Procedia of Engineering and Life Science Vol. 6 2024
The 3rd International Scientific Meeting on Health Information Management (3rd ISMoHIM)
Asosiasi Perguruan Tinggi Rekam Medis dan Manajemen Informasi Kesehatan Indonesia - Universitas Muhammadiyah Sidoarjo

Adoption of Electronic Medical Records: A TOE Framework Analysis

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Abstract. The implementation of digital technology in the global health sector has received strong support, with the adoption of Electronic Medical Records (EMR) becoming a primary focus in modernizing health systems to improve service quality. However, in Indonesia, 48.9% or 4,807 community health centers (Puskesmas) have not yet adopted EMR technology. Therefore, pre-implementation analysis is crucial to identify barriers and opportunities for success. The TOE (Technology-Organization-Environment) framework serves as an analytical model for technology adoption at the organizational level, capable of explaining the factors influencing the decision to adopt technological innovations.This study aims to develop a TOE instrument in Indonesian, adapted from previous research, and adjusted to the research context. The instrument is structured in the form of a questionnaire, tested for validity and reliability. The validity test results indicate that all questionnaire items are valid (r calculated > r table), while the reliability test shows a Cronbach's Alpha value of 0.916, indicating that the instrument is reliable. This questionnaire can be used to analyze the factors influencing technology adoption in the implementation of EMR in health facilities and can serve as a basis for future research development.
Keywords: Technology Adoption, TOE, Electronic Medical Record (EMR).

I. BACKGROUND

The development of technology plays a crucial role in enhancing the capability of health systems to provide beneficial healthcare services and improve individual well- being [1]. In 2020, global funding for digital health totaled $13.9 billion, demonstrating the strong support from the healthcare sector for the adoption of digital technology in health practices [2]. Based on a survey conducted by the American Medical Association regarding the acceptance of technology in healthcare services, technology is predicted to minimize medical errors, reduce operational costs, and enhance performance [3]. The presence of technology also enhances service quality, efficiency, and ease in data collection and reporting [4], [5].

The global trend in healthcare technology adoption is Electronic Medical Records (EMR) [6]. However, in reality, over 50% of EMR projects worldwide fail to meet their targets [7]. The implementation of EMR in Indonesia is also limited. According to a survey conducted by the Indonesian Hospitals Association (PERSI) in March 2022, reported on persi.or.id, only 50% of the 3,000 hospitals in Indonesia have adopted EMR, and of these, only 16% have successfully implemented it effectively [8]. Additionally, a researcher from the Center for Indonesia's Strategic Development Initiatives (CISDI) noted that 48.9% or 4,807 community health centers (Puskesmas) in Indonesia have not yet adopted EMR technology [9]. These findings indicate that many healthcare facilities still need to transition to electronic systems and optimize the electronic systems that are already in place.

Adopting technology involves more than just designing or purchasing functional technology; it also includes the acceptance and use of the system by healthcare professionals [10]. Therefore, the implementation of EMR requires comprehensive planning and preparation. A thorough analysis of technology adoption factors is crucial in this preparation phase. Such analysis helps healthcare facilities identify barriers and potential success factors for EMR implementation. This enables them to develop effective plans to address or anticipate future challenges, ensuring a smooth adoption of EMR and maximizing its benefits.

Considering the organization, technology, and social dimensions, as well as their interactions, is crucial for ensuring the success of implementation [11]. It is recommended to use a perspective that encompasses technology, organization, and environment as a potential lens for exploring the factors that influence the adoption of information systems in healthcare facilities [12].

The TOE framework was first introduced by Tornatzky, Fleischer, and Chakrabarti in 1990 [13]. TOE is an organizational-level technology adoption analysis model that helps in understanding how an organization adopts technological

innovations. The key determinants discussed in the TOE framework are technology, organization, and environment [14]. TOE offers significant reliability and predictability in adoption and is applicable to various types of businesses and organizational sizes [15]. This framework can analyze both internal and external factors influencing the adoption of technological innovations [16]. Based on these variables, the TOE instrument can also be used to evaluate EMR adoption in healthcare facilities.

II. METHOD

This study employs a descriptive quantitative approach with correlation analysis, using Purposive Sampling to determine the sample. The developed instrument is adapted from previous research titled "Hospital Information System Adoption: Expert Perspectives on an Adoption Framework for Malaysian Public Hospitals" by Ahmadi (2016) [12].

The initial stage of developing the TOE instrument involved translating it from English to Indonesian and adjusting it to fit the research context. Subsequently, a questionnaire was designed and scored for each question. The instrument was then tested for validity and reliability using statistical data analysis software. Validity and reliability testing are crucial for ensuring accurate and useful research results.

A total of 34 medical record practitioners from various institutions participated in the instrument's trial. The instrument was deemed valid based on the calculated r value being higher than the table r value (using Pearson Product Moment). Reliability testing was conducted using Cronbach's Alpha formula.

III. RESULTS AND DISCUSSION

Based on the distribution of the questionnaires, the research findings will be presented in three categories: respondent characteristics, results of the questionnaire modifications and their scores, and the outcomes of validity and reliability testing.

A. Respondent Characteristics

Table 1. Respondent Characteristics

Category	Frequency	Percentage (%)
Gender		
Male	4	11,8%
Female	30	88,2%
Age		
20 – 24 years	18	52,94%
25 – 29 years	15	44,12%
30 – 34 years	1	2,94%
Education Level		
D III / D IV	31	91,2%
Bachelor's Degree (S1)	3	8,8%
Work Experience		
< 1 year	13	38,2%
1 – 5 years	17	50%
6 – 10 years	3	8,8%
11 – 15 years	1	2,9%

Source: Processed data, 2024

The respondent characteristics table reveals that the majority of participants in the instrument trial were female medical record practitioners, totaling 30 individuals (88,2%). Most respondents were in the age ranges of 20-24 years (52,94%) and 25-29 years (44,12%). According to the new age standards set by the WHO, most respondents fall into the young age category (25-44 years) [17]. This age group is known for its high enthusiasm for adopting new technology [18].

In terms of education, 91,2% of respondents have an associate degree (D3) or bachelor's degree (D4) in Medical Records. This indicates that the majority of respondents, who are medical record practitioners, have a sufficient educational background. Healthcare professionals with higher education and knowledge are generally more prepared and quicker to adopt

EMR technology, which is expected to facilitate the effective preparation and implementation of EMR in healthcare facilities.

Additionally, a significant portion of respondents had work experience ranging from 1 to 5 years (50%). Those with adequate work experience are expected to have a good understanding and knowledge of the adoption of EMR technology in healthcare settings.

B. Questionnaire

The questionnaire consists of a total of 30 closed-ended questions (27 positive and 3 negative) related to the adoption of technological innovations within the dimensions of technology, organization, and environment, as well as the adoption status of EMR in healthcare facilities. Each variable includes the following indicators:

a. Technology Dimension Variables include: Relative Advantage; Compatibility; and Complexity.

b. Organization Dimension Variables include: Top Management Support; IT Infrastructure; and Financial Resources.

c. Environment Dimension Variables include: Competitive Pressure; and Regulatory Environment.

d. EMR Adoption Variable represent the variable that describes the phase of EMR technology adoption in healthcare facilities.

The Likert scale is used to allow respondents to express their views on the extent of their agreement or disagreement with each statement [12]. A 1-7 Likert scale is applied to the independent variables, which include Technology Dimension, Organization Dimension, and Environment Dimension. For the dependent variable, EMR Adoption, a 1-

8 Likert scale is used to measure the phase of EMR technology adoption. The results from the TOE instrument will assess the level of correlation and indicate which dimension factors have strong or weak influence on EMR adoption in healthcare facilities.

The scoring for the questionnaire items, both positive and negative, for the independent variables is detailed in the table below.

Table 2. Questionnaire Scoring

Statement	Score						
	1	2	3	4	5	6	7
Positive	1	2	3	4	5	6	7
Negative	7	6	5	4	3	2	1

Below is a sample table of modified EMR technology adoption questionnaire items (Table 3).

Tabel 3. Sample Modified EMR Technology Adoption Questionnaire

TECHNOLOGY DIMENSION										
N	**Statement**	**Code**	**Score**						
			1	**2**	**3**	**4**	**5**	**6**	**7**
	Relative Advantage								
1.	The implementation of EMR technology enables healthcare professionals to communicate more effectively within the hospital.	RA1	☐	☐	☐	☐	☐	☐	☐
2.	The implementation of EMR technology allows for cost savings in daily operations.	RA2	☐	☐	☐	☐	☐	☐	☐
3.	The implementation of EMR technology improves the quality of care in the hospital.	RA3	☐	☐	☐	☐	☐	☐	☐
4.	EMR technology provides timely information to the hospital for decision-making.	RA4	☐	☐	☐	☐	☐	☐	☐
5.	The implementation of EMR technology helps reduce errors in medical record-keeping.	RA5	☐	☐	☐	☐	☐	☐	☐

C. Validity Test

Whiston [19] defines an instrument as valid if it measures what it is intended to measure and produces data that aligns with the instrument's intended purpose.

Validity testing is conducted using Pearson correlation coefficients (r) to measure the relationships between variables in the questionnaire. This test involves comparing the calculated r-value (results from statistical analysis of the data obtained through data processing software) with the table r-value (critical value used to determine if the observed relationship is statistically significant at a certain level of significance).

Table 4. Results of the Validity Test for the EMR Adoption Questionnaire

Instrument Code	r-Value
RA1	0,811
RA2	0,807
RA3	0,835
RA4	0,777
RA5	0,541
COM1	0,781
COM2	0,864
COM3	0,843
COM4	0,899
COMP1	0,853
COMP2	0,840
COMP3	0,709
TMS1	0,967
TMS2	0,951
TMS3	0,957
IFS1	0,763
IFS2	0,856
FR1	0,923
FR2	0,958
FR3	0,960
CP1	0,872
CP2	0,940
CP3	0,915
CP4	0,959
CP5	0,892
CP6	0,871
RE1	0,672
RE2	0,721
RE3	0,610
AP1	1

Source: Processed data, 2024

The table r-value obtained with a significance level (ρ) of 0,05 or 5% (n=34) is 0,328. After conducting the validity test, all questionnaire items were found to be valid as their r-values were greater than the r-table value (r > 0,328). Therefore, the TOE questionnaire instrument can be used to assess factors affecting the adoption of Electronic Medical Records (EMR) in healthcare facilities. The validity results indicate that this questionnaire accurately and consistently measures the intended variables, making it a reliable tool for identifying, evaluating, and analyzing critical factors in the EMR implementation process [12].

D. Reliability Test

Reliability refers to the ability of a measurement to provide consistent results with the same values [20]. Reliability testing was conducted using the Cronbach's Alpha formula. An instrument is considered reliable if the Cronbach's Alpha value exceeds 0,6. Values above 0,6 indicate a low likelihood of errors [19].

Table 5. Reliability Interpretation

***Cronbach's Alpha* Coefficient**	**Reliability Criteria**
$0,81 < \alpha \leq 0,9$	Very High
$0,61 < \alpha \leq 0,80$	High
$0,41 < \alpha \leq 0,60$	Moderate
$0,21 < \alpha \leq 0,40$	Low
$0,00 < \alpha \leq 0,21$	Very Low

Source: Arikunto in [21]

Table 6. Reliability Test Results for the EMR Adoption Questionnaire

Reliability Statistics	
Cronbach's Alpha	N *of Items*
0,916	30

Source: Processed data, 2024

The reliability test results indicate a Cronbach's Alpha of 0,916, which is classified as very high according to Table 5. This shows that the 30 questions in the EMR adoption questionnaire are reliable and consistent.

One factor within the Technology Dimension influencing EMR adoption is Relative Advantage. In this instrument, implementing EMR is perceived as enhancing the quality of healthcare services. Effective EMR adoption allows healthcare facilities to optimize care processes, expedite diagnoses, improve inter-departmental coordination, and facilitate better communication between medical staff and patients, thus reducing potential medical errors due to inaccurate or incomplete information [22].

Within the Organization Dimension, Top Management Support is a significant factor. The instrument indicates that strong support from top management plays a crucial role in technology implementation. When top management understands and is knowledgeable about EMR, it can reduce uncertainties about new technological innovations and encourage healthcare providers to adopt EMR [23]. Consequently, the speed of EMR implementation is influenced by organizational policies [24].

In the Environment Dimension, the factor of Competitive Pressure is evaluated as having a significant role in EMR adoption. The potential benefits from adopting EMR in healthcare facilities globally encourage other facilities to follow suit [12]. The success and advantages of EMR can motivate organizations to enhance efficiency, service quality, and competitiveness.

IV. CONCLUSIONS AND SUGGESTIONS

The modified TOE questionnaire instrument can be utilized in research to identify and analyze the factors affecting technology adoption in the implementation of EMR at the organizational level within healthcare facilities. The findings from this research can assist healthcare facilities in planning and taking appropriate actions to address potential opportunities and challenges that may arise during the technology adoption process.

V. ACKNOWLEDGMENT

Thanks to Poltekkes Tasikmalaya and the 2024 ISMOHIM committee for organizing international conference activities so that this article can be published.

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