Socio-Technical Aspects Of Electronic Medical Record Use Related To Patient Safety At Prof Dr. R. D. Kandou Manado Hospital

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ABSTRACT

In the current era of industrial digitalization 4.0, the use of information and communication technology has been widely adopted by various sectors, including the health sector. Electronic Medical Records (RME) is one form of information technology that has been recognized to have an impact on increasing patient satisfaction, documentation accuracy, accelerating data access and reducing clinical errors, but on the other hand, some emerging empirical evidence shows that health information technology can cause new problems related to patient safety. Socio-technical aspects of RME use such as user behavior, poor system design and lack of supporting infrastructure were identified to compromise patient safety. This study used mixed methods with a sequential explanatory design, which was conducted at Prof. Dr. R.D. Kandou Hospital Manado in February-May 2023. Quantitative research was conducted by distributing questionnaires to RME users, namely doctors, nurses, midwives and other health workers with a sample of 324 respondents taken by proportional stratified random sampling technique, while qualitative research was conducted by interview, observation and documentation with the role of the researcher as a human instrument. The results showed that there was a significant relationship between patient safety and user behavior (r=0.611), system design (r=0.702) and the condition of RME supporting facilities (r=0.529). To prevent the occurrence of patient safety incidents as a result of the use of RME, basic IT training and mastery of RME features for users must be improved, continuously conducting user-centered RME redesign and optimizing RME supporting infrastructure.

Keywords: Patient Safety; Electronic Medical Records; Hospital

1. INTRODUCTION

Patient safety has been considered a global problem in health care. WHO data (2021) shows that 4 out of 10 patients experience harm in primary health care, 80% of which are preventable adverse events. It is estimated that one in ten patients are harmed while undergoing hospital care in developed countries. The cause of harm is due to a variety of adverse events, of which nearly 50% are preventable. 134 million patient safety incidents are reported in hospitals in small and middle-income countries each year, caused by unsafe care processes and leading to 2.6 million deaths. Recognizing that patient safety is a global health priority, the World Health Assembly (WHA) adopted a patient safety resolution aimed at increasing global public awareness and engagement. A systems approach to human factors is critical to improving patient safety. In

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addition to human factors, organizational factors, tasks, environment, tools and technology such as medical devices and electronic health records also affect patient safety (Carayon et al, 2013). Hospitals in the healthcare industry are busy making strategic investments in improving the quality of care through Hospital Management Information Systems (HIMS). The widespread recognition that investment in health information technology can improve the safety and cost efficiency of patient care has increased interest in using information technology and encouraged hospitals to continue to develop SIMRS (Florence, 2016).

One of the contributions of SIMRS in improving the quality and efficiency of hospital services is the implementation of Electronic Medical Records (RME). RME is defined as a repository of patient data that is digital, can be stored securely and can be accessed at once by many authorized users. RME contains prospective information as well as retrospective data with the aim of supporting integrated, efficient, sustainable and quality health care. The use of RME has an impact on increasing patient satisfaction, documentation accuracy, accelerating data access and reducing clinical errors in health care facilities (Amin et al, 2021). Empirical evidence by several international researchers shows that socio-technical factors of RME implementation are closely related to patient safety issues. In primary care practices in the United States national database, it was identified that socio-technical factors of using electronic records such as human resources, workflow, policies and cultural practices were empirically strongly related to patient safety.

Another study conducted in the UK's National Health Service (NHS) also proved that there was an increased risk to patient safety during RME system implementation. The risks perceived by users were attributed to various socio-technical factors such as poor system design that resulted in increased potential loss of clinical information due to input errors. The evidence was also corroborated by another empirical study in a hospital in Jordan that socio-technical factors such as data entry errors by users, minimal clinical reminders and alerts in RME applications, lack of infrastructure and poor network systems were identified as jeopardizing patient safety (Meeks et al, 2014; Tanner et al, 2015; Clarke et al, 2016; Tubaishat, 2019). The benefits of information technology including RME are recognized as instrumental in improving the effectiveness and efficiency of services, but the perceived negative impact of the application of such technology should not be ignored. The enactment of Permenkes Number 24 of 2022 which requires all health service providers to apply RME causes potential risks and implications for patient safety to be very important to study, not only the potential in terms of benefits because patient safety is far more important than service efficiency.

Initial interviews with quality committee officers at Kandou Hospital showed that RME in this hospital has only been implemented since September 2021, so the use of RME in this hospital is still in the early stages of development. There has been no previous research related to the evaluation of RME and there have been no reports of adverse events related to the use of RME. The author assumes that exploring user perceptions and experiences is the best way to identify the risks of RME use to patient safety so that based on the data above, the author is interested in conducting research on "Socio-Technical Aspects of Electronic Medical Record Use Associated with Patient Safety at Prof. Dr. R. D. Kandou Hospital Manado".

2. LITERATUR REVIEW

a. Medical Records
Medical records are defined as "files containing records and documents related to patient identity, examination history, therapy history, action procedures and various other services that have been provided to patients. Based on the International Federation Health Organization (1992: 2) (In Ikawati, 2021), the functions of medical records include: Administration, Legal, Financial, Education and Documentation. This means, apart from being a management tool between PPAs, medical records are also used as a means of communication and information. The legal function of medical records is as evidence when there is a medical dispute between doctors or other PPAs and patients and or their families.

b. Electronic Medical Records

Electronic Medical Records (RME) are defined as "medical records created using an electronic system and intended for the organization of Medical Records. The implementation of RME is carried out from the patient's admission to the patient's discharge, referral or death" (Kemenkes RI, 2022). Electronic Medical Records are "The activity of computerizing the contents of medical records with an electronization process. Electronization

is intended to make a system that is primarily designed to support users with all the facilities that must meet the requirements of data completeness and accuracy, provide alerts as warnings, system signs as clinical decision support and connect data with medical knowledge as well as other tools" (Kusumadewi et al, 2009). According to Amin et al (2021), the implementation of RME provides many benefits for care professionals, patients and the health system as a whole.

Some of the benefits of RME include:
a) Facilitate Access to Information
b) Increase Efficiency
c) Improving the Quality of Health Services
d) Reduce Cost

Although it has many benefits, the implementation of RME is also faced with several challenges, among others:
a) Data Confidentiality and Security
b) Cost and Infrastructure
c) Health Worker Training

In the transition of an organization from the use of paper-based medical records to electronic medical records, Meeks et al (2014) divides it into 3 phases of implementing RME related to patient safety, namely the first phase; making health information technology (HIT) or health information technology safe, the second phase; using health information technology safely and the third phase; using health information technology to improve safety. where there are 8 socio-technical dimensions that play a role in each of these phase models: a. Hardware and Software, b. Clinical content, c. Human-compute interface, d. Human, e. Workflow and Communication. People, e. Workflow and Communication, f. Internal organizational features, g. Rules, regulations and external pressures, and System measurement and monitoring.
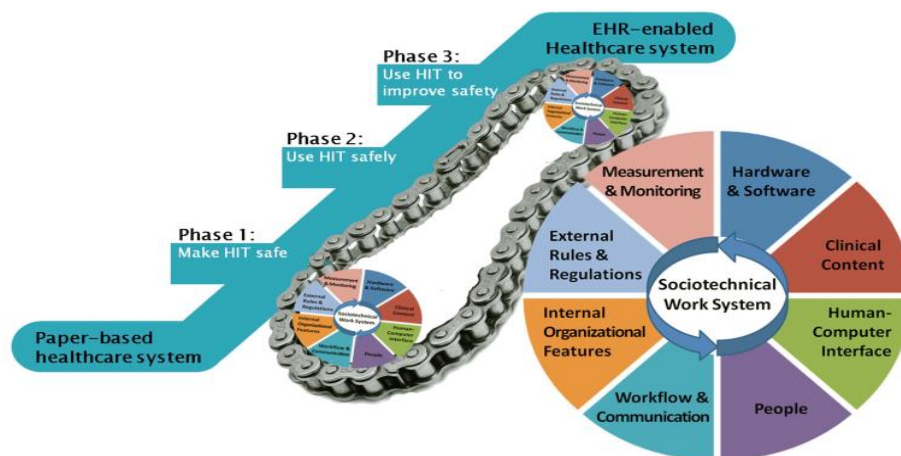
Figure 1
Conceptual model of socio-technical dimensions and implementation phases
safety HER

Picture 1 is a diagram illustrating the interaction between the eight socio-technical dimensions and the three phases of the electronic health record (HER) safety model. The goal is for organizations to move from a paper-based medical record system like "riding an escalator" to a healthcare supporting electronic record system, where in each phase, the eight socio-technical dimensions play a role.
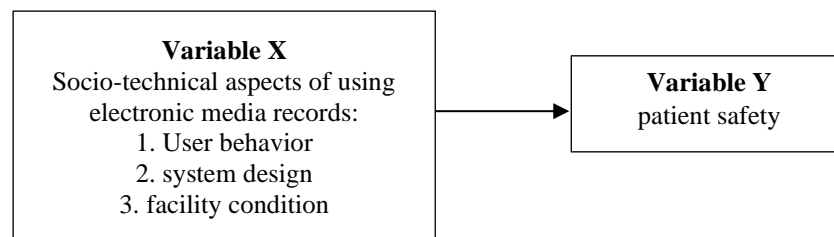
c. Patient Safety
Patient safety is a health care discipline with growing complexity in the health care system and resulting increased harm to patients in health care facilities. The patient safety movement aims to prevent and reduce risks and reduce errors and harm that occur to patients while receiving care in health services. The foundation of this discipline is continuous improvement based on learning from errors and adverse events" (WHO, 2021). Patient safety includes the subject, the scale of the problem, equality with other high-risk industries and weaknesses in the health care system that trigger human error.

According to Vincent (2011), some of the root causes of errors include institutions, organization and management, work environment, teams, individuals, tasks and patients. Another opinion was expressed by Carayon et al (2013) who created the system engineering initiative for patient safety (SEIPS) model explaining system parameters that can affect human performance and ultimately affect patients. Patient Safety Standards:

There are 7 patient safety standards based on Permenkes No. 11 of 2017 concerning Patient Safety. These standards are:

a. Patient rights
b. Patient and family education
c. Patient safety and continuity of care
d. Use of performance improvement methods in assessment and programs to improve patient safety
e. The role of leadership in improving patient safety
f. Staff education on patient safety
g. Communication is key for staff to achieve patient safety

Figure 2. Conceptual Framework

d. Hypothesis Development
Hypothesis 0 (H0):
1. There is no relationship between user behavior and patient safety at Kandou Hospital.
2. There is no relationship between electronic medical record system design and patient safety at Kandou General Hospital.
3. There is no relationship between the condition of electronic medical record facilities and patient safety at Kandou General Hospital.
Alternative hypothesis (Ha):
1. There is a relationship between user behavior and patient safety at Kandou General Hospital.
2. There is a relationship between electronic medical record system design and patient safety at Kandou General Hospital.
3. There is a relationship between the condition of electronic medical record supporting facilities and patient safety at Kandou General Hospital.

3. RESEARCH METHOD

This research uses quantitative and qualitative mixed methods with a sequential explanatory design. The reason for choosing this type of research is because researchers want to get the best understanding of the research problem formulation. In sequential explanatory design, research begins with a quantitative approach and then continues with a qualitative approach (Creswell, 2018). Quantitative research was conducted starting in the third week of February 2023, then continued with qualitative research in the third week of March 2023 and ended when the information obtained had reached the saturation level / point of redundancy. A cross-sectional design was used in the quantitative approach, namely by collecting data at once on individuals at one time (Hardani et al, 2020), while in the qualitative approach using a phenomenological design.

4. RESULTS AND ANALYSIS

a. Questionnaire Validity Test Results

Table 1
Questionnaire Validity Test Results

Variables	Statement	r_{table} 5%(30)	R_{count}	p-*value*	Description
User Behavior	6	0,361	0,385 – 0,784	0,000 – 0,036	Valid
System Design	9	0,361	0,500 – 0,874	0,000 – 0,005	Valid
Facility Condition	3	0,361	0,578 – 0,690	0,000 – 0,001	Valid
Patient Safety	8	0,361	0,727 – 0,904	0,000	Valid

Based on the r value distribution table, at a significance level of 5% and a sample size of 30, it is known that the r table value is 0.361. Table 1 shows that all statement items produce an r value greater than r table with a p-value <0.05, so this research questionnaire is declared valid.

b. Questionnaire Reliability Test

Table 2
Questionnaire Reliability Test Results

Variables	Statement	Cronbach's Alpha	Description
User Behavior	6	0,851	Reliable
RME System Design	9	0,874	Reliable
Facility Condition	3	0,820	Reliable
Patient Safety	8	0,948	Reliable

Based on the results of the analysis, all variables show a Cronbach's Alpha value of more than equal to or with 0.6, so that the research questionnaire is declared reliable.

c. Respondent Characteristics

Table 3
Overview of Respondent Characteristics

Age (Years)	Value	
Minimum	25	
Maximum	64	
Mean	39	
Age Group (Year)	n	%
≤ 25	7	2,2
26 - 35	130	40,1
36 - 45	101	31,2
46 - 55	65	20,1
56 - 65	21	6,5
Gender		
Male	88	27,2
Female	236	72,8
Profession		
Doctor	61	18,8
Nurse/Midwife	212	65,4
Other Health Workers	51	15,7

Primary Data, 2023

The majority of respondents in this study were aged 26-35 years (40.1%), most were female (72.8%) and most worked as nurses/midwives (65.4%).

d. Quantitative and Qualitative Data Research Variables

Table 4.
Quantitative and Qualitative Data Research Variables

No.	Variabel	Quantitative Data	Qualitative Data
1.	*User behavior*	Good :88.3% Fair :11.4% Poor :0.3%	In general, the user behavior of RME is good. The use of RME is considered to facilitate daily work and is easy to operate. Complaints arose from senior users due to limited computer literacy skills so they were afraid of making inputting errors. For senior Specialist Doctors with a high level of busyness, RME entry is carried out by resident doctors (at least second year) but verified in less than 24 hours by Specialist Doctors. To simplify the verification process, the hospital has created the KandouOne application which has an interface with RME, so that the verification process can be done through each user's personal cell phone.
2.	RME system design	Good :82,7% Fair :17,3% Poor :0%	In general, the design features of the RME application that are currently in place are safe and user-friendly, with only a few features that need to be improved and adapted to various service needs.
3.	Facility Condition	Good :35,5% Fair :46,3% Poor:18,2%	Most informants complained about the lack of computers and mobile devices in their work units. Network errors, especially during peak hours, were the main complaints from users. However, in general, the condition of the facilities/infrastructure, including the availability of hardware and networks in the implementation of RME, is considered adequate.
4.	Patient Safety	Good :87,7% Fair :12,3% Poor :0%	In general, the use of electronic medical records is considered by most users to improve patient safety. RME facilitates the process of patient identification, facilitates effective communication between officers, facilitates the process of double-checking high alert drugs, reduces medication errors and shortens service waiting times. When using paper-based medical records, the risk of losing medical record sheets or medical records being scattered is very high.

The results of the analysis in table 4 show that quantitatively most respondents (88.3%) have good use behavior, while from the results of qualitative analysis it is known that in general user acceptance is positive because the use of RME is perceived in terms of benefits, convenience and social encouragement in the form of RME enforcement policies from hospital leaders.

A total of 82.7% of respondents stated that the RME system design used was in the good category. From the qualitative approach, it is known that the current RME feature design is quite safe to use and user friendly, but users hope that the RME application/feature design can continue to be developed following service needs.

The majority of respondents (46.3%) considered the condition of the facilities to be in the fair category. The qualitative approach identified that the problematic condition of the facilities was dominated by problems

with the internet network and the number of computers available. Interviewees complained about network connectivity problems that were often disrupted, especially during peak hours.

Quantitative data in table 2 shows that according to the majority of respondents, the level of patient safety related to the use of RME at Prof. Dr. R. D. Kandou Hospital Manado is in the good category (87.7%). Quantitative data in this study is corroborated by qualitative data that the use of RME improves patient safety because it reduces patient identification errors, facilitates the process of effective communication between officers, facilitates the process of double checking high alert drugs, reduces medication errors and shortens service waiting times..

e. Quantitative and Qualitative Analysis of the Relationship between Research Variables

Table 5
Quantitative and Qualitative Analysis of the Relationship Between Research Variables

Relationship Between Variables	Quantitative Data (Correlation)	Qualitative Data (Relationship)
Relationship between user behavior and patient safety	p-*value*: 0,000 r : 0,611	User resistance to RME means that important information related to patient history will not be recorded, potentially leading to patient safety incidents. The higher the user acceptance, the more information they will enter so that the better the impact on patient safety.
Relationship between RME system design and patient safety	p-*value* : 0,000 r : 0,702	An application design that is user friendly, has a good appearance, is accurate, fast response, safe, guarantees the confidentiality of the data and is easy to fix when an error occurs, making it easier for authorized users to input and access important clinical information about patients.
The relationship between the condition of RME supporting facilities and patient safety	p-*value* : 0,000 r : 0,529	Lack of infrastructure and poor quality network connectivity cause obstacles in entering and accessing important clinical data related to patient care which can jeopardize patient safety.

Table 5 presents a strong positive relationship between user behavior and patient safety. This is evidenced by the results of the Spearman Rank correlation test which yielded a p-value of 0.000 with a correlation coefficient of 0.611. Qualitative data describes that user resistance can be one of the causes of patient safety incidents.

There was a strong positive relationship between system design and patient safety from the Spearman Rank test results (p-value: 0.000, r=0.702). The qualitative study in this study deepened the quantitative data that the RME system design currently in place at Prof. Dr. R.D. Kandou Hospital Manado is sufficiently secure and user friendly to make it easier for authorized users to access or enter important patient clinical information.

Statistical tests showed a strong positive relationship between facility condition and patient safety (p-value=0.000, r=0.529). Qualitative research shows that the lack of computers and frequently interrupted network connectivity can cause obstacles in entering and accessing important clinical data related to patient care which can jeopardize patient safety.

DISCUSSION

a. Relationship between User Behavior and Patient Safety

From the previous table 7, it is known that there is a significant relationship between user behavior of electronic medical records and patient safety, the direction of the relationship is positive and has a strong relationship strength as evidenced by the results of statistical analysis on the Spearman Rank correlation test, obtained a significance value of 0.000 (<0.05) with a correlation coefficient value of 0.611. This means that there is a strong positive relationship between user behavior and patient safety. User behavior in this study is translated as social factors of RME users, related to computer literacy skills and mastery of RME features.

Through qualitative research, it is known that user behavior is measured by the presence or absence of the user's desire to use RME and objectively seen from the achievement of quality indicators for the number of completeness of RME filling. User resistance can be caused by a system design that is difficult to operate or a lack of computer literacy skills that can increase the risk of data entry errors that jeopardize patient safety.

The findings in this study are in line with the research report of Tanner et al (2015) where the study identified that among primary care practices in the USA national PPPSA database, electronic records were empirically strongly associated with human resources, workflow, policies, communication and cultural practices recommended for safe patient care. Clarke et al (2016) that poor computer literacy in the use of RME increases patient safety risks.

Researchers' assumptions, user behavior to continue using RME can be seen in terms of the benefits they feel when using RME. A health worker will continue to use RME if he considers RME to make his daily work easier. This positive user acceptance response directly impacts performance in an effort to minimize patient safety incidents. The possibility of not inputting data into the RME becomes smaller because according to users it is not difficult to do. The solution to this problem is to conduct ongoing training on basic Information Technology (IT) and mastery of RME features as well as increasing socialization and monitoring of evaluation of RME use from the Medical Records Installation and SIMRS, so that users who find it difficult to use this system get extra support and are more confident and more accustomed to using this system..

b. Relationship between Electronic Medical Record System Design and Safety Pasien

Table 7 shows the relationship between electronic medical record system design and patient safety. From the results of the Spearman Rank correlation statistical test, a significance value of 0.000 (<0.05) was obtained, thus it can be concluded that there is a significant relationship between RME system design and patient safety. The correlation coefficient value of 0.702 means that the direction of the relationship is positive with a strong relationship. The qualitative study in this study shows that the design of the RME system currently in place at Kandou Hospital is quite safe and user friendly. The better the design of RME features is designed, the more user friendly the system will be and the easier it will be for users to input or access patient clinical records so that the better the potential for improving patient safety.

This finding is in line with research conducted by Meeks et al (2014) that of the 344 incidents reported, most patient safety problems (94%) were related to unmet data display needs in RME. Similar research was also conducted by Ratwani (2018) which stated that of the 9,000 patient safety event reports collected, 56.4% were confirmed to be related to the Electronic Health Record. In the same year, Keene et al (2018) in their research also presented several definitions and examples of the use of electronic medical records that were identified as causing patient safety incidents.

Regarding interoperability, stand-alone electronic ancillary examination systems that are not integrated with the RME add new problems for professional caregivers (PPAs). PPAs who are RME users cannot transcribe the results of medical examinations or actions directly into the RME, which means they have to copy from the ancillary examination application to the RME. Long supporting results will reduce the efficiency of service time, increase length of stay (LOS), and cause service delays. Based on the type of patient safety incident, service delays can be reported as a potentially significant injury condition (KPCS). Continuous system improvement and refinement with consideration from the user's point of view is one solution to the problem. As stated by Blijleven et al (2022) that the solution to improving RME is user-centered RME redesign to improve patient safety, service quality and cost efficiency of patient care..

c. Relationship between Facility Condition and Patient Safety

Further analysis of the relationship between the condition of electronic medical record support facilities and patient safety. The significance value of 0.000 (<0.05) obtained from the results of the Spearman Rank statistical test in table 10 above means that there is a significant relationship between facility conditions and patient safety. The direction of the relationship is positive and has a strong relationship, as evidenced by the correlation coefficient value obtained of 0.529. This means that the more supportive the RME infrastructure, the better the level of patient safety in the implementation of RME in the unit. Qualitative research in this

study showed that the limited number of computers and mobile devices in the work unit caused officers to queue to input RME.

The findings in this study are supported by research by Meeks et al (2014) which states that the meeting point between patient safety and EHR implementation is the use of technology including hardware and software, clinical content and human-computer interface. Another study conducted by Andriani et al (2017) showed that facility conditions have a positive effect on attitude, where attitude is the most dominant factor affecting patient safety (Lastriana, 2010). Lack of infrastructure, facilities and access cause additional hazards that are fundamental to patient safety (WHO, 2020).

Researchers' assumptions, the transition of using medical records from manual to electronic makes the condition of internet network availability a top priority to be considered. A poor internet network prevents users from accessing patient-related information needed in the treatment process. Unstable networks also make it difficult for users to enter information into the RME, especially if the information is crucial for determining the patient's procedure or treatment. The solution to this problem is to improve the quality of the network and create a backup policy that there must be a backup of manual medical records in the work unit. This policy must be understood by all staff that recording in manual medical records is a mandatory requirement in the event of a system failure or network disruption, and officers must input it into the RME as soon as the network returns to normal to avoid the risk of losing important information in the future.

Another issue is the lack of computer equipment in some work units. The disproportionate number of computers with officers makes officers have to queue for a long time to use the RME. The time spent waiting for the computer to be used and the ease of logging into the system are considered to increase the length of waiting time for clinic services. In addition, the layout of the device is also very influential. The solution to this problem is that hospitals must re-map the needs of computers or mobile devices in each room, then immediately procure as needed to prevent unexpected events (KTD). For hospitals that are new to RME, before introducing the system, hospitals should ensure that sufficient infrastructure is placed in the right location to prevent delays in service and risks in emergency situations. If technologically and financially feasible, wireless devices or computers on wheels can help alleviate emergency situations where staff do not have to choose between accessing information or leaving patients at risk of deterioration.

5. CONCLUSION

Based on the data analysis and discussion that has been carried out in the previous chapter, the results of this study can be concluded as follows:

a. User behavior is strongly positively related to patient safety at Kandou Hospital. User behavior is in the good category with the majority of users feeling the impact of using RME in terms of benefits, ease of operation and social influence in the form of internal policies of the hospital director.
b. RME system design has a strong positive relationship with patient safety at Kandou Hospital. In general, RME system design is in the good category, the design of application features is felt to be quite user friendly, safe and so far sufficient to meet the needs of users in various services, but there is still room for improvement for a better system design to improve patient safety.
c. The condition of RME supporting facilities is strongly positively related to patient safety at Kandou Hospital. The majority of users think that the condition of RME supporting facilities is in the sufficient category, but hardware availability and network connectivity are still the main complaints of most users. Obstacles in entering and accessing important clinical information from patients are the main concerns of users related to patient safety due to inadequate RME supporting facilities.

limitations

Data collection took place only at one point in time, namely in the early years of using RME, so it is possible that the views of participants may be different in institutions that have been using RME for longer, especially those that have gone through various stages of improvement or those that have used more sophisticated systems so that this study is only relevant as a reference in the early stages of RME implementation.

In this study, patient safety measurements were only based on the perceptions of RME users. It is recommended that patient safety indicators be measured based on patient safety incident reports which will help confirm and validate user perceptions and experiences of patient safety..

Suggestion

1. It is expected that hospitals conduct ongoing training on basic Information Technology (IT) and mastery of RME features, increase socialization and monitoring of evaluation of the use of RME and its impact on patient safety on an ongoing basis starting from before, during and after implementation,
2. It is expected that hospitals regularly carry out user-centered RME redesign to improve patient safety, service quality and cost efficiency of patient care.
3. It is expected that hospitals further improve the quality of internet network connectivity, increase the number of computers to be comparable to users and if possible add mobile devices so as to reduce the queue for using RME.
4. It is hoped that the topic of RME can be one of the discussions in lecture material, because Permenkes RI Number 24 of 2022 already requires every health care facility to use RME.
5. For researchers in hospitals or other health facilities that have not or will soon implement RME, it is hoped that this study can be taken into consideration about the positive impact and potential negative impact of implementing RME on patient safety, especially in the early stages of implementation.

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