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Explaining resistance to system usage in the PharmaCloud: A view of the dual-factor model

Pi-Jung Hsieh[a,*], Weir-Sen Lin[b]

[a] Department of Hospital and Health Care Administration, Chia Nan University of Pharmacy & Science, No. 60, Section 1, Erren Rd., Rende Dist., Tainan 71710, Taiwan, ROC

[b] Department of Hospital and Health Care Administration, Chia Nan University of Pharmacy & Science, No. 60, Section 1, Erren Rd., Rende Dist., Tainan 71710, Taiwan, ROC

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ABSTRACT

Use of the PharmaCloud can improve the quality of healthcare, but improvements are likely to be thwarted if physicians resist using the system. This study uses the dual-factor model to explain physicians' resistance behaviors to system usage. The results of a field survey conducted in Taiwan showed that physicians' resistance to using the PharmaCloud stemmed from regret avoidance, inertia, perceived value, and perceived threat. These results also indicate that system, information, and service qualities are the key determinants of the behavioral intention to use. This research advances the theoretical understanding of user acceptance and resistance to technology post-implementation and offers practical implications.

1. Introduction

Since 1995, Taiwan's National Health Insurance (NHI) has been providing comprehensive healthcare coverage for the majority of the country's 23 million inhabitants. The majority of patients tend to visit several hospitals throughout their lives, and "hospital shopping" has become relatively common. In this situation, because of the lack of infrastructure for sharing health and medication history information among hospitals, patients who practice hospital shopping are more likely to receive duplicate medications and suffer adverse drug reactions. In 2009, approximately 1.43% of Taiwan's inhabitants aged 12–64 years (252,000 people) abused drugs at least once [1]. The misuse and abuse of prescription drugs is a grave concern in healthcare management policy. In response, the National Health Insurance Administration (NHIA) was tasked with establishing the NHI PharmaCloud as a platform to manage all prescriptions of the insured and to provide timely and comprehensive medication information to a wide range of healthcare providers who have been contracted by the NHIA [2]. The NHI PharmaCloud aims to improve drug safety, reduce medication duplication, and improve the quality of care by allowing physicians at the NHIA-contracted facilities to obtain patients' timely and comprehensive medication information from the preceding 3 months. However, for these information technology-enabled benefits to materialize, physicians must adopt and use the NHI PharmaCloud to the extent that they obtain a complete history of or information about patients' prescription records from the PharmaCloud platform.

The information systems (IS) literature has focused on technology acceptance and use as a means of realizing the value of new technology investments [3–5]. In fact, user resistance is an unavoidable issue that management must face, and it may cause the performance to be lower than expected [6]. For example, IS are supposed to positively influence the efficiency and quality of healthcare, but these goals are likely to be thwarted if physicians avoid using them. A previous study indicated that the efficiency of IS reduced by 20–40% because of user resistance in a hospital [7], as physicians often felt that traditional paper-based ordering was faster. User resistance demonstrates asymmetric behaviors that are typical of inhibitors because the presence of resistance hinders new technology usage; however, a lack of resistance does not necessarily enhance new technology usage [8]. Prior research on IS usage has largely ignored the problem of user resistance, while prior research on user resistance has itself been limited. Cenfetelli's [8] dual-factor model of IS usage therefore provides a theoretical bridge linking research on technology usage and resistance within an integrated model. The core argument in this model is that technology usage among users is based on simultaneous considerations of enabling and inhibiting factors. Cenfetelli's [8] study was motivated by extant theories of IS usage, such as the technology acceptance model (TAM) [3] and the IS success model from DeLone and McLean [4,5]. TAM assumes that two specified beliefs, perceived usefulness and perceived ease of use, determine technology adoption, acceptance, and use. Although TAM has success-

* Corresponding author.
E-mail addresses: beerun@seed.net.tw (P.-J. Hsieh), weirsen@mail.cnu.edu.tw (W.-S. Lin).

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fully guided many studies in technology adoption, it fails to address external factors that may influence other motivators such as service quality [9]. DeLone and McLean's IS success model provides a useful foundation for identifying the full range of enabling beliefs about an IS's attributes [8]. These enabling beliefs may be about the technical quality of the IS itself or the semantic quality of the information provided by the system. Although Cenfetelli [8] did not identify any specific inhibitor to IS usage, based on our literature review, the status quo bias (SQB) perspective [10] explains why an individual may remain in a status quo state even in the presence of better alternatives. Thus, the SQB perspective provides a set of useful theoretical explanations for understanding the impact of maintaining the current status or situation as inhibiting perceptions of IS usage.

According to Cenfetelli's [8] model, the present study proposes a novel research model that integrates both DeLone and McLean's updated IS success model and the SQB theory to effectively understand physicians' resistance behavior to system usage. We propose that a physician's decision to use the NHI PharmaCloud is based on two opposing perceptions: "users' intention to use" and "users' resistance to use." In terms of enabling perceptions, we propose that a user's intention to use is affected by enablers such as system, information, and service qualities. With regard to inhibiting perceptions, according to the SQB perspective, we extend six causes of user resistance, namely sunk costs, regret avoidance, inertia, perceived value, switching costs, and perceived threat, from psychological commitments, cognitive misperceptions, and rational decision-making. These inhibitors provide a higher explanatory power and a more precise understanding of user resistance antecedents. From a practical standpoint, understanding why physicians resist or use the PharmaCloud and how resistance is manifested in their subsequent behavior can help governmental agencies and hospital managers devise appropriate intervention strategies for minimizing user resistance and its effect on healthcare policy. Therefore, our study objectives are as follows: (a) to clarify which enablers have the greatest influence on the decision to use the PharmaCloud, (b) to clarify which inhibitors have the greatest influence on the decision to resist the PharmaCloud use, (c) to investigate whether resistance to use significantly affects physicians' behavioral intentions to use the PharmaCloud, and (d) to investigate whether the intention or resistance to use considerably affects system use.

2. Literature review

Cloud computing is a solution employed by healthcare organizations because it provides computation, software, data access, and storage services that do not require users' knowledge of the physical location and configuration of the system that delivers the services [11]. Although previous studies have identified the merits of cloud computing [12–14] and the security and privacy issues associated with cloud computing in the healthcare sector [15–17], a limited understanding of physicians' behavior exists regarding the PharmaCloud. The grounding of user resistance in the technology usage and user resistance literature is quite weak. Compared with previous studies, we specifically highlight the factors driving physicians' intention to use the PharmaCloud.

2.1. The NHI PharmaCloud

Taiwan's NHIA applied cloud computing technology to develop the NHI PharmaCloud in July 2013. The NHI PharmaCloud focuses primarily on adopting private cloud computing for physicians. Users are no longer device dependent (or system dependent); instead, they are more service oriented. After confirming the identity of each user, the sharing of medication information proceeds over a virtual private network. Medication information, such as the name and code of the drug, its related anatomical therapeutic chemical classification and main chemical compounds, the prescription date, the location where the drug was prescribed, the quantity of the prescribed drug, and the estimated surplus quantity of the drug, can be accessed from the NHI PharmaCloud. Using this system, physicians can access outpatients' and inpatients' prescription records from the preceding 3 months when giving prescriptions or providing drug consultations. As physicians examine patients, they can determine which drugs patients have recently used or are using through the NHI PharmaCloud. Repeated medication and drug interactions can be avoided when physicians issue prescriptions to improve medication safety and quality of care. Thus, the major aims of the NHI PharmaCloud include the following: (a) to offer comprehensive medication information to authorized physicians, thereby enabling them to provide patients with high-quality care; (b) to protect patients from drug interactions and dosage errors; (c) to prevent prescription fraud and the accidental duplication of prescriptions; and (d) to reduce the cost of drug expenditure. Therefore, hospitals have increasingly implemented the NHI PharmaCloud to facilitate decision-making regarding individual patient care. Because of its rapidly increasing use, the NHI PharmaCloud has recently become the focus of the NHIA, hospital managers, and clinicians. At the post-implementation stage, physicians must use the NHI PharmaCloud, but they can show resistance in doing so. Because of their unstructured and uncertain tasks, physicians have considerable opportunities to avoid using such systems [7]. As a result, only about 15% of the physicians at these hospitals have used the NHI PharmaCloud for queries regarding patients' drug records, while 85% of the physicians have not used it. This high level of nonusage was surprising. Therefore, physicians' acceptance of and support for the NHI PharmaCloud and their usage of it need to be significantly improved in Taiwan.

2.2. Technology use and resistance

Health IT has tremendous potential to reduce the incidence of medical errors and improve care quality and patient safety; however, this benefit is not always realized, as many health IT efforts encounter difficulties or fail. Many of these difficulties and failures can be traced back to user resistance [18]. In the TAM, usage behavior is a direct function of behavior intention. Behavior intention is, in turn, a weighted function of attitude toward usage, which reflects feelings of favorableness that using the new system will enhance performance [3]. Resistance is not equivalent to nonusage, as nonusage can imply that potential adopters are simply unaware of the new technology or are still evaluating it prior to its adoption, while resistance suggests that the technology has been considered and rejected by the users [19]. As suggested by prior literature, initial IS adoption, implementation, and post-implementation are the three different stages in the technology innovation cycle [20]. Initial IS adoption refers to the stage at which decisions are made about whether to adopt a new IS. Once the IS has been implemented successfully, the IS post-implementation stage is involved with how much organizational learning takes place within the organization to facilitate further IT adoption [20]. User resistance becomes particularly significant in such IS implementations because of the multifarious changes that occur in social and technical systems. For example, users may resist the new IS and cause delays in the budget and project duration, as well as underutilization of the new IS [21]. In the post-implementation stage, users may accept that the system has been implemented and that they should use it, but they may still expend little time and effort to use it [22]. Thus, user resistance does not necessarily end at implementation; rather, it includes a broad spectrum of behaviors ranging from active resistance, such as vandalism, to more passive resistance, such as apathy [22]. Although more active resistance is less likely to continue after health IT is successfully implemented, more passive resistance, is liable to persist. Accordingly, we adopt the term "user resistance" as a passive form—an individual's preference to avoid working with health IT despite the need and opportunity to do so—to describe a specific type of post-adoption resistance. Despite the above differences, technology usage and resistance must be examined together within a common theoretical model, as user resistance is a barrier to IS usage [8]. Thus, the present study proposes a research model that integrates both technology usage and resistance literature to effectively understand physicians' resistance behaviors to system usage.

2.3. Dual-factor theory of IS usage

The dual-factor theory, Herzberg's influential needs theory of the 1960s, proposed that humans have two different sets of needs and that the various elements of the work situation satisfy or frustrate these needs [23]. The findings supported his belief that job satisfaction was essentially determined by one set of factors and job dissatisfaction by a different set. The first set concerns the basic survival needs of a person—the hygiene factors [24]. These factors are not directly related to the job itself but are related to the conditions that influence job performance. Hygiene factors that were found to affect job dissatisfaction include the quality of supervision, salary, company policies, physical working conditions, interpersonal relations, and job security. When they are adequate, people are neither dissatisfied nor satisfied. Herzberg et al. [24] referred to these factors as motivation factors—for example, the recognition of a completed task, advancement, responsibility, and work itself. These factors are inherently related to the job and the results of job performance. These factors are, according to Herzberg, motivation factors, implying that humans try to become all that they are capable of becoming, and when their needs are satisfied, they become motivated. Herzberg and colleagues proposed that job satisfaction and dissatisfaction are separate, though not opposite, constructs. Several studies using the dual-factor theory have been conducted to better suit the specific context under study. In the education context, the hygiene factors were represented by the quality of the advising staff (e.g., accessible, reliable, and responsive). The motivation factors were translated into faculty performance variables (e.g., understanding, helpful, and professional) and classes (course scheduling and projects) [25].

In IS usage studies, Cenfetelli [8] contended that while IS usage is best predicted by enablers, IS resistance tends to be best predicted by inhibitors. Enablers are external beliefs about the design and functionality of an IS. These external beliefs may be about the technical quality of the IS itself or about the semantic quality of the information provided by the IS. Cenfetelli [8] defined inhibitors as hygiene factors that discourage system usage when present but do not necessarily favor the usage when absent. This asymmetric effect implies that inhibitors are not quite the opposite of enablers; instead, they are qualitatively distinct constructs that are independent of, but may coexist with, enablers. Inhibiting perceptions can be further distinguished from enabling perceptions by having differing antecedents and consequent effects. In the medical informatics context, Bhattacherjee and Hikmet [19] drew upon Cenfetelli's dual-factor model of IS usage to explain physicians' resistance to healthcare IT. The principal findings of the study by Bhattacherjee and Hikmet support Cenfetelli's model. Thus, Cenfetelli's dual-factor model of IS usage provides a theoretical bridge that links health IT usage and resistance in an integrated model.

2.4. DeLone and McLean's IS success model

On the basis of Shannon and Weaver's communication research [26] and Mason's information influence theory [27], DeLone and McLean [4] proposed the following six dimensions that can be used to measure the IS success model as follows: system quality, information quality, system use, user satisfaction, individual impact, and organizational impact. Shortly after the publication of DeLone and McLean's IS success model, IS researchers began proposing modifications. Accepting the authors' call for "further development and validation," Pitt et al. [28] added the service quality of the IT department to the IS success model. The service quality of the IT department is a postservice measurement of the information users receive and the human service quality that staff members offer through the IS [27,29]. Although the IS success model initially focused on the traditional system's success, recent research has applied it to understand web applications. Based on prior studies, DeLone and McLean [5] extended and streamlined the original model by combining the individual and organizational impacts into one success dimension called "net benefits" and adding another quality dimension called "service quality." A final enhancement, "intention to use," was added to update the IS model and further clarify the construct of "use." This resulted in an updated model that is particularly applicable to assess the success of IS in the Internet environment. This updated model consists of six dimensions: system quality, information quality, service quality, intention to use/use, user satisfaction, and net benefits. System quality refers to the desired quality characteristics of a web-based environment, including availability, usability, and reliability. Information quality is measured in terms of completeness, personalization, and relevance in a web-based environment. Service quality is the quality of the services provided by the IT units or those outsourced to service providers; it is measured in terms of assurance, responsiveness, empathy, and dependability. User satisfaction is a response to the use of system output. The "intention to use" is an attitude, whereas "use" is a system phenomenon-related behavior, including the nature, level, appropriateness, and frequency of use. Net benefits are the most important success measured, as they capture the integrated results of the system's positive and negative impacts. DeLone and McLean suggested that system, information, and service qualities affect system use and user satisfaction, adding that increased user satisfaction will lead to a higher intention to use, which will subsequently affect the actual use. Furthermore, it was proposed that system use and user satisfaction would affect not only each other but also the net benefits. According to Cenfetelli's dual-factor perspective, DeLone and McLean's updated IS success model focused on users' enabling perceptions related to IS usage (e.g., its system, information, and service qualities) [8]. Past studies have used DeLone and McLean's updated IS success model to address the concerns regarding successful health IT implementation/use, the conceptualization and empirical examination of important model antecedents/constructs, system quality, information quality, and service quality [30–33]. Thus, the present study applies DeLone and McLean's updated IS success model to explain physicians' intention to use the PharmaCloud.

2.5. The SQB theory

The SQB theory aims to explain an individual's preference for maintaining his or her current status or situation rather than switching to a new (potentially superior) course of action [10]. Thus, the SQB theory can provide theoretically driven explanations of new system-related change evaluations and the reasons for user resistance as an inhibitor of new IS adoption [34]. Samuelson and Zeckhauser [10] described the SQB explanations in terms of three main categories: (a) psychological commitment stemming from misperceived value costs and regret avoidance, (b) cognitive misperceptions in the presence of inertia and perceived value, and (c) rational decision-making in the presence of switching costs and perceived threat. The first SQB explanation is based on psychological commitment. Psychological commitment may result from incorrectly factoring in sunk costs, striving for cognitive consistency in decision-making, attempting to maintain one's social position, trying to avoid the regret that might result from making a bad decision [35,36], or desiring to maintain a feeling of being in control. Sunk costs represent an individual's reluctance to cut his or her losses and the tendency to justify previous commitments. Regret avoidance, such as experiential lessons, teaches individuals to avoid, if possible, regrettable consequences [10]. SQB may also be the result of cognitive misperceptions due to loss aversion. Kahneman and Tversky [37] showed that individuals weigh losses as heavier than gains when making decisions. They label this phenomenon "loss aversion." According to the loss aversion perspective, Polites and Kankanhalli [36] defined inertia in an IS context as user attachment to and persistence in using an incumbent IS, even when there are better alternatives or incentives to change. The loss aversion principle from the SQB theory qualifies how the perceived value of change is assessed (i.e., losses appear larger than they are). Perceived value as the perceived net benefits refers to whether the benefits derived are worth the costs incurred in changing from the status quo to the new system [34,37]. Thus, an individual's inertia and perceived value contribute to cognitive misperceptions of loss aversion. From the rational decision-making viewpoint, switching costs refer to the perceived disutility a user would incur in switching from the status quo to the new situation [34]. For example, a user might recognize that a new system would be more efficient for performing a given job task, but the costs of learning to use the new system are perceived as greater than the potential gains. Perceived threat, representing the psychological uncertainty associated with the new alternative, can also cause SQB. Thus, the SQB perspective provides a set of useful theoretical explanations for understanding the impact of maintaining these factors' current status as inhibitors.

3. Research model

This study makes use of the dual-factor model of IS usage as an important theoretical foundation in the IS usage and resistance literature. We used this model to integrate and add to the relevant concepts from DeLone and McLean's updated IS success model and used the SQB theory to explain physicians' resistance behavior to system usage at the post-implementation stage. Thus, we propose that physicians' decision to use a new form of health IT, such as the PharmaCloud, is based on two opposing forces: enabling and inhibiting perceptions. In terms of enabling perceptions, we propose that physicians' intention to use the PharmaCloud is based on the traditional enablers of IS usage—their perceived system, information, and service qualities with respect to IS usage. With regard to inhibiting perceptions, considering the SQB perspective, we extend the causes of user resistance to include psychological commitment (e.g., sunk costs and regret avoidance), cognitive misperceptions (e.g., inertia and perceived value), and rational decision-making (e.g., switching costs and perceived threat) in the form of six inhibitors, which provide a higher explanatory power and a more precise understanding of user resistance antecedents. The "intention to use" is assumed to be a positive predictor of system usage, while "resistance to use" is considered to be a negative predictor. We also examined the relationship between behavioral intention (e.g., the intention and resistance to use) and system use. Further, we examined the relationship between the intention to use and the resistance to use. Fig. 1 shows the framework of the proposed research model that details its various dimensions and the development of the theoretical arguments.

Bhattacherjee and Hikmet [19] suggested that physicians' decision to use a new form of health IT is based on two opposing forces: behavioral intention to use health IT and resistance to using health IT. Norzaidi et al. [6] also proposed an examination of the relationship between users' usage and resistance to using health IT. Thus, health IT usage is determined by the users' behavioral intention and resistance to use. Further, Bhattacherjee and Hikmet [19] proposed an examination of the relationship between the intention and resistance to use. The introduction of a new technology often engenders considerable changes in a user's existing work process. When usage is mandatory, the physicians who first refused to use the new technology may finally use it because they have no other method to accomplish their job tasks. There are circumstances in which physicians may use the system voluntarily; however, they will stop doing so after a while. Another factor that likely causes user resistance to a new technology is negative prior experience. For example, if the PharmaCloud failed to provide useful information or the system crashed, users may be less likely to use it thereafter. Prior studies have provided support for the negative effect of resistance on IS usage [7,19]. Thus, we suggest the following hypotheses:

H1. Physicians' usage intention is positively related to their use of the PharmaCloud.

H2. Physicians' resistance to use is negatively related to their use of the PharmaCloud.

H3. Physicians' resistance to use is negatively related to their intention to use the PharmaCloud.

DeLone and McLean's updated IS success model suggests that system, information, and service qualities affect usage [5]. Prior studies have used DeLone and McLean's model to address the concerns regarding the use of health IT for conceptualizing and empirically examining important model antecedents/constructs, system quality, information quality, and service quality [7,19]. Thus, we suggest the following hypotheses:

H4. System quality has a positive impact on the intention to use the PharmaCloud.

H5. Information quality has a positive impact on the intention to use the PharmaCloud.

H6. Service quality has a positive impact on the intention to use the PharmaCloud.

Based on the SQB theory, sunk costs may lead to user resistance because people do not want to forego their past investments in the status quo [34,36]. In the context of this study, sunk costs include costs related to learning to use the old way of practice with the incumbent current information system (e.g., computerized physician order entry [CPOE]) for healthcare jobs. The greater the investment in the status quo alternative, the more likely it will be retained [10]. This implies that the more time and effort a user has invested in learning the incumbent system, the more likely he or she will exhibit inertia depending on the perceptions of high sunk costs [34,36]. The findings of a previous empirical research support the expectation of a positive relationship between sunk costs and resistance to use [38]. Thus, we suggest the following hypothesis:

H7. Sunk costs have a positive effect on resistance to using the PharmaCloud.

Regret avoidance can affect human decisions insofar as individuals may reject decisions they feel are likely to cause regret [10]. As Kahneman and Tversky [37] argued, users feel stronger regret for bad outcomes that are a consequence of new, adopted technology than for similar outcomes resulting from the status quo. Furthermore, regret avoidance may enhance users' inhibition to use the new system [39]. The negative impact of regret on behavioral intentions has been demonstrated in previous studies [35,37,39]. We therefore suggest the following hypothesis:

H8. Regret avoidance has a positive effect on resistance to using the PharmaCloud.

According to the SQB perspective, an individual may retain the status quo out of inertia because of fear or innate conservatism [10]. In the IS context, individuals persist in using an incumbent system either because this is what they have always done or because it may be too stressful or emotionally taxing to change [36]. Thus, inertia will affect individuals' decision to continue or discontinue the use of an incumbent system independent of the availability or recognition of a different system [40]. The findings of previous empirical research support the expectation of a positive relationship between inertia and behavioral intentions [36,38]. Consequently, inertia increases physicians' resistance to using the PharmaCloud. Therefore, we suggest the following hypothesis:

H9. Inertia has a positive effect on resistance to using the PharmaCloud.

Now consider the choice between retaining the status quo and opting for a new system. If the perceived value of the change is low, users will be more likely to express greater resistance to the implementation of the new system [34,37]. Because of loss aversion,

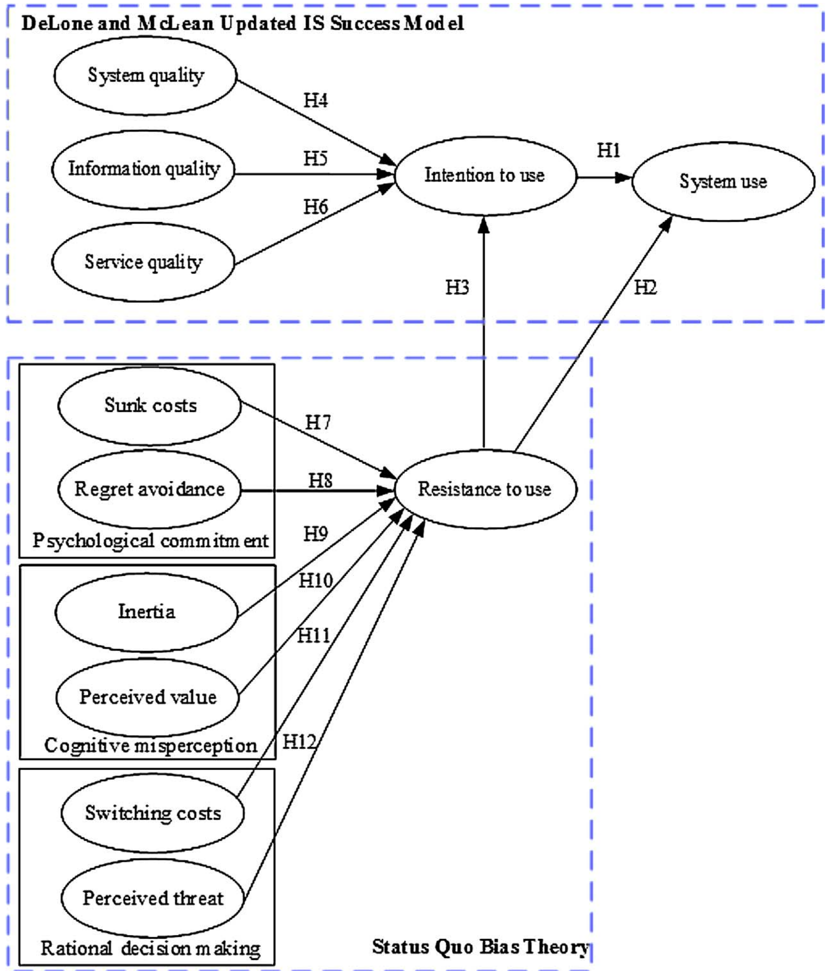

Fig. 1. Research framework.

individuals are biased in favor of the status quo [10]. Conversely, if the perceived value of the change is high, users will be more likely to lessen their resistance to using the new system. Accordingly, physicians have a strong tendency to maximize the value in the accidental duplication of prescriptions and are consequently less likely to resist changes with higher perceived value. Prior research has shown that perceived value by a user has a substantial effect on user resistance [34,38]. Thus, we suggest the following hypothesis:

H10. Perceived value has a negative effect on resistance to using the PharmaCloud.

Prior research has explicitly used the SQB perspective to explain the inhibiting effect of switching costs on user resistance to a new system [10,34,36]. Switching costs include the transient expenses and permanent losses associated with the change (e.g., time and effort required to adapt to a new system) [34]. As the switching costs increase, users become more likely to express reluctance about the implementation of the new system, as they are motivated to cut their losses [37]. Prior studies have shown that users will justify continuing their use of an incumbent system because of the concerns about the time required to learn a new one [34,36,41]. Thus, we expect that when the time and effort required to learn the PharmaCloud are perceived as being high, individuals will be more likely to stick with the status quo, thus resulting in greater levels of resistance. Accordingly, we propose the following hypothesis:

H11. Switching costs have a positive effect on resistance to using the PharmaCloud.

The presence of perceived threats is a necessary precondition for resistance behaviors to occur. The notion of perceived threats is reinforced in Lapointe and Rivard's [42] case study of physicians' resistance: "The interaction between the new system's features and the initial conditions of work habits and compensation system led physicians to perceive a threat to the organization of their work and their economic well-being. If expected conditions are threatening, resistance behaviors will result." In addition, a physician's resistance to use may occur if he or she expects the implementation of the new system to threaten the status quo—for example, in the form of a potential loss of power or control over strategic medication resources [19]. Consequently, a perceived threat increases the physician's resistance to using the PharmaCloud. Prior research has shown that perceived threat by a user has a substantial effect on user resistance [19]. Thus, we propose the following hypothesis:

H12. A perceived threat has a positive effect on resistance to using the PharmaCloud.

4. Research method

The research process comprised three steps. First, the construct measures shown in Fig. 1 were adopted from previous studies and measured using a seven-point Likert scale. For the first item of system use, anchor points ranged from extremely infrequent (1) to extremely frequent (7). For the second item, anchor points were less than 1 h (1), 1–5 h (2), 5–10 h (3), 10–15 h (4), 15–20 h (5), 20–25 h (6), and more than 25 h (7). For other measures, anchor points ranged from strongly disagree (1) to strongly agree (7). Although the instrument was validated in previous studies, we examined it again to ensure that

Table 1
Construct definitions, measured items, and sources.

Construct	Definition/measured items	Reference
System quality	*The PharmaCloud's capability in terms of tasks in patient care that are supported by computer-based applications.* SY1. The PharmaCloud provides high availability when I need it. SY2. The PharmaCloud provides high data accuracy when I need it. SY3. The PharmaCloud provides high reliability in functioning.	[5]
Information quality	*The value and usefulness attributed to the output of the PharmaCloud by users.* IQ1. The PharmaCloud provides information that is easy to understand. IQ2. The PharmaCloud provides personalized information. IQ3. The PharmaCloud provides information that is exactly what I need.	[5]
Service quality	*The physician's perception of the overall support delivered by the PharmaCloud.* SE1. The department/staff of the PharmaCloud system provides proper online assistance and explanations. SE2. The department/staff of the PharmaCloud system provides services that meet my demands. SE3. The department/staff of the PharmaCloud system provides services on time.	[28]
Sunk costs	*The extent to which individuals do not want to forego their past investment in the status quo.* SC1. I have already invested a lot of time to learn how to use the incumbent current information system (CPOE) to search for patient drug information. SC2. I have already invested a lot of time in perfecting my skills at using my previous method to search for patient drug information.	[36]
Regret avoidance	*Physicians feel stronger regret for bad outcomes that are the consequence of new actions taken than for similar bad consequences resulting from inaction.* RA1. I regret choosing the PharmaCloud to search for patient drug information. RA2. I feel stronger regret for bad outcomes that are the consequences of new actions taken (using the PharmaCloud).	[35]
Inertia	*The extent to which individual attitudes and preferences from past actions will tend to persist in these actions.* IN1. I will continue using my existing method to search for patient drug information because it (the PharmaCloud) would be stressful for me to make changes. IN2. I will continue using my existing method to search for patient drug information simply because I always keep doing so. IN3. I will continue using my existing method to search for patient drug information simply because I have done so regularly in the past.	[36]
Perceived value	*The extent to which individuals evaluate whether the benefits derived are worth the costs incurred in changing from the status quo to the new situation.* PV1. Considering the time and effort that I have to spend, the change to the new way of working with the PharmaCloud will not enhance my effectiveness on the job. PV2. Considering the loss that I incur, the change to the new way of working with the PharmaCloud will not enable me to accomplish relevant tasks more quickly than working the current way. PV3. Considering the hassle that I have to experience, the change to the new way of working with the PharmaCloud will not improve the quality of my work more than working the current way.	[34]
Switching costs	*The extent to which individuals believe that using a specific application increases the time and effort required to adapt to a new situation.* SW1. It would take a lot of time and effort to switch my current working methods to the PharmaCloud. SW2. It would cause unpredictable problems if I were to switch my current working methods to the PharmaCloud. SW3. I would lose a lot in my work if I were to switch to the new way of working with the PharmaCloud.	[34]
Perceived threat	*The extent to which individuals perceive a loss of control over their work.* PT1. I am worried that I will lose job control if I use the PharmaCloud. PT2. I am worried that I will lose control of clinical decisions if I use the PharmaCloud. PT3. I am worried that I will lose control of prescription orders if I use the PharmaCloud.	[19]
Intention to use	*The extent to which individuals intend to use the PharmaCloud.* IU1. I intend to use the PharmaCloud in my healthcare work. IU2. I intend to use the PharmaCloud to accomplish and recheck diagnostic procedures. IU3. I intend to use the PharmaCloud to help me make clinical decisions. IU4. I intend to use the PharmaCloud to complete my job frequently.	[3]
Resistance to use	*The extent to which individuals did not want the PharmaCloud to change the overall nature of their job.* RU1. I do not want to change the patient care process because of the use of the PharmaCloud. RU2. I do not want to change how I make clinical decisions because of the use of the PharmaCloud. RU3. I do not want to change my interactions with other professional staff because of the use of the PharmaCloud. RU4. Overall, I do not want to change the current working methods because of the use of the PharmaCloud.	[19]
System use	*The extent to which individuals utilize the PharmaCloud to search for patient drug information.* US1. How frequently do you use the PharmaCloud to search for patient drug information? US2. How many hours do you use the PharmaCloud every week to search for patient drug information?	[5]

content validity and reliability were within the acceptable ranges. Initially, an expert review was conducted for the scale. The translation, wording, structure, and content of the scale were carefully examined by three selected practitioners and three academicians in this field. Their comments were considered when updating the scale to guarantee initial reliability and validity. We then pretested our instrument to evaluate the psychometric properties of the items. A small convenience sample was chosen for the pretest. Data were collected from 30 physicians at a medical center. This sample was chosen because these physicians had an experience in using the PharmaCloud. Factorial validity was assessed using the principal component analysis; item reliabilities were assessed using Cronbach's alpha. Items contributing to either poor factor validity or reliability were excluded from the survey. Table 1 presents the construct definitions, measured items, and sources.

Second, a field survey was conducted to test the research model. The target participants were physicians who had experience using the PharmaCloud in Taiwan. Because the resources necessary to use this system differ among hospitals, we classified the medical institutions into three categories (i.e., medical centers, regional hospitals, and local hospitals) and four locations (i.e., north, central, south, and east) for the sampling. Twenty-two medical institutions were successfully contacted to secure their collaboration. A total of 400 questionnaires were distributed through hospital administrators, and 320 questionnaires were returned. We collected questionnaires from eight medical centers, seven regional hospitals, and seven local hospitals; after discarding 16 incomplete questionnaires, 304 were available for analysis. This study was conducted using analysis of moment structures (AMOS) 20 as the tools of analysis. AMOS was used because of its simplicity and technically advanced nature. More importantly, AMOS provides a more precise assessment of discriminant validity than exploratory analysis [43]. The data analysis method involved descriptive statistics, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and structural equation modeling (SEM). The test of the proposed model included an estimation of two components of a causal model: the measurement and structural models.

Third, to further enhance the validity of the survey findings, follow-up in-depth interviews with physicians were conducted to explain and compare the key enablers and inhibitors of using the PharmaCloud. For follow-up interviews, convenience sampling was used to recruit 12 physician participants from five case hospitals that had already implemented the PharmaCloud. Follow-up in-depth interviews were conducted by two researchers trained in qualitative interviewing, who were supported by two research assistants. The reliability of the statements was increased through the use of semi-structured interviews, which facilitated the abstraction of relevant statements. Each interview lasted between 30 and 60 min and was fully recorded with prior permission from the physicians. A coding bias was avoided by having two investigators conduct the coding. An iterative process was used to further refine categories (e.g., inhibitors or enablers) until all investigators agreed upon a satisfactory representation that adequately accounted for the variety of statements.

Three consultants (a medical doctor, a director of a department of information management, and a top-level healthcare administrator) were invited as experts to provide their professional suggestions and help us develop appropriate interview questions. The overall interview questions were as follows:

- Do you already use the NHI PharmaCloud to search for patients' drug information?

For physicians with experience using the NHI PharmaCloud, the following additional questions were asked:

1. Which factors are influential regarding your continued usage intention?
2. Which factors are influential regarding your discontinued usage?

For physicians without experience using the NHI PharmaCloud, the following additional questions were asked:

1. Which factors are influential regarding your intention to use the NHI PharmaCloud?
2. Which factors are influential regarding your resistance to using the NHI PharmaCloud?

5. Research results

5.1. Respondent characteristics

The resulting 304 valid responses constituted a response rate of 76%. This response rate is a highly acceptable level and would be unlikely to cause nonresponse bias. Table 2 summarizes the demographics of the sample respondents.

5.2. Scale validation

EFA and CFA were used for scale validation, as described below. EFA was conducted using the principal component analysis with varimax rotation. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.89, higher than the recommended value of 0.6 [44], and the Bartlett test of sphericity was significant at $p < 0.01$, indicating the suitability of these data for factor analytic procedures. The results showed that all items loaded cleanly on their respective constructs, and there were no cross loadings. To ensure internal consistency among the items included in each of the scales, Cronbach's coefficient alpha was estimated [45]. The Cronbach's alpha was higher than 0.8 for all 12 constructs, satisfying Nunnally's [46] criteria for adequate internal consistency reliability. Thus, these 35 items were clearly divided across 12 dimensions (i.e., system quality, information quality, service quality, sunk costs, regret avoidance, inertia, perceived value, switching costs, perceived threat, intention to use, resistance to use, and system use). Table 3 shows the items and their factor loadings, eigenvalues, percentage of variance explained, and Cronbach's alpha following EFA.

Table 2
Respondent demographics ($N = 304$).

Respondent characteristics		Frequency	Percent (%)
Gender	Male	254	83.55
	Female	50	16.45
Age	21–30 years	25	8.22
	31–40 years	125	41.12
	41–50 years	93	30.59
	51–60 years	48	15.79
	≥61 years	13	4.28
Education	University	236	77.63
	Master	50	16.45
	Doctoral	18	5.92
Work experience	≤5 years	51	16.78
	6–10 years	83	27.30
	11–15 years	64	21.05
	16–20 years	43	14.15
	≥21 years	63	20.72
Position	Attending physician	253	83.22
	Chief resident	23	7.57
	Resident	28	9.21

To further confirm the factor structure, we conducted CFA derived from EFA [47]. First, a measurement model was assessed for model fit. The literature suggests that for a goodness of model fit, chi-square/degrees of freedom (χ^2/df) should be less than 5 [48]; the Tucker–Lewis Index (TLI), incremental fit index (IFI), normed fit index (NFI), and comparative fit index (CFI) should be greater than 0.9; and root mean square error (RMSE) should be less than 0.10 [49]. The test results indicated a goodness of model fit for the measurement model, as reported in Table 4.

Next, convergent validity was assessed using three criteria: item loading (λ) with a minimum of 0.7, composite reliability (CR) with a minimum of 0.6, and average variance extracted (AVE) for a construct larger than 0.5 [50]. Discriminant validity was assessed by the measure that the square root of AVE for a construct should be larger than its correlations with other constructs. Regarding reliability, all composite construct reliabilities were above 0.7. These results indicate that reliability, convergent validity, and discriminant validity were at acceptable levels, as reported in Table 5. Multiple regression analysis was conducted to assess the effects of eight predictor variables on care quality, access, and productivity. None of the variance inflation factors were greater than 5, thereby indicating that a serious multicollinearity problem did not occur [51].

5.3. Analysis of the structural model

The causal structure of the proposed theoretical framework was examined using the structural model. The first step was to examine the model fit of the structural model; the second was to find path coefficients for the hypothesized relationships and coefficients of

Table 3
Results of principal component analysis using varimax rotations.

Construct	Items	Loadings	Eigenvalues	% of variance explained	Cronbach's alpha
System quality	SY1	0.83	2.73	4.79	0.91
	SY2	0.87			
	SY3	0.91			
Information quality	IQ1	0.63	1.12	3.05	0.89
	IQ2	0.84			
	IQ3	0.82			
Service quality	SE1	0.93	5.39	12.4	0.94
	SE2	0.88			
	SE3	0.90			
Sunk costs	SC1	0.93	4.49	7.12	0.87
	SC2	0.94			
Regret avoidance	RA1	0.88	1.21	3.31	0.85
	RA2	0.91			
Inertia	IN1	0.90	1.68	4.65	0.96
	IN2	0.93			
	IN3	0.96			
Perceived value	PV1	0.97	2.98	5.06	0.96
	PV2	0.96			
	PV3	0.91			
Switching costs	SW1	0.88	1.36	3.75	0.89
	SW2	0.78			
	SW3	0.80			
Perceived threat	PT1	0.96	4.08	5.96	0.98
	PT2	0.98			
	PT2	0.93			
Intention to use	IU1	0.92	1.42	4.21	0.95
	IU2	0.90			
	IU3	0.85			
	IU4	0.87			
Resistance to use	RU1	0.97	11.46	32.8	0.97
	RU2	0.94			
	RU3	0.97			
	RU4	0.80			
System use	US1	0.95	3.98	5.65	0.88
	US2	0.92			

Table 4
Goodness-of-fit measures.

Fit indices	Recommended indices	Measurement model	Structural model
χ^2	–	1036.49	1091.22
df	–	494	512
Normed χ^2	≤3.0	2.12	2.13
TLI	≥0.90	0.94	0.94
IFI	≥0.90	0.95	0.95
NFI	≥0.90	0.92	0.92
CFI	≥0.90	0.95	0.95
RMSE	< 0.10	0.06	0.06

determination (R^2) for the endogenous variables. Finally, the forming indicators were presented for the major constructs with weight scores. All measuring indices reported a goodness of model fit with χ^2/df (1091.22/512 = 2.13), TLI (0.94), IFI (0.95), NFI (0.92), CFI (0.95), and RMSE (0.06), as reported in Table 4. The test results of the structural model are indicated in Fig. 2. In general, the statistical testing conclusions partially support this research model. The intention to use ($\beta = 0.78, p < 0.001$) significantly influenced system use while explaining 63% of the total variance in system use. Accordingly, hypothesis 1 was supported. Resistance to use ($\beta = -0.03$, $p > 0.05$) did not significantly affect system use. Hence, hypothesis 2 was not supported. The intention to use in this study was jointly predicted by system quality ($\beta = 0.14, p < 0.05$), information quality ($\beta = 0.28$, $p < 0.01$), service quality ($\beta = 0.16$, $p < 0.05$), and resistance to use ($\beta = -0.41, p < 0.001$), and these variables together explained 49% of the variance in the intention to use. As a result, hypotheses 3–6 were supported. Resistance to using the PharmaCloud in this study was predicted by regret avoidance ($\beta = 0.16, p < 0.05$), inertia ($\beta = 0.21, p < 0.01$), perceived value ($\beta = -0.13, p < 0.05$), and perceived threat ($\beta = 0.31, p < 0.001$). Together, these variables explained 50% of the total variance. These findings validated hypotheses 8, 9, 10, and 12. Further, sunk costs ($\beta = 0.05$, $p > 0.05$) and switching costs ($\beta = 0.11$, $p > 0.05$) did not significantly affect resistance to using the PharmaCloud. Hence, hypotheses 7 and 11 were not supported.

5.4. Follow-up in-depth interviews

Of the 12 physicians who were initially contacted by email, 10 agreed to participate in the study (83.33% participation rate). Follow-up in-depth interviews with 10 physicians in five case hospitals (two medical centers, two regional hospitals, and one local hospital) were individually conducted from February to July 2016, in which the physicians were asked to provide further qualitative data to contribute to a deeper understanding of the factors that determined user resistance to the PharmaCloud. Participants included eight attending physicians and two residents from four hospitals located in different areas of Taiwan. Participants were mostly men (70%) aged between 31 and 52 years. At the time of interview, they averaged 16.8 years of experience in the medical profession, and their hospitals had been adopting the NHI PharmaCloud for 6 months. The characteristics of the respondents are presented in Table 6.

We corresponded the results of these interviews and the constructs of the quantitative research model, as reported in Table 7. The first research question was as follows: *Which factors are influential regarding your continued usage intention*? We found that an awareness of medications causing drug interactions, dosage errors, accidental duplication of prescriptions, data completeness, care task requirement, and top manager support are the key enablers that would influence physicians' continued usage intention. These answers reflect factors such as information quality (e.g., data completeness, data usability, and convenience) as determinants of physicians' usage intentions in the quantitative research model. The second research question was *Which factors are influential regarding your discontinued usage?* We found that prior bad experience (e.g., difficult to use and incompleteness), wasting time, poor efficacy, job threat, and work habits were the key inhibitors of usage among physicians. The respondents' results in the quantitative research model, such as regret avoidance (e.g., difficult to use and incompleteness), inertia (e.g., work habits), perceived value (e.g., wasting time and poor efficacy), and perceived threat (e.g., job threat), were the determinants of user resistance. The third research question was *Which factors are influential regarding your intention to use the NHI PharmaCloud?* We found that government support, data completeness, and convenience were the key enablers that would influence physicians to adopt the PharmaCloud. Consistent with the results of the qualitative research model, information quality (e.g., data completeness) was a determinant of physicians' usage intentions in the quantitative model. The fourth research question was *Which factors are influential regarding your resistance to using the NHI PharmaCloud?* We found that wasting time (e.g., more time and effort required to adapt to the PharmaCloud), system instability, incomplete data, work overload, loss of control over their work, different needs for job tasks, and work habits were the key inhibitors that would influence physicians to resist using the PharmaCloud. Consistent with the results, regret avoidance (e.g., work overload and difficult to use), inertia (e.g., work habits), perceived value

Table 5
Reliability and validity of the scale.

Construct	Item loading	CR	AVE	Correlation											
				SY	IQ	SE	SC	RA	IN	PV	SW	PT	IU	RU	US
SY	0.83–0.92	0.87	0.69	**0.83**											
IQ	0.80–0.91	0.83	0.62	0.67	**0.79**										
SE	0.87–0.93	0.89	0.73	0.53	0.68	**0.88**									
SC	0.84–0.91	0.83	0.70	−0.20	−0.20	−0.10	**0.85**								
RA	0.83–0.88	0.72	0.56	−0.17	−0.27	−0.38	0.18	**0.75**							
IN	0.91–0.98	0.92	0.80	−0.05	−0.07	−0.03	0.08	0.34	**0.75**						
PV	0.91–0.97	0.93	0.81	0.21	0.34	0.30	−0.02	−0.38	−0.33	**0.89**					
SW	0.80–0.89	0.82	0.60	−0.20	−0.28	−0.25	0.13	0.64	0.48	−0.52	**0.77**				
PT	0.94–0.99	0.96	0.88	−0.15	−0.10	−0.01	0.02	0.33	0.45	−0.32	0.52	**0.94**			
IU	0.87–0.94	0.94	0.79	0.48	0.48	0.47	−0.11	−0.31	−0.32	0.39	−0.37	−0.18	**0.89**		
RU	0.92–0.97	0.95	0.83	−0.23	−0.23	−0.16	0.02	0.45	0.50	−0.41	0.53	0.55	−0.52	**0.91**	
US	0.84–0.94	0.85	0.60	0.24	0.24	0.07	−0.14	−0.15	−0.27	0.14	−0.18	−0.11	0.26	−0.20	**0.77**

Note: Diagonal elements (in bold) represent square root of the average variance extracted (AVE) value for the corresponding construct.

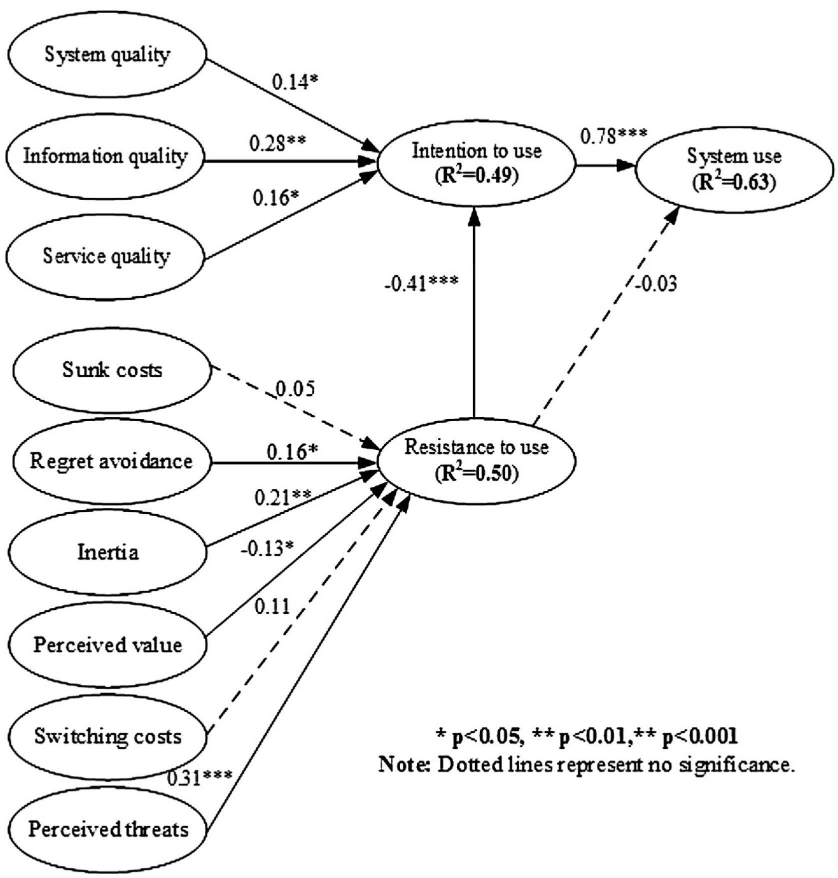

Fig. 2. Results of the structural model.

(e.g., wasting time and failure to meet job needs), and perceived threat (e.g., job threat) were the determinants of user resistance in the quantitative research model. From these in-depth interview findings, we expand the causes of user resistance to include psychological commitment (e.g., work overload, difficult to use, incomplete data, and system instability), cognitive misperceptions (e.g., working habits and wasting time, poor efficacy, and failure to meet job needs), rational decision-making (e.g., job threat), and job characteristics (e.g., lack of task needs) that can act as inhibitors to the acceptance of a new system. Enablers are a physician's external beliefs about a system's attributes (e.g., data usability, data completeness, and convenience) and social factors (e.g., government support and top manager support) that influence his or her decision to adopt a new system or continue to use the previous system. This supports the thesis that inhibitors and enablers are dual-factored constructs and thus supports the Cenfetelli's [8] dual-factor model of IT usage.

6. Discussion

The findings of this study should be interpreted considering its empirical limitations. The first limitation was our choice of constructs, which was based on the prior literature and our own observations of physicians' behavior at our study site. According to the in-depth interview findings, there may be other enablers or inhibitors of PharmaCloud usage that were not included in this study, and these can be study subjects in future research. Further, in addition to sunk costs, regret avoidance, inertia, perceived value, switching costs, and perceived threat, there may be additional predictors of resistance that

Table 6
Characteristics of physicians in the follow-up in-depth interviews.

Hospital	PharmaCloud implementation	Case	Gender	Age	Position	Work experience	PharmaCloud experience
I	2013	A	Male	50 years	Attending physician	22 years	–
		B	Male	31 years	Resident	5 years	1.5 years
		C	Female	48 years	Attending physician	23 years	–
II	2014	D	Male	51 years	Attending physician	23 years	2 years
III	2015	E	Female	35 years	Attending physician	9 years	3 months
		F	Male	40 years	Attending physician	14 years	1 month
IV	2014	G	Male	50 years	Attending physician	22 years	–
		H	Male	32 years	Resident	6 years	6 months
V	2014	I	Female	45 years	Attending physician	18 years	–
		J	Male	52 years	Attending physician	26 years	2 years

should be examined in future research. The identification and validation of such constructs will also help to advance our preliminary model of PharmaCloud resistance. Second, the relevance of this study is confined to the PharmaCloud behavior of one general population: physicians. Therefore, the findings and implications drawn from this study cannot be readily generalized to other groups, such as patients and pharmacists. A study targeting physicians who might have different information needs and different levels of computing support and abilities could obtain different results. Future research should focus on accumulating further empirical evidence and data to overcome the limitations of the present study.

In the proposed model, the explanatory power of system use ($R^2 = 0.63$) appeared to be superior to that reported in prior studies [19,52,53] in explaining physicians' usage behavior. This implies that the proposed research model could be robust in predicting physicians' intention or resistance to using similar health IT. The intention to use was positively associated with the impact on system use, while resistance to use had no significant associated impact on system use. This result is consistent with the findings of a previous study on user resistance [6]. As such, if a perceived task requires physicians to download patients' drug-related data to the COPE system, they will use it to complete the task. Moreover, resistance to use does not affect system use. Compared with managers in other industries in Taiwan, managers in healthcare settings are typically less able to mandate system use because physicians often have greater status and freedom to resist. This is probably the reason why user resistance is not a predictor of system usage. Further, our study confirmed that there was a significant negative correlation between the intention to use and user resistance. This is consistent with the findings of a previous study on the adoption of health IT [19]. Thus, higher user resistance will reduce physicians' intention to use the PharmaCloud, further inhibiting their PharmaCloud usage behavior.

Among the enablers considered in the present study, system, information, and service qualities were the determinants of physicians' usage intentions. This finding is consistent with the results obtained by Su et al. [30] and Petter and Fruhling [54]. In particular, information quality is a strong predictor of the intention to use. It appears that this factor has a substantial influence on whether or not physicians are satisfied with the system and are likely to use the PharmaCloud in the future. A plausible explanation for this particular information system is that the physicians are using patients' drug records to aid in their medical decision-making. In our follow-up interviews, physicians also indicated that the information quality (e.g., data completeness, usability, and convenience) of the PharmaCloud was a high priority. As physicians examine patients, they can determine through the PharmaCloud which drugs patients have recently used or are using. When issuing prescriptions, they can see how often the medication has been taken or whether there are drug interactions, thereby improving medication safety and quality of care. System quality and service quality were also strong predictors of usage intention. This implies that the PharmaCloud operations might not be particularly complex, especially considering the availability, data accuracy, and reliability as well as the staff support systems typically available through IT specialists. Consequently, system managers and designers should pay more attention to the stability, overall delivery of support, information provided, information integration ability, and flexibility of the PharmaCloud to improve its perceived usefulness among users.

Among the inhibitors considered in this study, our research confirmed that physicians' resistance to use was caused by regret avoidance, inertia, perceived value, and perceived threat. Perceived threat had a greater influence on the decision to resist using the PharmaCloud than regret avoidance, inertia, and perceived value. This result is consistent with the findings of previous studies on the adoption of health IT [19]. In the context of this study, perceived threat represented physicians' fear of loss of control over their work because of the work-related changes imposed by the PharmaCloud. This study also revealed the salience of regret avoidance in determining user resistance, implying that physicians find themselves in the unpleasant position of regretting the outcomes of past decisions. Interviewees reported that most physicians using the PharmaCloud spend more time for each patient. These increased time costs resulted in longer workdays or fewer patients being seen, or both, during the initial period of implementation. Such experiential lessons have taught them to avoid regrettable consequences if possible, thereby making them more likely to resist using the PharmaCloud depending on the perceptions of high regret avoidance. Moreover, inertia had a direct positive effect on physicians' resistance to use, which implies that higher inertia resulted in higher resistance to using the PharmaCloud. This finding is consistent with that of a previous study [36]. Our study also found that the perceived value of a change reduces physicians' resistance to new technology, which is in line with the findings of previous studies on IS adoption [34,55], and that changes in which the costs exceed the benefits (e.g., there is low perceived value) are likely to be resisted. In our follow-up interviews, physicians also indicated prior work habits as the main influence on resistance to using the PharmaCloud. There was a significant difference in data presentation between paper-based medical records and the PharmaCloud. However, sunk costs and switching costs did not significantly affect usage intention. As Polites and Karahanna [36] suggested, although the SQB perspective represents a comprehensive set of theoretical explanations that account for the SQB, not all explanations are present in a specific context. In particular, physicians' usage behavior differs in certain ways from typical users' behavior, including the following factors (a) in healthcare, the PharmaCloud is not only a type of service but also represents a lifesaving mechanism (b) physicians are not responsible for implementing and selecting a PharmaCloud; rather, the NHIA and a hospital's administrators would typically make such IT adoption decisions, while physicians use the PharmaCloud to help patients who require quick diagnoses or to prevent the accidental duplication of prescriptions. Physicians' resistance to new technologies such as the PharmaCloud has been attributed

Table 7
Case answers in the follow-up qualitative interviews to reflect hypothetical variables in the quantitative research model.

Case answer in the follow-up qualitative interview	Hypothetical variables in the quantitative research model						
	Inhibitors of usage					Enablers of usage	
	Psychological commitment	Cognitive misperception		Rational decision-making	Job characteristics	System attributes	Social norms
	Regret avoidance	Inertia	Perceived value	Perceived threat			
A			Wasting time		Lack of task needs	Data completeness, convenience	
B		Working habits				Data usability (to reduce medications causing drug interactions, dosage errors, and the accidental duplication of prescriptions)	
C	Work overload	Working habits	Wasting time	Loss of control over their work			Government support
D		Working habits				Data usability (to reduce medications causing drug interactions, dosage errors, and the accidental duplication of prescriptions), data completeness	
E	Difficult to use, Incomplete data	Working habits	Poor efficacy			Data usability (to reduce medications causing drug interactions, dosage errors, and the accidental duplication of prescriptions)	
F	Difficult to use, Incomplete data		Wasting time			Data usability (to improve drug safety, reduce medications causing drug interactions, dosage errors, and the accidental duplication of prescriptions)	
G	Difficult to use	Working habits	Failure to meet job needs	Job threat			Government support
H	Work overload	Working habits	Wasting time			Data usability (to improve drug safety, reduce medications causing drug interactions, dosage errors, and the accidental duplication of prescriptions)	
I	System instability	Working habits	Wasting time, Failure to meet job needs				Government support
J		Working habits		Job threat			Top manager support

to concerns about its effective integration into job tasks, adequate system functioning applications (e.g., management of patients' drug records) to improve the quality of care, confidentiality and privacy issues, and interoperability problems between CPOE and the PharmaCloud. Therefore, sunk costs and switching costs do not influence physicians' resistance to using the PharmaCloud.

6.1. Implications for research

This study makes several contributions and has numerous implications for other researchers. A primary contribution is the combination of technology use and resistance theories to examine how users assess overall change related to a new technology. According to the dual-factor perspective, by using DeLone and McLean's updated IS success model to integrate and add to relevant concepts from the SQB theory, the present study contributes by operationalizing and testing the developed model through a survey and follow-up in-depth interview methodology, which has little precedence in the user resistance literature. Thus, the present study provides theoretical insights for researchers into what may encourage or discourage users from using a new technology. Second, enablers and inhibitors have been neither clearly defined nor measured in prior research. This study therefore also contributes to the dual-factor theoretical perspective by explicitly conceptualizing and measuring individual-level enablers and inhibitors. Further, this survey study confirms that system, information, and service qualities are critical factors for facilitating physicians' intention to use the new technology and that regret avoidance, inertia, perceived value, and perceived threat are critical inhibitors that facilitate physicians' resistance to use the new technology. Findings from interviews indicate that inhibitors represent changes from the status quo caused by system usage (i.e., incomplete data, difficult to use, system instability, wasting time, poor efficacy, failure to meet job needs, work overload, work habits, and job threat) and job characteristics (e.g., lack of task needs) with consequent effects on the decision to reject or discontinue technology use, whereas enablers represent perceptions held by a user about a system's attributes (i.e., data usability, data completeness, and convenience) and social factors (i.e., government support and top manager support) with consequent effects on the decision to use a system or continue to use it post adoption. Therefore, technology acceptance behavior is targeted at a specific system and driven by user perceptions; considering this, user resistance is a generalized opposition to change engendered by its expected adverse consequences, as suggested by Cenfetelli's [8] dual-factor model. Inhibitors and enablers are not opposites but are independent constructs; in addition, as independent constructs, they have different sequent effects. This finding could interest and encourage researchers who are developing a resistance to system usage model. Future research should aim to identify additional incumbent system constructs and theorize on the interplay between an incumbent system and new system cognition and behaviors. The intention to use was positively associated with the impact on system use, while resistance to use had a nonsignificant impact on system use. The statistical testing conclusions partially support the Cenfetelli's dual-factor model of IS usage. Based on the dual-factor perspective, future studies on the context of various technologies could produce different results. This study has a third key theoretical implication with regard to the SQB theory. The theory was developed for explaining planning bias toward maintaining the status quo in human decision-making and behavior. Since then, it has been applied to explain human decision-making in the IS adoption field [34,36]. As an extension of previous research, the present study has demonstrated how the SQB theory can be applied in health IT research to explain physicians' resistance to new health IT-related change. Thus, this reliable and valid instrument provides an effective tool for researchers to measure user behavior and explain, justify, and compare the differences in study results.

6.2. Implications for practice

The results of this study offer suggestions to management regarding how to alleviate user resistance to PharmaCloud implementation. First, higher levels of system, information, and service qualities encourage physicians to have a more positive attitude toward the PharmaCloud. The PharmaCloud should be designed in a more user-friendly manner that meets the current needs. Physicians who can accurately and reliably use the PharmaCloud, as well those who can retrieve medication information from the PharmaCloud, are more likely to develop a positive attitude toward the system, thereby encouraging them to use the PharmaCloud. Hospital managers should focus more on providing adequate resources and staff support systems for physicians who use the PharmaCloud. Second, the NHIA and hospital managers can attempt to reduce regret avoidance, inertia, and perceived threat by enhancing physicians' favorable opinions toward new IS-related change. For example, in the present study, the perceived threat was physicians' fear of loss of control over their work because of the work-related changes imposed by the PharmaCloud. Thus, managers should identify and quantify such threats by communicating openly and honestly with physicians through focus groups or anonymous surveys and should make good-faith efforts to alleviate these threats at the post-implementation stage. In addition, management should also aim to increase the perceived value of change to reduce user resistance. To increase the perceived value, the advantages of the PharmaCloud should be emphasized from the viewpoint of the physician. Third, system managers and designers should always be vigilant of users' changing needs and never take user adoption for granted. Thus, what we are proposing should augment system managers' and designers' insights and help them identify and evaluate strategies to enhance users' adoption and continued use of the PharmaCloud at the post-implementation stage. System managers and designers in particular require a better understanding of why physicians resist using the PharmaCloud in order to devise practical methods for evaluating systems, explain how physicians will respond to them, and improve physicians' acceptance by altering the nature of the systems and processes by which they are implemented. Furthermore, most health IT designs tend to focus on system considerations, such as new functionalities and connectivity, rather than on user considerations, such as the system's impact on users' behaviors and potential user resistance. The NHIA continues to apply the relevant norms setting to further promote the use of the NHI PharmaCloud. A more comprehensive understanding of user resistance to new health IT may facilitate the design of better systems that are both functional and acceptable to their targeted user population.

7. Conclusion

This study presented a theoretical model of resistance to system usage by synthesizing the technology use and resistance literature streams and linking them using the dual-factor model of IS usage. The study contributes to the existing body of knowledge by narrowing the research gap through the examination of the causal relationships between behavioral intention (e.g., intention and resistance to use) and actual system use at the post-implementation stage. Further, the novelty of this study is that it provides a holistic perspective of the critical factors (e.g., enablers and inhibitors) that influence technological intention and resistance to PharmaCloud use. These findings support our initial expectation that physicians' decision to use the PharmaCloud is predicted by both enabling and inhibiting perceptions, although some inhibitors may be less salient in predicting resistance to use. This finding is encouraging for researchers who are interested in building a resistance to system usage model. Hence, we offered implications regarding medical practice and academic research on the basis of our findings. We hope that this study will stimulate future interest in IS resistance phenomena and motivate researchers to perform a more in-depth examination of this interesting area of IS research.

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References

[1] National Bureau of Controlled Drugs, Bureau of Health Promotion and National Health Research Institutes. Report no. 2: Drug Abuse Survey on 2009 National Health Interview and Drug Abuse Survey in Taiwan, Department of Health, Taiwan, 2009.
[2] S.K. Huang, P.J. Wang, W.F. Tseng, F.K. Syu, M.C. Lee, R.L. Shih, M.T. Sheen, M.S. Chen, NHI-PharmaCloud in Taiwan – a preliminary evaluation using the RE-AIM framework and lessons learned, Int. J. Med. Inf. 84 (10) (2015) 817–825.
[3] F.D. Davis, Perceived usefulness, perceived ease of use, and user acceptance of information technology, MIS Q. 13 (3) (1989) 319–340.
[4] W.H. DeLone, E.R. McLean, Information systems success: the quest for the dependent variable, Inform. Syst. Res. 3 (1) (1992) 60–95.
[5] W.H. DeLone, E.R. McLean, The Delone and Mclean model of information systems success: a ten-year update, J. Manage. Inform. Syst. 19 (4) (2003) 9–30.
[6] M.D. Norzaidi, S.C. Chong, M. Intan Salwani, K. Rafidah, A study of intranet usage and resistance in Malaysia's port industry, J. Comput. Inform. Syst. 49 (1) (2008) 37–47.
[7] E.G. Poon, D. Blumenthal, T. Jaggi, M.M. Honour, D.W. Bates, R. Kaushal, Overcoming barriers to adopting and implementing computerized physician order entry systems in U.S. hospitals, Health Aff. 24 (4) (2004) 184–190.
[8] R.T. Cenfetelli, Inhibitors and enablers and dual factor concepts in technology usage, J. Assoc. Inform. Syst. 5 (11–12) (2004) 472–492.
[9] S. Petter, W.H. DeLone, E.R. McLean, Measuring information systems success: models, dimensions, measures, and interrelationships, Eur. J. Inform. Syst. 17 (2008) 236–263.
[10] W. Samuelson, R. Zeckhauser, Status quo bias in decision making, J. Risk Uncertain. 1 (1) (1988) 7–59.
[11] S. Mathew, Cloud computing: a new foundation towards health care, Int. J. Innov. Technol. Explor. Eng. 3 (2) (2013) 118–121.
[12] N. Sultan, Making use of cloud computing for healthcare provision: opportunities and challenges, Int. J. Inform. Manage. 34 (2) (2014) 177–184.
[13] F.N. Nur, N.N. Moon, Health care system based on cloud computing, Asian Trans. Comput. 2 (5) (2012) 9–11.
[14] P.D. Kaur, I. Chana, Cloud based intelligent system for delivering health care as a service, Int. J. Inform. Manage. 113 (1) (2013) 346–359.
[15] S.G. Shini, T. Thomas, K. Chithraranjan, Cloud based medical image exchange-security challenges, Proc. Eng. 38 (2012) 3454–3461.
[16] D. Thilakanathan, S. Chen, S. Nepal, R. Calvo, L. Alem, A platform for secure monitoring and sharing of generic health data in the Cloud, Future Gener. Comput. Syst. 35 (2014) 102–113.
[17] W. Wang, L. Chen, Q. Zhang, Outsourcing high-dimensional healthcare data to cloud with personalized privacy preservation, Comput. Netw. 88 (2015) 136–148.
[18] C.E. Bartos, B.S. Butler, R.S. Crowley, Ranked levels of influence model: selecting influence techniques to minimize IT resistance, J. Biomed. Inf. 44 (2011) 497–504.
[19] A. Bhattacherjee, N. Hikmet, Physicians' resistance toward healthcare information technology: a theoretical model and empirical test, Eur. J. Inform. Syst. 16 (6) (2007) 725–737.
[20] J.Y.L. Thong, Resource constraints and information systems implementation in Singaporean small businesses, Omega 29 (2001) 143–156.
[21] M.L. Markus, Technochange management: using IT to drive organizational change, JIT 19 (2004) 3–19.
[22] G.C. Kane, G. Labianca, IS avoidance in health-care groups: a multilevel investigation, Inform. Syst. Res. 22 (3) (2011) 504–522.
[23] F. Herzberg, Work and the Nature of Man, The Word Publishing Company, New York, 1966.
[24] F. Herzberg, B. Mausner, B.B. Snyderman, The Motivation to Work, Transaction Publishers, New Brunswick, 2005.
[25] O.W. Deshields Jr., A. Kara, E. Kaynak, Determinants of business student satisfaction and retention in higher education: applying Herzberg's two-factor theory, Int. J. Educ. Manage. 19 (2) (2005) 128–139.
[26] C.E. Shannon, W. Weaver, The Mathematical Theory of Communication, University of Illinois Press, Urbana, IL, 1949.
[27] R.O. Mason, Measuring information output: a communication systems approach, Inform. Manage. 1 (5) (1978) 219–234.
[28] L.F. Pitt, R.T. Watson, C.B. Kavan, Service quality: a measure of information systems effectiveness, MIS Q. 19 (2) (1995) 209–221.
[29] J.W. Kettinger, L.L. Lee, Perceived service quality and user satisfaction with the information services function, Decis. Sci. 25 (5) (1994) 737–766.
[30] Y.Y. Su, K.T. Win, J. Fulcher, H.C. Chiu, Measuring end-users' opinions for establishing a user centered Electronic Health Record (EHR) system from the perspective of nurses, J. Theor. Appl. Electron. Commer. Res. 4 (2) (2008) 55–63.
[31] F. Lau, M. Price, K. Keshavjee, From benefits evaluation to clinical adoption: making sense of health information system in Canada, Healthc. Q. 14 (1) (2011) 39–45.
[32] C. Bossen, L.G. Jensen, F.W. Udsen, Evaluation of a comprehensive EHR based on the DeLone and McLean model for IS success: approach, results, and success factors, Int. J. Med. Inform. 82 (10) (2013) 940–953.
[33] S. Akter, J. D'Ambra, P. Ray, Development and validation of an instrument to measure user perceived service quality of mHealth, Inform. Manage. 50 (4) (2013) 181–195.
[34] H.W. Kim, A. Kankanhalli, Investigating user resistance to information systems implementation: a status quo bias perspective, MIS Q. 33 (3) (2009) 567–582.
[35] M. Tsiros, V. Mittal, Regret: a model of its antecedents and consequences in consumer decision making, J. Consum. Res. 26 (2000) 401–417.
[36] G.L. Polites, E. Karahanna, Shackled to the status quo: the inhibiting effects of incumbent system habit, switching costs, and inertia on new system acceptance, MIS Q. 36 (1) (2012) 21–42.
[37] D. Kahneman, A. Tversky, Prospect theory: an analysis of decision under risk, Econometrica 47 (1979) 263–281.
[38] P.J. Hsieh, An empirical investigation of patients' acceptance and resistance toward the health cloud: the dual factor perspective, Comput. Hum. Behav. 63 (1) (2016) 959–969.
[39] C. Liao, C.C. Liu, Y.P. Liu, P.L. To, H.N. Lin, Applying the expectancy disconfirmation and regret theories to online consumer behaviour, Cyberpsychol. Behav. Soc. Netw. 14 (4) (2011) 241–246.
[40] J.C. Recker, Towards a theory of individual-level discontinuance of information systems use, in: E. Karahanna, A. Srinivasan, B.T. Atlanta (Eds.), Proceedings of the 35th International Conference on Information Systems, Association For Information Systems, Auckland, New Zealand, 2014.
[41] D. Lending, D. Straub, Impacts of an integrated information center on faculty end-users: a qualitative assessment, J. Am. Soc. Inform. Sci. 48 (5) (1997) 466–471.
[42] L. Lapointe, S. Rivard, A multilevel model of resistance to information technology implementation, MIS Q. 29 (3) (2005) 461–491.
[43] J.N.V. Miles, Statistical software for microcomputer: AMOS 4.0, Br. J. Math. Stat. Psychol. 53 (1) (2000) 141–144.
[44] S. Sharma, Applied Multivariate Techniques, John Wiley & Sons, New York, 1996.
[45] R.P. Bagozzi, Causal Methods in Marketing, John Wiley and Sons, New York, 1980.
[46] J.C. Nunnally, Psychometric Theory, 2nd ed., McGraw-Hill, New York, 1978, p. 1978.
[47] H.J. Smith, J.S. Milberg, J.S. Burke, Information privacy: measuring individuals' concerns about organizational practices, MIS Q. 20 (2) (1996) 167–196.
[48] P. Bentler, EQS Structural Equations Program Manual, BMDP Statistical Software, Los Angeles, 1989, p. 1989.
[49] J. Henry, R. Stone, A structural equation model of end-user satisfaction with a computer-based medical information system, Inform. Resour. Manage. J. 7 (3) (1994) 21–33.
[50] C. Fornell, D. Larcker, Structural equation models with unobservable variables and measurement error: algebra and statistics, J. Mark. Res. 18 (3) (1981) 382–388.
[51] J.F. Hair, R.E. Anderson, R.L. Tatham, W.C. Black, Multivariate Data Analysis with Readings, 3rd ed., Macmillan, New York, 1992.
[52] W. Jen, C.C. Chao, Measuring mobile patient safety information system success: an empirical study, Int. J. Med. Inf. 77 (2008) 689–697.
[53] S. Chatterjee, S. Chakaraborty, S. Sarker, S. Sarker, F.Y. Lau, Examining the success factors for mobile work in healthcare: a deductive study, Decis. Support Syst. 46 (2009) 620–633.
[54] S. Petter, A. Fruhling, Evaluating the success of an emergency response medical information system, Int. J. Med. Inf. 80 (2011) 480–489.
[55] K. Joshi, A model of users' perspective on change: the case of information systems technology implementation, MIS Q. 15 (2) (1991) 229–242.56.

Pi-Jung Hsieh is currently an associate professor in the Department of Hospital and Health Care Administration at Chia Nan University of Pharmacy and Science. She gained her master's and doctoral degrees in Information Management from the National Chung Cheng University in Taiwan. Her work has been published in journals such as *International Journal of Medical Informatics, Computers in Human Behavior*, and *Total Quality Management & Business Excellence*. Her current research interests are in medical informatics management, information technology and performance assessment, behaviors in information technology usage, and quality of care.

Weir-Sen Lin is currently an associate professor in the Department of Hospital and Health Care Administration at Chia Nan University of Pharmacy and Science. He gained his master's and doctoral degrees in Health Education from the University of Iowa, U.S.A. His current research interests are in patients' satisfactions of medical and nursing services, health promotion in the community, and health behaviors. He is a member of the Patient Safety Committee in a teaching regional hospital. He is also a member of the Accreditation Council for Society Care in Tainan City.