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The Usability Assessment of PRiSMA and My.Pharma-C Web Application System

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ABSTRACT

The Pharmaceutical Services Program (PSP) has not yet evaluated the usability of the web application system. The System Usability Scale (SUS) and Net Promoter Score (NPS) assessment tools give you a quick overview of your system's usability and help you improve it further. The goal of this study was to assess the usability of the PRiSMA and My.Pharma-C systems using SUS and NPS. From April 2019 to July 2020, a survey was conducted using a validated self-administered questionnaire that was prompted after each successful log-out from the PRiSMA and My.Pharma-C systems. The questionnaire was divided into three sections: demographic, device type, and SUS and NPS questionnaire. The mean SUS and NPS scores were computed. The survey was completed by 3,959 PRiSMA users and 811 My.Pharma-C users. The SUS score was interpreted as a grade, adjective, and range of acceptability. The PRiSMA mean SUS score was 70.2 (SD 15.44), indicating a 'Grade C' and 'Good' system. The mean SUS score for My.Pharma-C was 58.2 (SD 15.13), indicating a 'Grade D' and 'OK' system. Users accepted both systems on the basis of their usability. Calculated NPS value for PRiSMA was p=42%, n=49% and d=9%, NPS value=+33, whereas My.Pharma-C p=18%, n=46% and d=36%, NPS value=-18. A positive NPS value for PRiSMA represents the user's readiness to recommend the system to others compared to My.Pharma-C. The findings also established that SUS alone is insufficient and needs to be complemented by another method, such as qualitative instruments. It could help to drill down in depth to understand how to address potentially problematic areas for web application systems and assist in the improvement phases. However, both of the tools are applicable to be used to evaluate the usability of the web application systems that managed by the Pharmaceutical Services Program.

Keywords: usability, system usability scale, net promoter score, web application system

INTRODUCTION

According to ISO 9241-11, usability is "the extent to which a system, product, or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use." Furthermore, the 2018 revision clarifies that usability is the result of people interacting with a system, product, or service (ISO, 2018). Effectiveness is defined as the accuracy and completeness that users achieve in targeting a specific goal. Meanwhile, efficiency refers to the ratio of resources used to the results obtained. Satisfaction is defined as the extent to which a user's physical, cognitive, and emotional responses when using a system, product, or service meet the user's needs and expectations. Furthermore, user experience refers to the perceptions and reactions that arise from the use or anticipated use of a system, product, or service. Thus, usability is a broader concept than the commonly understood "ease-of-use" or "user-friendliness" (ISO, 2018) (Bevan et al., 2016).

Measuring usability can be difficult; various evaluation methods are used to determine a web application system's level of usability. A systematic mapping review of 215 studies discovered that a questionnaire (n=97 studies) is the most used technique to evaluate usability due to its technical simplicity (Paz & Pow-Sang, 2016). The System Usability Score (SUS) is one of the questionnaires used to assess usability. John Brooke created SUS in 1986, and it was updated in 2013. The objective of SUS is to measure people's perception towards the usability of a system in the limited time available during the evaluation session (Brooke, 2013). In 2008, an adjective rating scale, grading scale, and acceptability range were studies that interpreted SUS scores and explained the results to non-human factors professionals. Studies done by Bangor et al. recommended that the adjective rating scale, grading scale, and acceptability range should be used in complement to the single result of the SUS score to create a clearer picture of a system, product, or service overall usability (Bangor et al., 2008) (Bangor et al., 2009).

Numerous studies proved that SUS was reliable and straightforward to be used across various sample sizes as compared to the other usability scales (Tullis & Stetson, 2004). This method is generic, simple, and inexpensive to implement. Most importantly, the SUS method is robust and reliable (Brooke, 2013). Sauro (2010) studied the relationship between SUS scores with Net Promoter Score (NPS), which is a tool that essentially asks people whether they are likely to recommend a system or product to a friend or colleague.

The calculation for SUS consists of ten questions, which each of SUS question items were presented as 5-point scales ranging from 1 (anchored with "Strongly disagree") to 5 (anchored with "Strongly agree). The scale of each question item later will be converted as score contribution, which ranges from 0 to 4. For positively worded items (1, 3, 5, 7, and 9), the score contribution is the scale position minus 1. For negatively worded items (2, 4, 6, 8, and 10), it is 5 minus the scale position. The overall of SUS score calculated by multiply the sum of the item score contributions by 2.5. Thus, SUS scores range from 0 to 100 in 2.5-point increments (James & Jeff, 2009) (Brooke, 1996). Bangor et al., (2009) discovered that the adjective rating scale allows better understanding of SUS for non-expert person with the subjective insights. In this study, SUS score was paired with the adjective scaling, grading system, and acceptability range (Bangor et al., 2009). For example, an evaluation gave the usability of a product or system a single value of SUS, 82. User's evaluation perceived this value as the "excellent" product or system with grade A, and it is acceptable to use the product or system (Figure 1 and 2).

The NPS works by quantifying whether the product/service provided by assessing the likelihood of customer to recommend that product/service to others (Hamilton et al., 2014). The finding showed that people tend to be a promoter when they rate the system or product with a SUS (Souro, 2010). Three categories of responder are identified and classified as promoters (those who would recommend and use the service again), passives (who are broadly happy but would not actively promote the service), and detractors' (who actively discourage others from experiencing the service). The overall score is calculated by the percentage of promoters minus the percentage of detractors (excluding the passives). Score ranges from -100 (everyone is a detractor) to +100 (everyone is a promoter) (Souro, 2016).

One of the studies in Malaysia by Hassan Basri et al., (2019) studied the possible effect of service usability as a contributing factor in the adoption of e-participation employed SUS in four ministries websites. E-participation is the use of electronic to encourage public involvement in governmental decision making. Results showed that the e-participation modules on e-government websites were in the "marginal" range using the SUS method. Another study in 2019 evaluated the usability using SUS in a Spatial Information System (SIPR) developed by the City Government of Malang, Indonesia. It showed an overall SUS score of 52.50, which falls in an adjective rating of "OK". Based on this usability evaluation, improvement has to be made on the SIPR to make it more user-friendly so that people can operate it with less dependent on technicians (Pradini et al., 2019).

Pharmaceutical Services Programme (PSP) is one of the programs under the Ministry of Health Malaysia (MoH), which is responsible for ensuring that the public gets access to safe, efficacious and quality pharmaceutical products. Moreover, PSP also protects the public via the enforcement of relevant legislation and ensures the rational use of medicines by both healthcare providers and patients. In 2019, PSP reported that 12 out of the 14 pharmacy technology-related projects or proposals were categorised as system development (PSP, 2016).

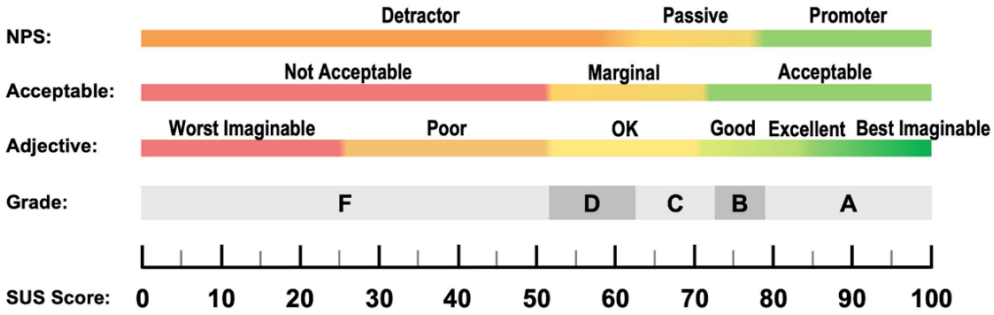

Figure 1. Grades, adjectives, acceptability, and NPS categories associated with raw SUS scores (17)

Grade	SUS	Percentile range	Adjective	Acceptable	NPS
A+	84.1-100	96-100	Best Imaginable	Acceptable	Promoter
A	80.8-84.0	90-95	Excellent	Acceptable	Promoter
A-	78.9-80.7	85-89		Acceptable	Promoter
B+	77.2 – 78.8	80-84		Acceptable	Promoter
B	74.1 – 77.1	70 – 79		Acceptable	Passive
B-	72.6 – 74.0	65 – 69		Acceptable	Passive
C+	71.1 – 72.5	60 – 64	Good	Acceptable	Passive
C	65.0 – 71.0	41 – 59		Marginal	Passive
C-	62.7 – 64.9	35 – 40		Marginal	Passive
D	51.7 – 62.6	15 – 34	OK	Marginal	Detractor
F	25.1 – 51.6	2– 14	Poor	Not Acceptable	Detractor
F	0-25	0-1.9	Worst Imaginable	Not Acceptable	Detractor

Table I. Percentiles, grades, adjectives, and NPS categories to describe raw SUS scores (17)

System development in this context refer to as the period for the development activities which may involve the procurement of the infrastructure of the web application system and/or the development phases of web application system until the system ready to be use or launch.

Mohd Hadafi et al., (2019) has conducted a study to evaluate the customer satisfaction and the ease of use of Pharmacists Registration Management System (PRiSMA). PRiSMA is a web application that caters the registration of a pharmacist to obtain the annual certificate governed by the Pharmacy Board Malaysia Division. The result from Mohd Hadafi et al., (2019) showed a strong positive correlation between acceptance of the layout design and ability to operate the system ($r=0.86$; $p=0.01$), implying that the layout design significantly impacts users' ability to work the system. More than 70% of respondents were satisfied with using PRiSMA when applying for their professional annual certification. Mohd Hadafi et al., (2019) concluded that more research was needed to focus on user's experience to continue improving the usability of the PRiSMA.

However, currently there is no standard or generic assessment tools used by the PSP for internal evaluation for existing systems and no comparison or ranking could be done to highlight any priority especially as supporting evidence for any funding request to maintain the operating system. Majority of the evaluations are post-implementation review and satisfaction survey that designed specifically for individual system.

There are two prominent web applications system under PSP, which are PRiSMA and My.Pharma-C. My.Pharma-C is a web-based system used for license A application, where license A is required by the pharmacist to handle poison according to the Schedule under the Poison Act 1952. Both systems have vast number of users and similarity in term of work processes and monitoring indicators even though has different style of infrastructure. Hence, suitable to assess the usability of both systems using one generic evaluation tools.

MATERIALS AND METHODS

Recruitment occurred between April 2019 and July 2020 for both PRiSMA and My.Pharma-C. Participants were recruited via a prompt to answer a survey after they logged out of the system. The participant could either choose the "accept" button to proceed or the "reject" button to decline. Participants are considered recruited once they have completed the questionnaire given. Based on Tullis & Stetson (2004), the minimum sample size required is at least 12 samples because the SUS obtained the same findings as the larger sample size and the accuracy is consistent. However, after calculating using the Raosoft calculator with a margin error of 5% and a confidence level of 95%, the population of PRISMA users is 21,036 and that of My.Pharma-Cusers is 3,637. Therefore, the sample size needed is 378 for PRiSMA and 348 for My.Pharma-C.

Selection of Participants

All registered pharmacists applying for the annual certification and poison license are eligible to be involved in this study. There are criteria set to ensure a representative sample is included during the study period. Below are the inclusion criteria: The applicant must agree to answer the online survey by clicking the pop-up consent; The applicant can be either a first-time user or a return applicant for both systems; The applicant must apply for the annual certificate and poison license A using the web application systems provided during the research timeline.

Below are the exclusion criteria: Sample with missing information regarding the variables measured; The user is responsible for processing the application in both systems (the officer shall be involved in subsequent processes after the application is submitted).

Instruments

Data from the questionnaire, consisting of modified SUS and NPS, was used for this study. The modified SUS is a 10-question usability scale that was proposed in 2008, incorporated modest wording modifications compared to the original scale, and proved equal validity and reliability. Each response is graded on a Likert scale of 1 (strongly disagree) to 5 (strongly agree). Overall, SUS scores are computed using a published formula and provided as a score out of 100 (Kortum & Bangor, 2013). Participants also need to answer one question regarding NPS to evaluate the user's willingness to recommend the system to other people (Sauro & Lewis, 2011) (Souro, 2019).

Data collection and analysis

The questionnaire includes demographic data such as age, gender, type of device used to access the system (technology platform used, such as a mobile phone, tablet, or desktop), and the user's familiarity with the systems used (new user or returned user). Other variable parameters extracted directly from the systems were also collected in this study, such as the number of error incidents and the time of submitting the form application. This study defines the number of error incidents as the number of inquiries in each application submission.

Data was compiled and managed using the Microsoft Excel spreadsheet. Data cleaning performed to identify any missing values, duplications, and inconsistencies. The data subsequently transferred to SPSS Windows version 21.0 for statistical analysis. All the categorical data summarised as percentiles and the numerical data as means and standard deviations. Pearson's or Spearman's correlation analysis used to assess the association between the proportion of the SUS scale and the other independent variables (age, gender, type of device, time to fill out the form). Multiple linear regressions also performed to determine the predictors of the SUS scale. The level of significance for statistical analysis is set at $p<0.05$. The association between the SUS score and the identified variables was further explored by using forward-backwards stepwise multiple linear regression analyses. The results were presented as adjusted regression coefficients (b), along with their corresponding 95% confidence intervals (CI) and p-values. The significant level of the statistical test was set at 0.05.

Ethic oversight

This study has been approved by the National Medical Research Registry, Malaysia [NMRR-20-553-54268] and the Medical Research & Ethics Committee, Ministry of Health Malaysia [NMRR-20-553-54268 (IIR)].

Table II. Demographic data

Characteristics		**PRiSMA (n=3,959)**	**My.Pharma-C (n=811)**
Age (years), mean (SD)		34.7 (9.60)	40.5 (11.47)
Gender, n (%)	Male	911 (23.01)	430 (53.02)
	Female	3,048 (76.99)	381 (46.98)
User experience, n (%)	New	954 (24.10)	179 (22.07)
	Return	3,005 (75.90)	632 (77.93)
Device type, n (%)	Desktop	3,290 (83.10)	779 (96.05)
	Tablet	45 (1.14)	5 (0.62)
	Mobile	624 (15.76)	27 (3.33)
Error of incidence, mean (SD)		1.3 (1.41)	0.19 (0.54)

Table III. Grades, adjectives, acceptability, and NPS categories associated with mean SUS scores

	PRiSMA (n=3,959)	**My.Pharma-C (n=811)**
SUS, mean (SD)	70.2 (15.44)	58.2 (15.13)
Grade	C	D
Adjective	Good	OK
Acceptability range	Marginal	Marginal

Table IV. NPS scores

	PRiSMA (%)	**My.Pharma-C (%)**
Promoter	42	18
Neutral	49	46
Retractor	9	36
Net Promoter Score	+33	-18

RESULTS AND DISCUSSION

This study involved 3,959 participants for PRiSMA and 811 participants for My.Pharma-C. The mean age of the study participants was 34.7 years old, with a standard deviation of 9.60 for PRiSMA. Meanwhile, the mean age for My.Pharma-C was 40.5 years old with a standard deviation of 11.47. In PRiSMA, 911 (23%) out of the 3,959 participants were male, while 3,048 (77%) were female. In My.Pharma-C, 430 (53%) were male, while 381 (47%) were female. Results also showed that most of the participants preferred to use desktop computer over tablet and phone for both systems (Table II).

The mean number of error incidents acquired for PRiSMA was 1.3 with a standard deviation of 1.41 and My.Pharma-C was 0.19 with a standard deviation of 0.54. The study also found that more than 70% of both systems' participants were actually experienced users, which means they had used the system at least more than once (Table II).

For the usability evaluation, the mean SUS score in PRiSMA and My.Pharma-C were 70.2 with a standard deviation of 15.44 and 58.2 with a standard deviation of 15.13, respectively. In terms of adjective scaling, PRiSMA can be described as “Good” and for My.Pharma-C as “OK”. The mean SUS scores fall under grade C for PRiSMA and grade D for My.Pharma-C sequentially (Table III). This grade means the study participants evaluated both PRiSMA and My.Pharmac-C as acceptable; however, further improvements are required (Table III).

In terms of customer loyalty towards a system, (Table III) the mean of overall NPS scores as 8.2 (1.30) and 6.8 (1.90) for PRiSMA and My.Pharma-C, respectively. Based on the mean individual NPS scores, this study concluded that PRiSMA's participants were categorized as the “promoters” while My.Pharma-C’s participants were determined as “detractors”. The single value NPS score of +33 for PRiSMA while -18 for My.Pharma-C (Table IV).

Table V. Variables related to SUS for PRiSMA and SUS for My.Pharma-C

Variables		b	95% CI		P-Value
SUS for PRiSMA	**(Constant)**	9.272	6.021	12.524	.000
	Age	.140	.091	.190	.000
	NPS	6.600	6.289	6.912	0.000
	Return	2.588	1.490	3.686	.000
	Tablet	-7.788	-11.531	-4.044	.000
	Mobile	-3.506	-4.615	-2.396	.000
SUS for My.Pharma-C	**(Constant)**	27.098	22.466	31.731	.000
	NPS	4.732	4.290	5.175	.000

The positive NPS value for PRiSMA indicates the user's readiness to recommend the system to others compare to My.Pharma-C.

This study used multiple linear regression method to analyze the relationship of variables against system's SUS score (Table V). For PRiSMA, results showed that NPS score, returned users, and device used to access the system (tablet and mobile phone) as the significant contributing factors. Meanwhile, for My.Pharma-C, there was only one contributing factor that associated with its SUS score, which is NPS score.

This study explores the usability of two systems using one generic evaluation tool, which the findings as discussed in Lewis & Sauro (2018), elaborate on SUS scores for benchmarking the usability of systems. Many studies recommend at least a score of 70, with grade B indicating the system's usability is acceptable. A higher score above 90 with grade A shows the system's usability and user willingness to use and recommend it to others. A cut-point score below 50 with a grade of F indicates an unacceptable level of usability and must make improvements towards the systems (James & Jeff., 2009) (Bangor et al., 2008)(Kortum, 2018) (Lewis & Sauro, 2018).

Bangor et al., (2008) had discussed the acceptable score for SUS by a further distinction in the marginal scores by dividing them into "low marginal" and "high marginal". This break occurs near the start of the second quartile range. The acceptance range by the user showed that products with a SUS score of less than 50 are unacceptable and be viewed with caution (Bangor et al, 2008). With the SUS score and different grades, the acceptability ranges differ, PRiSMA showed as having a higher level of acceptance than My.Pharma-C.

A similar study in 2016 by Ganapathy et al. examined Malaysian English as a Second Language (ESL) students' perception of the usability of a mobile application for grammar tests, namely the MyGrammarTest (MyGraTe) App. Findings showed that the mean SUS score is 64.17, which is marginally accepted, but the MyGraTe app is slightly below what respondents experienced as average usability, with a SUS score less than 68, which indicates that the app still has several areas that need to be improved (Ganapathy et al., 2016). Thus, similar action needs to be carried out for My.Pharma-C for it's further improvement by looking at the score gathered from this study.

An adjective rating used in this study is relevant as it helps to manifest the user's perceived ease of use for the studied systems. Brooke (2013) mentioned that subjective opinions were much more relevant in the case of office systems. If the system is known to have been perceived as difficult to use, this will heavily influence the decision to purchase the system as it requires higher support requirements in terms of cost and deployment of the system (Brooke, 2013). Bangor et al. (2009) found that the adjective rating scale closely aligned with the SUS scale, suggesting that it is a useful tool in helping to provide a subjective label for an individual study means of SUS score (Bangor et al., 2009).

This study showed that the NPS score calculated was +33 for PRiSMA and -18 for My.Pharma-C (Table IV). Sauro et al, (2010) stated a positive correlation between NPS and SUS. The study suggested that people tend to be loyal to the system if it is easy to use, leading them to put more effort into recommending it to others (Sauro et al., 2010). Sasmito et al., (2019) show similar results when one of the systems tested provides an average SUS score of 87.5 with an NPS score of +75.

The results are consistent with the recommendations that a system user with SUS score of 80 or more is a potential promoter, while SUS with an average score of 67 or less is a potential detractor (Sauro, 2010) (Sauro, 2019).

In addition, regression analysis showed that the NPS score was a significant factor influencing the SUS score for both systems tested (PRiSMA b=6.600; My.Pharma-C b=4.732; p 0.05). Therefore, to ensure user loyalty, improvements in the usability of each system, as assessed by SUS, are needed.

Besides the NPS value, several variables such as age, returned user and type of device used are significant. Bangor et al., (2008) discovered in their study that there was a weak negative relationship exists between age and SUS score. However, this study showed a significant positive relationship between age and SUS score (b=0.140; $p < 0.05$). In addition, a study run by Mujinga et al. (2018) reached a similar conclusion where the user's age significantly affects the NPS score in South Africa.

Furthermore, returned user also proved to have a significant effect on the SUS score of the system and this finding is similar in Ganapathy et al., (2016). It is also consistent with Mujinga et al., (2018) study that discovered the more familiar users are with a system interface, the easier it is to complete the task. Both studies concluded that familiarity improves website usability over time as users become less irritated with the system. As a result, the more experience a user has with the system, the more the user perceives the system to be usable than a first-time user.

This study also proved that both tablet and mobile phones have a negative relationship with SUS scores. The user tends to score less SUS when they use the tablet and mobile phones compared to desktop. The researcher expected this because both PRiSMA and My.Pharma-C were developed for a more desktop friendly interface. Likewise, Kortum & Sorber (2015) found that there was a main effect of types of devices used on the SUS score, $F (1, 72) = 56.75$, $p < 0.0001$, with phone apps having higher usability than tablet apps. In contrast to previous results, Pal & Vanijja, (2020) stated that there is no main effect of the types of devices used (smartphone vs. laptop) on the average SUS scores when Microsoft Teams is used as an online learning platform COVID -19 [$F (1, 1591) = 0.153$, $p = 0.696$].

While this study has proven a relationship between the type of devices used and the SUS score, it is a negative relationship. It is essential to include the possible features that can increase the usability and functionality of the system in different types of devices, as this could have an impact on how users complete a task. Kortum & Sorber, (2015) also mentioned the need for consistency to maintain usability in each application. However, Kortum & Sorber (2015) also emphasized that more research is needed to understand the relationship between the impact of these cross-platform access points on user interactions and perceptions, as this is not yet fully understood.

The limitation identified while conducting the study is that the SUS can only answer the usability values of a web application system, and the NPS measures user loyalty towards the system. Neither tool can provide a comprehensive answer to determine the usability improvement needed for a system. Based on the literature, some studies use qualitative tools, like how Hassan Bari et al. (2019) incorporated an in-depth survey tool to investigate a more comprehensive usability evaluation of e-participation from four ministries in his research. The usage of a qualitative tool supported by Mujinga et al., (2018) suggests getting the views of non-user of the system, especially when exploring the contributing factors for non-adoption. The analysis of qualitative tools provides feedback that aided in paving the way for improvement by upgrading the system accordingly to make it easy to use. Therefore, a more comprehensive evaluation under usability laboratory or other instruments or methods to complement the scoring provided by SUS and NPS is needed. As for the recommendations, this study recommends SUS and NPS to be used to benchmark any web application systems or products developed, whether in-house or out-source based on the strength of the instruments themselves as a valid measurement. Many studies discuss and elaborate using the SUS ten questions survey for quick usability assessment and suitable for any kind of products. Based on the overall SUS score and adjective interpretations, it helps to gain insight into the usability of products and systems used across platforms and further improve understanding between clients and nonexperts about the value of usability during the testing process before launching or distribution (Kortum & Bangor, 2013) (Kortum & Sorber, 2015) (Lewis & Sauro, 2018).

NOVELTY AND ADDED VALUE FROM THIS STUDY

It simultaneously employs the SUS and NPS, providing a comprehensive evaluation of web application usability. While SUS offers a quantitative measure of system usability, NPS adds a qualitative dimension by gauging user loyalty and their likelihood to recommend the system.

Moreover, by comparing the usability of two different pharmaceutical systems (PRiSMA and My.Pharma-C), the study highlights the strengths and weaknesses of each system, offering actionable insights for targeted improvements.

In addition, the study incorporates feedback from a substantial user base (3,959 PRiSMA users and 811 My.Pharma-C users), ensuring that the findings are statistically significant and reflective of a broad user spectrum.

CONCLUSION

This study evaluated two web application systems using the SUS for usability and the NPS for customer loyalty. While users found both systems acceptable, the results indicated that a higher SUS score correlates with greater user loyalty and willingness to recommend. However, SUS alone was deemed insufficient, necessitating complementary qualitative methods to identify and address potential issues. The findings suggest that SUS can serve as a baseline for improvement and standard setting during development and post-implementation. These outcomes provide a foundation for developing a standard evaluation tool, enhancing the Pharmaceutical Services Program (PSP) system, and guiding future ICT framework research in PSP.

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CONFLICT OF INTEREST

No conflict of interest

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