more importantly, its usage continuance in the future. Therefore, the current study made efforts to build an integrated model that can reliably predict the health care providers' intentions to continue use CDSS in the future in Jordan.

Although TAM theory has been extensively used in IS acceptance literature, the current study proved that ISSM is an important model in the context of predicting HIS and CDSS usage continuance intentions. However, the good explanatory power provided by the proposed integrated model justify its significance.

One other contribution of the current study is investigating the moderating effects of gender, experience, and CDSS alerts' frequency on the proposed model. These findings strengthen our understanding of how these factors moderate the proposed hypotheses. It also assists in resolving the contradicted findings regarding the CDSS ability to support health care providers in their clinical decision-making. CDSS designers can also use our findings to be informed about the alerts' fatigue issue that prevent health care providers from adopting CDSS.

6.2 Limitations and future recommendations

The main limitation of the study is the sample size. The proposed model has integrated number of factors from several models. A larger sample size could support the precision of our estimates, and our ability to generalize the conclusions. However, the difficulty of employing respondents from the health care providers' community prevented us from getting any larger sample. Thus, our recommendations for future research are to replicate the study with a larger sample size.

One other limitation of the study could be the omission of investigating CDSS alerts' characteristics, such as alert's appropriateness, effectiveness, and usability, and the moderating impact of these characteristics on CDSS usage continuance intention. Alerts' frequency is an important factor; however, a high number of appropriate alerts could be more convenient to the health care providers than a low number of inappropriate alerts. Prior research has not paid enough attention to the factors that determine CDSS alerts' appropriateness, effectiveness, and usability. Therefore, future research should consider the CDSS alerts' characteristics in addition to its frequency.

7 References

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8 Appendix

Table A1. The study measurement items and its sources

The Study Measurement Items	The Measurement's Source
Perceived Ease of Use (PEOU) PEOU1: I would find it easy to get CDSS to do what I want it to PEOU2: I would find it easy to get CDSS to do what I want it to PEOU3: My interaction with CDSS would be clear and understandable PEOU4: I would find CDSS to be flexible to interact with PEOU5: It would be easy for me to become skillful at using CDSS PEOU6: I would find CDSS easy to use	[11]
Perceived usefulness (PU) PU1: Using CDSS in my job would enable me to accomplish my tasks more quickly PU2: Using CDSS would improve my job performance PU3: Using CDSS in my job would increase my productivity PU4: Using CDSS would enhance my effectiveness on the job PU5: Using CDSS would make it easier to do my job PU6: I would find CDSS useful in my job	[11]

(Continued)

Table A1. The study measurement items and its sources *(Continued)*

The Study Measurement Items	The Measurement's Source
System Quality (SQ) SQ1: CDSS is easy to use. SQ2: CDSS is user friendly. SQ3: I find it easy to use CDSS to do what I want it to do. SQ4: I believe that CDSS is cumbersome to use. SQ5: Using CDSS requires a lot of effort. SQ6: Using CDSS is often frustrating.	[76]
Information quality (IQ) IQ1: CDSS provides sufficient information. IQ2: Through CDSS, I get the information I need in time. IQ3: I am satisfied with the accuracy of CDSS. IQ4: Information provided by CDSS meets my needs. IQ5: Information provided by CDSS is in a useful format. IQ6: Information provided by CDSS is clear. IQ7: Information provided by CDSS is accurate. IQ8: Information provided by CDSS is up-to-date. IQ9: Information provided by CDSS is reliable.	[76]
Decision making satisfaction (SAT) SAT1: Utilization of CDSS has enabled me to make better clinical decisions. SAT2: After As a result of utilizing CDSS, I am better able to set my priorities in decision making. SAT3: Use of data generated by CDSS has enabled me to present my arguments more convincingly. SAT4: CDSS has improved the quality of clinical decisions I make. SAT5: As a result of utilizing CDSS, the speed at which I analyze my decisions has increased. SAT6: As a result of utilizing CDSS, more relevant information has been available to me for decision making. SAT7: CDSS has led me to greater use of analytical aids in my decision making.	[77]
Usage continuous intentions (UCI) UCI1: I intend to continue using CDSS rather than discontinue its use. UCI2: My intentions are to continue using CDSS than use any alternative means. UCI3: If I could, I would like to discontinue my use of CDSS	[55]

9 Author

Jehad Imlawi is an Associate Professor at Al al-Bayt University, Information Systems department. He received his PhD degree from the University of Colorado Denver, USA. His research interests focus on online user behaviour, human computer interaction, and health information systems. His research work has appeared in journals like the *International Journal of Human Computer Interaction, and Computer and Education*, among others.

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