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Digital capabilities of health workers to use electronic medical records: Digital maturity self-assessment in Indonesian hospitals

Guardian Yoki Sanjaya[1*], Devi Emrianti Ramadhan[1], Agus Mutamakin[2], Taufiq Sitompul[2], Dian Sulistiyowati[3], Haidar Istiqlal[3]

[1]Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Indonesia
[2]USAID Country Health Information Systems and Data Use (CHISU) Indonesia
[3]The Ministry of Health Indonesia

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Abstract

Digital skills influence the successful implementation of information systems and electronic medical records (EMR) in health care facilities. The Ministry of Health measures digital maturity levels to identify gaps in improving digital transformation, including the digital skill of health workers in hospitals in 2022. The digital maturity in all hospitals in Indonesia was measured quantitatively based on the 7 components of Hospital Information Systems Maturity Model (HISMM). The low response rate was anticipated with a number of efforts such as outreach, capacity building and a circular letter from the Ministry of Health. Internal and external consistency was conducted to ensure the quality of the self-assessment. Specifically, the level of digital skills was analysed by calculating the average score of one components of digital maturity, namely Human Resources, Skills and Use of Hospital Information Systems. There are 11 parameters for assessing the level of digital literacy, perceived usefulness and encouragement to use RME in hospitals. All parameters were assessed using a 5-point scale and were analysed quantitatively. The response rate was 31.9% (973 out of 3,052 hospitals) where overall average of digital maturity level was 2.6. Hospital type A, higher accreditation status and located in Jawa-Bali has relatively high maturity level compare to others. The digital skills of health workers in hospitals are relatively high, with the majority already using the hospital information system. This was align with the perception of the ease of use and usefulness of using a hospital information system. Even though there have been several digital health champions in the hospital, health workers have not been fully involved in the process of developing information systems in hospitals and not many hospitals have utilized HIS to assess the performance of health workers. It is clearly that health workers in hospitals are capable and quite aware of the use of digital technology. However, their role needs to be increased to support the development of appropriate digital technology.

*Correspondence Address:
Faculty of Medicine,
Universitas Gadjah Mada,
Yogyakarta, Indonesia.
E-mail: gysanjaya@ugm.ac.id

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Introduction

Many countries have made major investments in improving health information systems to respond to growing demand for new and better health data (WHO, 2023). Electronic medical records (EMR) is the most widely adopted that many hospitals prioritize as an effort to support quality and patient safety (Vos, et al. 2020). Clinical documentation, computerized provider order entry, electronic prescription, digital test results, and clinical decision support systems are amongst features that recommended to improve patients care (Pawloski, 2019). A number information technologies are also converged in RME with the increasing development of the Internet of Things (IoT), big data technology, augmented reality, blockchain, digital twins (Gartner, 2016; Saifudin, et al. 2021) and artificial intellegence (Hamet and Tremblay, 2017). Hospitals are required to have the ability to manage internal and external resources to adopt various priority digital technologies. In addition, the implementation of information systems and/or electronic medical records (EMR) requires an electronic system that has compatibility and/or interoperability capabilities between one electronic system to another, and/or data exchange with one or more other electronic systems (Maldonado, 2016). The application of electronic medical records and various interconnected digital technologies must meet the principles of security and confidentiality of patient data and information (Shuaib, et al. 2021; Shah, et al. 2020).

Apart from aspects of information and communication technology, the implementation of RME in hospitals is influenced by several factors. National regulations, requirements from the health insurance company, current state of information technology and market trends are the main drivers for hospitals to adopt digital technology (Kruse et al, 2016). In many hospitals, organizational leadership and governance play an important role in making digital technology a strategy to improve the efficiency and quality of health services (Lau et al, 2012). Allocation of sufficient resources, especially budget allocation for both capital expenditure and operations for implementing EMR is related to the hospital's internal policies. Regulation of the Minister of Health of the Republic of Indonesia Number 82 of 2013 concerning Hospital Management Information Systems states that information technology human resources for hospital information systems or SIMRS must at least consist of staff who have qualifications in the fields of system analysis, programmers, hardware and network maintenance (Ministry of Health, 2013). The use of data standards, electronic data exchange, quality and information system services that implemented in hospitals is closely related to the ability to manage information systems and IT teams that have appropriate competencies and are always being improved. Including the acceptance of health workers in the use of EMR in hospitals. The large amount of resistance to the use of EMR is associated with legal certainty in the use of electronic systems, security and confidentiality of patient medical data, health service ethics where EMR is perceived to reduce patient-doctor interaction and the lack of digital skills from health workers (Kalayau et al, 2021).

According to Handayani et al (2015), the main priority that hospitals need to implement EMR is human resources. The user acceptance factor is one of the keys to the success of implementing electronic medical records. Many studies show that user acceptance is related to the convenience and usefulness of electronic medical records. EMR that can display patient information comprehensively, produce reports that correspond to the user needs, and support clinical decision are important benefits that EMR needs to provide (Jha, et al 2009). Ongoing training is related to increasing the digital competence of health workers, including health data processing, analysis and data use for monitoring, evaluation or research. Support and responsive technical assistance can reduce user resistance, especially for simple problems such as forgetting passwords, access to local or internet networks and hardware (computer client) problems.

The successful implementation of an information system in a hospital is related to the availability of staff and medical personnel who are able to operate digital technology that directly link with user needs. According to WHO 2006, one of the important issues that requires careful planning is the availability of human resources and their abilities to adapt with the technology (Pratama dkk, 2017). Medical staff and personnel require skills in using information systems, especially electronic medical records. Apart from training, it is also necessary to increase digital literacy to improve digital maturity in the hospitals. Digital maturity is the extent to which health information technology can provide high-quality services by supporting improved service delivery and patient experience. For this reason, it is important for hospitals to adopt digital technology with the management of human resources, skills and the use of existing hospital information systems.

Method

A cross-sectional survey was used to assess hospital digital maturity in 2022. There were 3,052 hospitals in Indonesia targeted for assessing digital maturity in Indonesia. The survey started in July 2022 until December 31, 2022. The digital maturity assessment instrument was adopted from the Hospital Information Systems Maturity Model (Carvalho, 2019) and several other models (World Bank, 2021; Duncan et al, 2022; Krasuska et al, 2020). There are 7 digital maturity components used, including information systems and hospital information system infrastructure, interoperability, leadership and governance, data analysis, human resource skills and information systems usefulness, security, data privacy and confidentiality, and electronic medical records and patient centered care. There are 69 questions with a 5 scale measurement. The instrument was validated through expert discussions, pilot test in 5 hospitals, and instrument refinement workshops with different stakeholders. An electronic tool for self-assessment survey was developed using the DHIS2 (District Health Information Software) platform.

The data collection stage in the 2022 digital maturity assessment includes: a). Socialization and mentoring carried out online using zoom meetings, YouTube channels and collaborating with the the Indonesian Hospital Association (PERSI) platform; b). Self-assessment by the hospital team; c). Data validation through internal consistency, external consistency analysis using Hospital Online Data (RS Online) and supervision directly to hospital.

A descriptive analysis was conducted, starting from the response rate, completeness analysis, and calculate digital maturity index (DMI) by each component and overall score. DMI was generated by calculating the average score of 69 digital maturity parameters. Hospitals must answer at least more than or equal to 70% (a total of 69 questions) to meet the DMI level assessment. The DMI level was interpreted as follows:

1. *Ad hoc* dan Fragmentation: The organization does not have the capacity for information system-based services and/or the available systems are ad hoc and are done casually.
2. Foundation Initiation: The organization has a hospital information system roadmap but it is not systematic. there is no protocol for monitoring and measuring system performance on an ongoing basis
3. Formed and Authority: The organization has a clear roadmap regarding the structure and function of the information system, supervision, quality improvement and systematic evaluation of the hospital information system.
4. Managed Collaboration: the organization has used the hospital information system according to its structure and function as well as established policies and procedures.
5. Optimally Integrated: The organization carries out digital maturity continuously to monitor and maintain the quality of the use of digital health technology in hospital.

Results

Hospital Information Systems Characteristics

Hospitals that completed the self-assessment at least 70% of all questions and analyzed were 973 out of 3,052 hospitals or 31.88%. The proportion of hospital involvement in digital maturity assessment is highest in Gorontalo Province and lowest in Papua Province. However, the largest contribution came from Java-Bali and Sumatra, 583 and 215 hospitals respectively. The highest contribution participating province was East Java (172 hospitals), and the lowest was West Papua and Papua, each with only 1 hospital whose data met the criteria for analysis. The results of the analysis also showed that class C hospitals were the majority contribution of the digital maturity assessment (54.7%) and followed by class B hospitals (21.6%).

Table 1 shows the characteristics of hospital information system management or SIMRS. Most hospitals collaborate operationally with other parties (34.5%), use open source information systems (20.3%) and develop independently (16.6%). Class A hospitals developed more independently or in combination, while class B and C hospitals often carried out operational collaboration with other parties. Hospital class D and D Pratama used more open source applications. If we look at the SIMRS length of used, the majority have been used SIMRS for more than 5 years (48.5%), especially Class A and B hospitals. The majority of class C, D and D Pratama have been used SIMRS for less than 5 years. Only a few hospitals that have been used SIMRS for less than 1 year (9.6%). The proportion of SIMRS users was relatively high in all hospitals, where 45.8% of hospitals have more than half of the total number of staff as active SIMRS users. The users of SIMRS in type C and type D hospitals was relatively high compared to other class hospitals. Staff in the IT unit is still very small. If we look at the ratio of human resources in hospitals, more than 50%

of hospitals have an IT personnel ratio less than 1 per 100 staff. This was almost the same in Class A, B, C and D hospitals.

Table 1. *Characteristics of the use of SIMRS in the hospital*

	Hospital Class					
	A	B	C	D	D PRATAMA	Total
Origin of SIMRS						
Operational Cooperation	3 (0.3)	62 (6.4)	211 (21.5)	60 (6.3)	1 (0.1)	337 (34.5)
Combination	14 (1.6)	47 (4.8)	83 (8.4)	10 (1)	(0)	154 (15.9)
Buying a Finished System	1 (0.1)	24 (2.4)	52 (5.4)	7 (0.7)	(0)	84 (8.6)
Develop Independently	18 (1.8)	52 (5.4)	65 (7)	23 (2.4)	(0)	158 (16.6)
Using Open Source	1 (0.1)	20 (2)	110 (11.2)	66 (6.8)	2 (0.2)	199 (20.3)
Unknown	(0)	5 (0.5)	11 (1.1)	20 (2)	5 (0.5)	41 (4.1)
Length of Use of SIMRS						
<1 Year	1 (0.1)	11 (1.1)	54 (5.6)	26 (2.6)	2 (0.2)	94 (9.6)
1-5 Years	8 (0.8)	42 (4.3)	219 (22.4)	86 (8.9)	(0)	355 (36.5)
5-10 Years	4 (0.5)	49 (5.1)	140 (14.3)	36 (3.7)	1 (0.1)	230 (23.7)
>10 Years	24 (2.5)	101 (10.3)	102 (10.5)	14 (1.5)	(0)	241 (24.8)
Unknown	(0)	7 (0.7)	17 (1.7)	24 (2.4)	5 (0.5)	53 (5.4)
SIMRS User Proportion Category*						
< 25%	5 (0.5)	36 (3.7)	126 (12.7)	47 (4.9)	1 (0.1)	215 (22)
25-50%	7 (0.7)	42 (4.2)	78 (8)	21 (2.1)	(0)	148 (15.1)
50-75%	10 (1)	47 (4.8)	105 (10.8)	16 (1.7)	2 (0.2)	180 (18.6)
75-100%	10 (1.2)	61 (6.3)	139 (14.3)	50 (5.2)	(0)	260 (27)
Not known	5 (0.5)	24 (2.4)	84 (8.7)	52 (5.3)	5 (0.5)	170 (17.4)
Hospital IT Personnel Ratio*						
< 1 per 100 Staff	18 (1.9)	142 (14.5)	282 (28.8)	61 (6.2)	4 (0.4)	507 (51.8)
1-2 per 100 Staff	17 (1.8)	51 (5.3)	155 (16)	63 (6.8)	1 (0.1)	287 (29.9)
3-5 per 100 Staff	2 (0.2)	5 (0.5)	34 (3.4)	21 (2.1)	1 (0.1)	63 (6.4)
> 5 per 100 Staff	(0)	(0)	12 (1.2)	9 (0.9)	(0)	21 (2.1)
Unknown	(0)	12 (1.2)	49 (5.2)	32 (3.2)	2 (0.2)	95 (9.8)

**Data on the total of hospital human resources is taken from the Hospital Online (RS Online) of the Ministry of Health in December 2022

Hospital Digital Maturity Level

In general, the average digital maturity level of hospitals in Indonesia was 2.63 (out of 5 scale). Only 973 hospitals were met the criteria for analysis. The level of digital maturity can be categorized as "establishment and authority". It can be interpreted that the majority of hospitals in Indonesia already have hospital information systems and clear road maps related to developing the structure and function of hospital management information systems, monitoring, quality improvement and systematic evaluation of hospital information systems. The proportion of digital maturity levels of hospitals in Indonesia can be seen in the following figure.

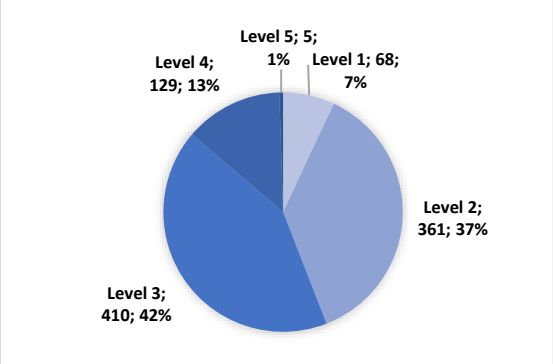

Figure 1*. Proportion of hospital digital maturity levels in Indonesia*

The results of a digital maturity survey in hospitals showed variations between provinces in Indonesia. Based on the self-assessment survey, the digital maturity of hospitals in the Java-Bali province were relatively high compared to other provinces. The lowest average hospital digital maturity was in West Papua province (1.62), while the highest average was in DKI Jakarta province with a value of 3.05. Unfortunately, the number of hospitals that carried out self-assessments in the regions of Papua, NTT Islands, NTB, Maluku and North Maluku was not very large. For example, only 1 hospital in Papua and West Papua province that eligible and included in the assessment.

If we look at the digital maturity level based on hospital class per geographic area, it was consistent between hospital class and the average digital maturity level in every regions in Indonesia. Class A hospitals have a higher average level of digital maturity (3.23) compared to the class D Pratama hospital group which only has an average of 1.57. The following figure shows the average digital maturity by hospital class.

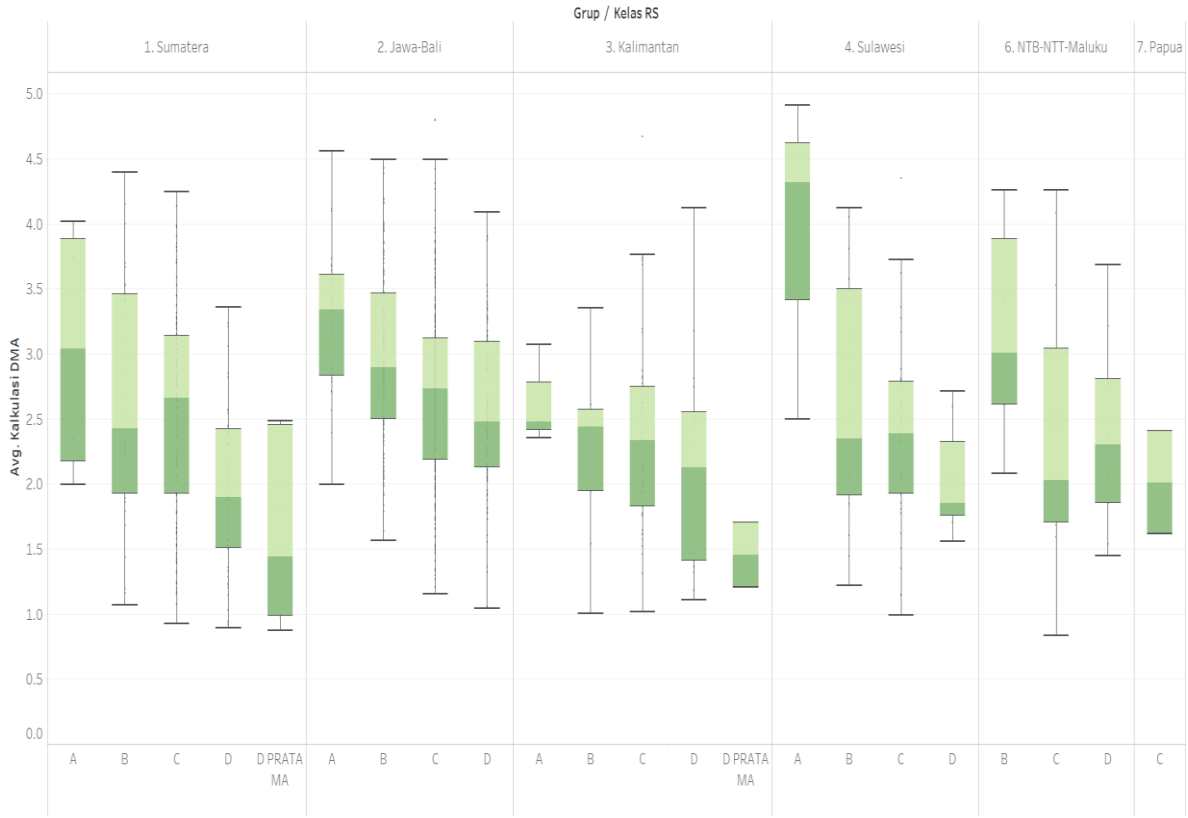

***Figure 2**. Digital maturity level based on hospital class*

Human Resource, Skills and Data Used

The average value of digital maturity in the human resource component, skills and data used of digital maturity in the Java-Bali provinces region were almost similar between 2.5 to 3.8. Meanwhile, in other regional groups such as Sumatera, Kalimantan, Sulawesi, NTB-NTT-Maluku and Papua, each province has more varied level of digital maturity.

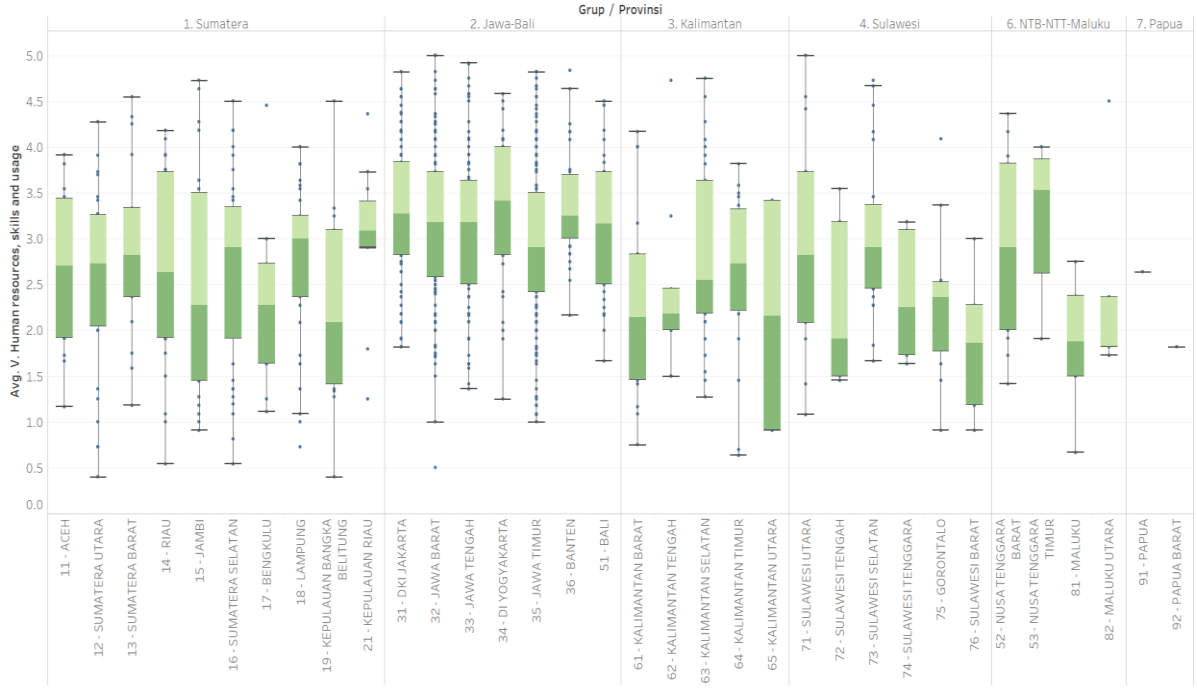

***Figure 3**. Digital maturity levels of human resources components, skills and data used per province and geographic region*

Implementation of information systems in hospitals needs to be supported by skilled human resources who are able to utilize digital technology for health services and capable to use information for strategic decision making. The results of the component human resource, skills and data used of the digital maturity assessment showed that the majority of human resources in hospitals have a good level of literacy and are able to utilize digital technology for the needs of the health care services . However, experience and learning from the use of information systems in hospitals, the involvement of service units in developing information systems needs to be managed for sustainable development as part of knowledge management. The following table shows the human resource capabilities, skills and knowledge management of information systems in hospitals

***Table 2**. Average level of digital maturity of human resources, skills and data use by hospital class*

Sub-component	Cannot be rated	Low	Intermediate	High	Total
Digital Literacy	5 (0.5)	136 (14)	450 (46.2)	382 (39.3)	973 (100)
Class A	(0)	(0)	12 (1.2)	25 (2.6)	37 (3.8)
Class B	2 (0.2)	15 (1.5)	97 (10)	96 (9.9)	210 (21.6)
Class C	1 (0.1)	75 (7.7)	250 (25.7)	206 (21.2)	532 (54.7)
Class D	2 (0.2)	41 (4.2)	88 (9)	55 (5.7)	186 (19.1)
D Pratama	(0)	5 (0.5)	3 (0.3)	(0)	8 (0.8)
Perception of Usefulness and Usefulness of information systems	1 (0.1)	89 (9.1)	476 (48.9)	407 (41.8)	973 (100)
Class A	(0)	(0)	15 (1.5)	22 (2.3)	37 (3.8)
Class B	(0)	12 (1.2)	90 (9.2)	108 (11.1)	210 (21.6)
Class C	1 (0.1)	50 (5.1)	254 (26.1)	227 (23.3)	532 (54.7)
Class D	(0)	24 (2.5)	114 (11.7)	48 (4.9)	186 (19.1)
D Pratama	(0)	3 (0.3)	3 (0.3)	2 (0.2)	8 (0.8)
Encouragement Using information systems	2 (0.2)	194 (19.9)	451 (46.4)	326 (33.5)	973 (100)
Class A	(0)	2 (0.2)	11 (1.1)	24 (2.5)	37 (3.8)

Sub-component	Cannot be rated	Low	Intermediate	High	Total
Class B	(0)	24 (2.5)	102 (10.5)	84 (8.6)	210 (21.6)
Class C	(0)	99 (10.2)	257 (26.4)	176 (18.1)	532 (54.7)
Class D	2 (0.2)	65 (6.7)	79 (8.1)	40 (4.1)	186 (19.1)
D Pratama	(0)	4 (0.4)	2 (0.2)	2 (0.2)	8 (0.8)
Knowledge Management	17 (1.7)	365 (37.5)	388 (39.9)	203 (20.9)	973 (100)
Class A	1 (0.1)	6 (0.6)	18 (1.8)	12 (1.2)	37 (3.8)
Class B	(0)	59 (6.1)	99 (10.2)	52 (5.3)	210 (21.6)
Class C	6 (0.6)	204 (21)	215 (22.1)	107 (11)	532 (54.7)
Class D	10 (1)	88 (9)	56 (5.8)	32 (3.3)	186 (19.1)
D Pratama	(0)	8 (0.8)	(0)	(0)	8 (0.8)

Low, Medium and High categories were processed based on the minimum and maximum values for each sub-component.

Discussion

Digital Maturity and the EMR Implementation

Digital health transformation has been impact in the accelerating the use of hospital information systems in Indonesia especially electronic medical records (EMR). Starting from a digital health transformation blueprint containing strategies and roadmaps for implementing digital technology in the health sector (Ministry of Health, 2021), several regulations were then issued by the Ministry of Health such as adjustments the Ministry of Health's strategic plan through Minister of Health Regulation No 13 of 2022, Minister of Health Regulation No 24 of 2022 on medical records and management of one data in the health sector through the Minister of Health Regulation No 18 of 2022. This digital health transformation emphasizes the use of digital technology for individual health services compared to reporting, where hospitals are encouraged to implement interoperable electronic medical records through the SatuSehat (HL7 FHIR) platform. Until this article was written, 54.67% (n=3,157) of hospitals have been integrated and 34.72% of hospitals have sent data to the SatuSehat platform (SatuSehat, 2024).

Hospitals need to provide electronic medical records (EMR) as the digital technology priority. The EMR should be modified to follow metadata standards that have been established through MoH Decree No HK.01.07/MENKES/1423/2022. However, implementing RME is not only related to the use of applications and supporting digital infrastructure. Duncan et al (2022), World Bank (2021), Carvalho et al (2019) and NHS (2017) showed that digital technology is also related to organizational strategy and leadership; information technology capabilities; usage and interoperability standards; governance and information management systems; patient-centered care; digital skills, behavior and literacy; as well as analytical capabilities. These 7 dimensions are reflected in the digital maturity assessment. Hospital can use the assessment results to develop strategies for sustainable digital health implementation in the organization. The higher the digital maturity score, indicates the sustainability of digital technology implementation in hospitals. Hospitals can prepare or strengthen existing resources to manage, develop, implement and optimize digital technology for health services, organizational management, communication and digital collaboration.

Digital Capabilities of Health Workers in Hospitals

The hospital management information system is a series of activities that cover all health services that can provide information to be used by health workers for clinical services and managers for the management process and decision. An information systems should be interconnected to form a single unit and interact with one to another in the hospital to perform data processing starting from data input, processing, and output in the form of information to make decisions in order to achieve a goal (Astari, 2015). Similar to electronic medical records (EMR), a computerized health information system that contains population data, medical data, and can be equipped with a decision support system (Andriani et al., 2017). EMR normally contain essential clinical data that use certain medical terms, such as clinical findings, observations, medical orders, medical test results, and medical and pharmaceutical documentation. RME is also useful for paramedics to document, monitor and manage health services provided to patients in the hospital. Any hospital information systems or EMR is expected to collect the

high quality data, processing data, analysis and generate relevant information of health services for clinical and strategic decision in hospitals. This requires capabilities of health personnel to utilize hospital information systems and optimized the computer-based medical records to access information quickly and to make clinical decision accurately.

Many studies have proven that electronic medical records provide benefits for the health care services. However, many also argue the opposite that electronic medical records are "a source of frustration, stress, and fatigue for doctors". Kanjo et al (2019), mentioned several challenges such as none of the health staff provided support for the implementation of an electronic medical record system, an average of 27% of the doctors time spent was just to use the electronic medical records and 44.6% of family doctors have to spent a lot of time using electronic medical records at home. The tangible and intangible benefits should be shown when medical doctor use EMR. It requires more evidences to prove the benefits of using EMR such as minimizing patient information that is likely to be lost, minimizing human errors and improve patient care. The expected patient care benefits of EMR must of course take into account in term of costs of software, hardware and training.

Encouraging the use of digital technology for health workers needs to be done with various approaches. Rahal et al. (2021) identified 5 main factors that influence the use of EMR among physicians. The EMR technology should be user-friendly, ease of use, and provide the comprehensiveness of clinical functionalities that fit the main medical tasks of health workers. Improving the healthcare workers skills to use the advanced capability of EMR such as clinical decision support systems for better patient care. Provide integrated digital system that enables collaboration among health professionals that shares resources and financial incentives. Retention of health professionals to use advanced EMR that coaching by consultants and peer mentoring (IT champion). Develop national policy to increase the spread and use of digital health technology, especially EMR use amongst health workers. Most studies find that digital experience (knowledge and use of computers) for the majority of staff/users in health facilities in developing countries is still low. Training instilling confidence in the use of electronic medical records in users can increase knowledge and utilization of computers and facilitate the pace of technology into the health sector (Pandey dan Zheng, 2019).

Efforts to Improve the Digital Skills of Health Workers

Digital technology can assist health workers in providing better health services. The application of digitization will help provide health services to patients and make the work of health workers easier to optimize the achievement of a better health environment. Digital health should be viewed as a strategy in the hospitals and clearly stated in the organization's strategic plan. Hospitals can plan their digital approach more systematically, allocating resources, including investing in digital capacity for their health workers, either for the development, implementation and effective use of digital technology as well as evaluation the benefits for continuous improvement.

The digital capabilities of health professionals are related to digital literacy skills that includes information management, privacy and security, legal and ethical aspects, a balanced attitude towards technology, understanding and awareness of the ICT role and motivation to learn digital technology (Janssen et al., 2013). Improving digital capabilities will encourage continuous learning as more and more competency development become available for health workers through online training. When both facilitators (teachers) and participants have good digital literacy, the online learning process can take place effectively. In fact, Yojana (2022) mentioned that the digital literacy of the majority of health workers (midwives, sanitarians, occupational health counsellors and public health instructors) are very good.

Strategic decision makers, clinical managers, operational managers, disease control managers, human resource managers, doctors, nurses, nutritionists, supervision and monitoring officers, health information officers, and other frontline health workers require different digital skills. Hospitals need to identify the requirement for digital technology and its competency development to support clinical services, organizational management, advanced analytics and research or evaluation. Recently, the artificial intelligence become popular and required both technical skills and clinical competencies to be integrated into the EMR.

Improving Digital Health through the Interdisciplinary Collaboration

Digital health technology develops continuously to solve various health problems both on an individual and community scale. Telemedicine, mobile health, internet of medical things (IoMT), electronic health records, artificial intelligence and precision medicine are among the recommended digital technologies that can be adopted (Mumtaz et al, 2023). A cross-disciplinary team is needed in planning,

overseeing and coordinating the development of digital technology in hospitals. Tele-monitoring and tele-consultation are examples that have emerged recently to improve medical services, both provider-to-provider and provider-to-clients consultation, involving the services of general practitioners, specialists and or home visits. Apart from being a profitable innovation, this can also be a weakness for health workers. Very limited health workers in Indonesia have been taught in the use of telemedicine, IoMT or mobile apps for patient care, consultation or home visits. Health workers must be aware of the need for special skills whose quality must be maintained in carrying out online consultations, while maintain the quality of health services.

Apart from being users, the development of digital technology requires the role of health experts to participate in designing and developing digital technology which can improve the quality of life. According to Wulandari (2021) the internet of things (IoT) technology, biosensors, big data and artificial intelligence has implemented to meet its new opportunities and health challenges where the tacit knowledge of health experts is required. Reliable digital health can support health workers to provide better services, to improve diagnose, to monitor medical devices accurately with the right internet technology and to avoid worries about inadequate monitoring applications that can cause patient health and safety problems. In addition, digital health services make it easier for patients to access information, facilitate remote consultation services to save patients' energy and time and can speed up the handling of patient complaints. Medical personnel will find it easy to access patient information, to store medical record data, and to monitor patient conditions online. Therefore, there is a need for an interdisciplinary collaboration to implement the best ideas for the development digital technology for health care.

Conclusion

The level of digital capability of health workers in hospitals was relatively high where the majority of hospitals have been used information systems. The ease and usefulness of information systems for health workers encouraged the use of digital technology for health services. However, health workers have not been fully involved in the process of developing information systems in hospitals. Efforts to increase the use of digital technology amongst health workers need to be continued using several approaches. Experiences and learning from business processes carried out by health workers at each service unit are important to be identified, as part of knowledge management for the development of appropriate information systems in hospitals. Apart from that, an interdisciplinary collaboration to develop, implement and evaluate the digital health innovation is needed to achieve a more advanced information systems in the hospital.

Author Contributions

All authors contribute equally according to their respective roles. Conceptualization, GY Sanjaya.; methodology, GY Sanjaya, A Mutamakin and D Sulistiyowati.; software, T Sitompul.; validation, GY Sanjaya, A Mutamakin, T Sitompul, D Sulistiyowati, H Istiqlal; formal analysis, GY Sanjaya, D Sulistiyowati; investigation, GY Sanjaya, D Sulistiyowati.; resources, T Sitompul, D Sulistiyowati, H Istiqlal.; data curation, D Sulistiyowati, H Istiqlal.; writing—original draft preparation, GY Sanjaya and DE Ramadhan.; writing—review and editing, GY Sanjaya and DE Ramadhan.; visualization, GY Sanjaya.; supervision, T Sitompul.; project administration, A Mutamakin. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of Faculty Medicine, Public Health and Nursing Gadjah Mada University. The protocol code number KE/FK/1343/EC/2022 and approved on 22nd October 2022.

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Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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