Applying Model of Emergency Referral Information System (ERIS) by using DeLone and McLean Framework

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Abstract. Indonesian health regulation addresses all health providers, midwives and physicians that conducting medical practices should conduct patient Emergency Referral Information (ERI) exchange before referring the patient to other hospital facility. The ERI project was initiated in EMAS project that funded by USAID during 2012-2016. The EMAS project encouraged the patient of ERI systems to be adopted by all districts, cities, hospitals and health centers. Due to its wide adoption efforts, the ERI system implementation has gone quite slow, and exacerbated in some area. Only few district and/or facility are effectively to be utilized and supported. For this reason, the article applies DeLone and McLean model to analyse the ERI system implementation with the objective to provide valuable inputs for top decision makers.

1. Introduction

The maternal, neonatal and under-five mortality rate in Indonesia is three times higher than the target of MDGs. Indonesian Ministry of Health (MoH) and supported by the US government (USAID) had initiated the EMAS project during 2012-2016 to accelerate the declination of maternal and neonatal mortality rates. The EMAS project embraced the utilization of information and communication technology (ICT), with the main goals to develop a set of integrated interventions to strengthen emergency referral systems including establishing emergency referral information system (IS).

The emergency referral IS involves transferring data and information exchange from one health facility to another facility to assess availability, readiness and to improve emergency response time [1], [2]. The emergency referral information exchange was delivered through SMS, web and a call center. The system is enriched with medical advice that based on knowledge developed by obstetrics, gynecology (Obgyn), and pediatricians’ experts, that can be contacted 24/7. The outcome of the EMAS project is considered quite successful, so it is necessary to be evaluated and learned for its sustainability and continuous improvement. For this reason, the article proposes the use of the DeLone and McLean model to examine the key success factors of emergency referral IS related to EMAS project.

2. Theoretical Foundation

2.1. DeLone and McLean model

The DeLone and McLean model is quite famous to measure IS success in the organization. The model applies six distinct aspects of IS success such as system quality, information quality, intention to use,
user satisfaction, and net benefits (see figure 1) [3]. DeLone and McLean [4] addressed the complex environment in IS project through its identification and definition of the IS success concept.

2.2. Emergency Referral IS (ERIS)

ERIS is a referral exchange system that automates medical referrals from community midwives and health center at sub-district level to the nearest hospital that is ready and able to accept the medical emergency case [5]. The study shows that text-based messaging such as SMS for emergency referral information exchange has strong acceptance and appears to be feasible for most districts and facilities [6]. The ERIS developer had studied the effectiveness and perception of referral IS implementation in communicating with pregnant women at risk [2]. This study shows that even though the trend in adopting mobile phones keeps on rising, but only small number of pregnant women is willing to utilise the system. They develop high resistance to the idea of mobile phones for emergency information exchange.

To increase utilization, the system is enhanced by call centre as the first line of contact for midwives referring emergency patient to hospitals. The call centre is operated in 24 hours and 7 days a week and is operated by at least 8 trained midwives. The call centre operated in short code 119 and can be called from any phone free of charge [7]. During an emergency, the health workers dial 119 and are immediately connected to the operators. After validating the data, the operator asks and entries the common questions such as patient data, level of complication, diagnosis, and pre-treatment and input to the IS. The patient data will be automatically routed to the most appropriate hospital in the network until a hospital replies. The Senders will receive SMS notification from the server on where to refer and type of treatment to provide before/during transporting patient. Call centre also monitors and ensures all referrals are accepted and responded timely by hospitals [8].

Medical worker also requires adequate training and call center assistance due to their age and lack of IT knowledge. They prefer to use tools that do not radically change the way they work. As a result, system quality is the most acceptance factor for doctors’ adoption. The curiosity is whether the age of health worker related with their intention and satisfaction of using the IS [9].

Individual differences such as age, gender, tenure, educational background, etc. can influence an attitude toward the use of technology [10]. Moreover, employee’s experience of certain work can be predicted as essential factor for organizational change. The article examines the factor of age and duration of working experience as other essential factor related to IS success [11].

3. Methodology

3.1. Research Model Formulation

The article applies the DeLone and McLean model to examine the ERIS in the selected small hospitals (Puskesmas) in West Java. We formulate the hypotheses comprised of: (see figure 1)

H1: Information quality (KI) has positive effects on intention to use (IN).
H2: Information quality (KI) has positive effects on user satisfaction (KP).
H3: System quality (KS) has positive effects on intention to use (IN).
H4: System quality (KS) has positive effects on user satisfaction (KP).
H5: Service quality (KL) has positive effects on intention to use (IN).
H6: Service quality (KL) has positive effects on user satisfaction (KP).
H7: Age of user is moderated to intention to use (IN).
H8: Age of user is moderated to user satisfaction (KP).
H9: Duration of work experience (EXP) of users is moderated to intention to use (IN).
H10: Duration of work experience (EXP) of users is moderated to user satisfaction (KP).
H11: Intention to use (IN) has positive impact to net benefit (NB).
H12: user satisfaction (KP) has positive impact to net benefit (NB).
3.2. Population and Sampling
The article uses survey method with a Likert scale of 5, and applies random sampling technique in the Karawang and Cirebon districts (West Java) with total 2,057 health workers [12]. Data gathering was conducted during May-June 2018, with 221 valid data was returned and qualified for further analysis. The article applies Structural Equation Model Partial Least Square (SEM-PLS) method to examine the results.

![Figure 1. Conceptual ERIS based on DeLone and McLean model.](image)

4. Findings

4.1. Validity and Reliability Test

| Table 1. Respondent’s age profile. |
|-----------------------------------|
|                                    |
| Frequency | Percent | Valid Percent | Cumulative Percent |
|-----------|---------|---------------|--------------------|
| Valid 1   | 78      | 35.3          | 35.3               |
| 2         | 142     | 64.3          | 64.3               |
| 3         | 1       | 0.5           | 0.5                |
| Total     | 221     | 100.0         | 100.0              |

Source : Data Analysis using SPSS

Table 1 shows the profile of respondent’s age with majority 64.1% have working experiences < 20 years. The respondents were divided based on their work experiences into two major groups, such as the ones with working experiences < 20 years and the rest more than 20 years. This segregation is made based on the assumption that older workers tend to develop more resistance to adopt IT, and related their familiarity using existing working mechanism and tools [9]–[11]. The 221 respondents were likely good enough through KMO analysis, that have score 0.670 more than reference score 0.5, with significance values < 0.05 (see Table 2).

| Table 2. KMO and Bartlett's Test. |
|-----------------------------------|
|                                    |
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | 0.670 |
| Bartlett’s Test of Sphericity | Approx. Chi-Square | 2704.875 |
| Sphericity | Df | 595 |


Based on the SEM-PLS simulation, the Average Variance Extracted (AVE) for all variables show > 0.5; the Cronbach’s Alpha and Composite Reliability (CR) also confirmed with >= 0.7; these values shows the model has passed validity and reliability test, and eligible for further analysis.

4.2. Results Finding.

The path coefficient for the ERIS-DeLone and McLean model is shown below:

![ERIS Framework based on DeLone and McLean model.](image)

The results in figure 2 are confirmed in the following table (see Table 3):

| Hypothesis | Effect   | Relation   | Status                          |
|------------|----------|------------|---------------------------------|
| H1         | Positive | Significant| Supported with data             |
| H2         | Positive | Significant| Supported with data             |
| H3         | Negative | Not significant | Not supported with data         |
| H4         | Positive | Significant| Supported with data             |
| H5         | Positive | Not significant | Not supported with data         |
| H6         | Negative | Significant| Supported with data             |
| H7         | Moderate | Significant| Supported with data             |
| H8         | Moderate | Significant| Supported with data             |
| H9         | Positive | Significant| Supported with data             |
| H10        | Moderate | Significant| Supported with data             |
| H11        | Moderate | Significant| Supported with data             |

Table 3 shows the system quality of referral IS has negative effects on intention to use, it illustrates that users have developed lack of interest to use ERIS, although the system has improved. The service quality of referral IS also having negative effects on user satisfaction, it confirms the user satisfaction decreases although the quality of service provided increases. The decreased of user satisfaction can be understood
that many users have lack understanding about ICT-based ERIS. Therefore, there is urgency to promote IT training regarding to the use of emergency referral system.

5. Lessons Learned

The use of quality model for ERIS patients by using DeLone and McLean method is essential for developing health institutions in Indonesia. The model covers the main 6 criteria such as: quality of system, quality of information, quality of service, intention to use and user satisfaction. All variables have many sub-criteria for their characteristics. The article addresses several advantages such as: (1) specifications of reusable system software quality requirements. (2) identify and offer systematic IS quality assessment (3) the reuse of knowledge of quality models such as factors, attributes, and correlations for evaluating the quality of the referral system.

6. Conclusion

Emergency Referral Information System (ERIS) has emerged as important system to be applied in all state-owned health care institutions in Indonesia. The central government has invested heavily in national health care system, however come out with unsatisfactory results, especially in ERIS implementation. Many people and health workers still do not understand how the ERIS work, and it is necessary for policy makers to take necessary steps to promote user training and incentive regarding to ERIS implementation. Although the ERIS has improved, further improvements need to be taken to make the essential features simpler and applies simple interfaces. The use of DeLone and McLean model has advantages in examining the users' perspectives towards the ERIS project, where it enables to show that factor of age and work experience play important factors to increase user satisfaction and intention to use.

7. References

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