The analysis of an Electronic Health Information Management System Transition in Indonesian hospitals, 2019

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Declaration

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Declaration: Where other people's work has been used (either from a printed source, internet or any other source) this has been carefully acknowledged and referenced in accordance with departmental requirements.

The thesis "**The analysis of an Electronic Health Information Management System Transition in Indonesian hospitals, 2019"** is my own work.

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List of Abbreviation

BKKBN	:	The National Agency for Population and Family Planning or Badan Kependudukan dan Keluarga Berencana Nasional
BPJS	:	The National Health Insurance Agency or Badan Pelaksana Jaminan Sosial Kesehatan.
BPS	:	Central Bureau Statistics or Badan Pusat Statistic
DGCDCEH	:	Directorate General of Communicable Disease Control and Environmental Health
DHO	:	District Health Office
DQR	:	Data Quality Review
eHIMS	:	Electronic Health Information Management System
EHR	:	Electronic Health Record
EMR	:	Electronic Medical Record
EWARS	:	Early Warning Alert and Response System
HIM	:	Health Information Management
HIM	:	Health Information Management
HISs	:	Health Information System
HIT	:	Health Information Technology
IMRSSP	:	Indonesia Mortality Registration System Strengthening Project
IT	:	Information Technology
KARS	:	The Indonesian Commission for Hospital Accreditation or Komite Akreditasi Rumah Sakit
MAT	:	Management Assessment Tool
MOH	:	Ministry of Health
MoHA	:	Ministry of Home Affairs
MR	:	Medical Record
NCD	:	Non Communicable Disease
NIHRD	:	National Institute and Health Research and Development
OBAT	:	Organizational and Behavioral Assessment
OECD	:	Organization for Economic Corporation and Development
PHC	:	Primary Health Care
PHO	:	Province Health Office
POLINDES	:	Village Maternity Homes or Poliklinik desa
POLRI	:	Indonesian National Police or Polici Republik Indonesia
POSYANDU	:	Integrated Health Center or Pusat Pelayanan Terpadu
PRISM	:	Performance of Routine Information System Management
PUSLING	:	Mobile Health Center or Puskesmas Keliling
PUSTU	:	Auxiliary Health Center or Puskesmas Pembantu
RCA	:	Root Cause Analysis
RHIS	:	Routine Health Information System
RISFASKES	:	Health Facility Survey or Riset Fasilitas Kesehatan
RISKESDAS	:	Primary Health Survey or Riset Kesehatan Dasar
SDKI	:	Demographic Health Survey or Survey Demografi Kesehatan Indonesia
SIKDA	:	District/Municipality Health Information System or Sistem Informasi Kesehatan Daerah
SIKNAS	:	National Health Information System or Sistem Informasi Kesehatan Nasional
SIRS	:	Hospital Information System or Sistem Informasi Rumah Sakit
SKRT	:	Household Health Survey or Survey Kesehatan Rumah Tangga
SMS	:	Short Messaging Service

SNARS	:	The National Standard on Hospital Accreditation or Standard Nasional Akreditasi Rumah Sakit
SOP	:	Standard Operating Procedure
SURKESNAS	:	National Health Survey or Survey Kesehatan Nasional
TNI	:	Indonesian ational Armed Force or Tentara National Indonesia
UHC	:	Universal Health Coverage
VU	:	Vrije Universiteit
WHO	:	World Health Organization

Glossary

eHIMS: It is an integrated system for data collection, processing, reporting, and usage of health information with good management in order to improve health care service, management, and decision making of the health facilities and organization.[1]

Medical record: It often refers to as health record. It is all record of an individual's health status from birth to death. It includes records of birth, immunization, illnesses, treatments and medical procedures given by a hospital.[2]

HIM graduate: A person who has completed a formal education in medical record and Health Information Management (HIM).[2]

IT Graduate: A person who completed a formal education in information technology.

HIM unit: It refers as medical record room, clinical information service, patient information service, or health information department.[2]

User: A person who has authority to use an application, equipment, facility, process, or system to obtain a benefit or to solve a problem.[3]

SIRS report: It is data processing include collecting, processing, and displaying data of hospitals, both general hospital and specialist hospitals, government and private hospitals across Indonesia.[4]

BPJS-Health: It is an agency which organizes the health national insurance in Indonesia.[5]

Technical Factors of eHIMS: eHIMS determinants include the complexity of eHIMS reporting forms and procedures, eHIMS design, and computer software and IT complexity.[6]

Organizational factors of eHIMS: All management activities of eHIMS includes critical management function and information needs, governance, planning, training, supervision, quality assurance, finance, promotion of information culture, and availability of resources.[6]

Behavioral factors of eHIMS: All factors related to health workers as users of the eHIMS in the hospital, such as nurses, doctors, and HIM staffs. Those include the level of knowledge of eHIMS form, Data quality check-in skill, problem-solving for eHIMS task, competence in HIS task, the confidence level for eHIMS tasks, and motivation. [6]

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Abstract

Background: The electronic Health Information Management System (eHIMS) has been developed in Indonesian hospitals since 1972 with some policies and regulations. It is obligated as an accreditation requirement since 2017. However, it is implemented only 50% of the hospital with average only 36.87% reports submitted to the Ministry of Health.

Objective: To critically analyze the transition to eHIMS in Indonesian hospitals and provide recommendations for eHIMS development strategies.

Methodology: The study uses desk study, literature review and hospital data secondary analysis. Semi-structured interviews with people working in eHIMS were used for triangulation. Data were analyzed using PRISM (Performance of routine Information System Management) conceptual framework.

Results: This study found that the level of eHIMS implementation in Indonesian hospitals can be grouped an advanced, upper-intermediate, intermediate, and basic. Hospitals with advanced and upper-intermediate implementation levels can provide good quality data to improve health service quality, hospital management, public health interventions, and health system strengthening in contrast to lower levels' hospitals. Especially the management of funds and people, and user motivation and involvement in the system and its processes influenced implementation levels.

Conclusion: Technical, organizational, and human resource factors influence eHIMS implementation in Indonesian hospitals. Low quality of electronic data cannot be used for decision making. Meanwhile, a robust eHIMS provides good quality data and quality improvements in health service delivery.

Recommendation: Strategy to improve eHIMS implementation should include management strengthening and the creation of an electronic and paperless culture via users' awareness improvement in data processing

Keywords: Health information management system.

Word Count: 250

Introduction

Health Information Management System (HIMS) is one of the six building blocks of the health system. It is an integrated system for data collection, processing, reporting, and usage of health information with good management in order to improve health care service, management, and decision making of the health facilities and organization. [1,7-8] Definition of HIMS as a system involves health information process, management structure, and routinely produced quality health information by using technology. Therefore, its term is sometimes interchangeable with other terms such as Health Information Systems (HISs), Routine Health Information System (RHIS), and Health Information Technology (HIT). [7,9]

HIMS in hospitals is known as a hospital information system (HIS). It is a comprehensive system of patients information include health patient's history, diagnosis, examinations, billing, and others related procedures which are conducted in the hospital, and involving technical players in the process. [10-11] HIS has two main functions. Firstly, as a patient management that is related to health service deliveries to patients include promotional, preventive, curative, and rehabilitative service.[7] Secondly, as health system management that aims to provide information and statistics for health management such as health policy and strategic planning, programming and budgeting as well as patient referral coordination. Also, for implementation, monitoring and evaluation of program, human resources management as well as supply chain management (drugs and equipment).[7,12] In addition, it is important for public health as information of health population, vital registration (birth, death and migration), notification of infectious and non-infectious diseases in order to identify problems and interventions of environment protection, prevention, risk factors and disease control. [7,13]

Now a days, there has been transition from conventional HIMS to an electronic that is called Electronic Health Information Management System (eHIMS), and medical record as a key source of HIMS in the hospital[2,14] also has transformed from the paper based medical to Electronic Medical Record (EMR) which is often referred to as Electronic Health Record (EHR)[2,14]. EMR is data of a patient that is saved in an electronic system in order to improve quality of health care / service, administration and management,[14] as well as to provide quality data for public health surveillance and health information. Both EMR and EHR are sometimes interchangeable. However, the term of EHR is broader than EMR. It is a comprehensive health report of the patient that is designed to share information with other health facilities. Meanwhile EMR is aimed for diagnosis and treatment by a health facility and not designed for sharing with other health providers.[15-18]

Components of eHIMS include i) patient management system such as patient registration or master patient index, inpatient and outpatient monitoring. ii) clinical information system such as EMR, e-prescription, patient diet planning, and management of nursing station, operation theatre, emergency room, and intensive Care Unit, as well as occupational medicine, immunizations, public health, medical coding system, clinicians desktop, and medical transcription. iii) Administrative system such as transport, building, equipment and inventory management. iv) Financial system such as billing, payroll and insurer management system. v) Ancillary service such as Laboratory, radiology, pharmacy, and forensic medicine system. [19-20]

In Indonesia, Hospital Information System has been developing since 1972 with Indonesian Ministry of Health Decree Number 651/XI/-AU/PK/72 regarding hospital data collection and reporting system. [21] This decree has been revised for times, and the latest revised was in 2011 with decree number 1171/Menkes/PER/VI/2011 regarding Hospital Information System or Sistem Informasi Rumah Sakit (SIRS). [22] The government also required all Indonesian hospitals to provide medical record service,[23-24] and submit their report to the District Health Office (DHO), Province Health Office (PHO), and Ministry of Health (MoH). [24,26]

In 2017, Indonesian government established regulation regarding strategic of National electronic Health (eHealth) System includes eHIMS and EMR/EHRs.[27] The Indonesian Commission for Hospital Accreditation (KARS) also established National Standard on Hospital Accreditation 1st edition or Standar Nasional Akreditasi

Rumah Sakit (SNARS) Edisi 1 which stated that eHIMS implementation is one of the hospital accreditation requirement.[28] The hospital accreditation status also become a requirement to continue relationship contract between hospital and the national health insurance agency or Badan Penyenggara Jaminan Sosial Kesehatan (BPJS-Kesehatan). [29] However, the implementation of eHIMS in Indonesian hospitals comprehensively is still a big challenge, and most hospitals still use manual medical record although EHR policy and standards have been processed. [30]

As a health worker who has been working in the HIMS department in a hospital for more than ten years, I know how substantial this implementation problem is. Lack of skilled Health Information (HIM) staffs, limited finance, poor management, and lack of support from the high-level manager are factors of this problem. Hence, I would like to systematically explore factors that hinder the implementation of eHIMS in hospitals in Indonesia to come up with interventions and recommendations for improving implementation of eHIMS in this country.

Chapter 1: Background

1.1 Profile of Indonesia

Indonesia is a middle-income country, economically strong and politically stable in Southeast Asia, between the India and Pacific Oceans, as well as bordered by Singapore, Malaysia, Papua New Guinea, and Timur-Leste.[31-33] As the largest archipelago country, Indonesia has around 17,504 islands, a multi-ethnic and cultural country with numerous linguistic groups that are speaking 724 different languages and dialects.[31] The total area is 1,904,569 square kilometers. Jakarta is the capital city of Indonesia.[34]

1.2 Health Situation

The healthy life expectancy of Indonesia has improved by 2.3 years from 2000 (59.4 years) to 2016 (61.7 years). The Universal Health Coverage (UHC) index is 61%, the impoverishment is 0.8%, and 3.6 % of people spent more than 10% of their household's total expenditure on health care. [35]

Overall, Indonesian health status has improved since two and a half decades shown by the increasing healthy life expectancy. The under-five mortality rate has decreased from 52 death per 1000 live births in 2000 to 31 deaths in 2012, and the infant mortality rate has been declining from 41 deaths per 1000 live birth in 2000 to 26 deaths in 2012. However, Indonesia has been facing a double burden of disease as a result of the epidemiologic transition. [31]

Health service in Indonesia is delivered by private health clinics, Primary Health Care (PHC/Puskesmas), and hospitals. The number of puskesmas in Indonesia is 9825, and hospitals are 2818.[36-37]

1.3 Health Management Information System Situation in Indonesia

Indonesia has strengthened its HIMS by establishing standard electronic systems. In 2002, Indonesian MoH issued two decrees, namely MoH decree No. 511/Menkes/SK/V/2002 regarding regulation and development strategic of National Health Information System or Sistem Informasi Kesehatan Nasional (SIKNAS),[38] and MoH decree No.932/Menkes/SK/VIII/2002 regarding Guideline of development and implementation District/Municipality Health Information System or Sistem Informasi Kesehatan Daerah/Kota (SIKDA)[39] that is also supported by District Health Information System 2 (DHIS 2) since 2017 as an open source software that is designed to collect, process, analyze, and disseminate health information in the district level. [40]

SIKNAS is a health information system in national level, while SIKDA is in the district/municipality level. [38] The SIKNAS was designed for health service, financing, human resources, medicines and medical equipment.[31] Its function is supported by province health information system (PHIS), while PHIS is supported by SIKDA as a system that process all data in the district area. Those are interconnected as a whole

system. In other word, SIKNAS cannot be implemented without support of SIKDA as its main data source. [38]

SIKNAS reporting system is developed from the lowest level of health system to MoH. The flow reporting system as follows: auxillary health centers (Pustu), mobile health centers (Pusling), integrated health centers (Posyandu), village maternity homes (Polindes) and village midwives submit data to puskesmas, and then puskesmas, private and public hospital in the district submit monthly reports to the DHO. The compilation data are sent by the DHO to the PHO, then PHO compiles those reports from across districts/municipalities, and submits them to the MOH. [31]

In 2007, the Directorate General of Communicable Disease Control and Environmental Health (DGCDCEH) introduced the Early Warning Alert and Response System (EWARS). It is a web-based surveillance reporting system for early detection of 23 potential outbreak diseases. (Annex 1) The reporting using Short Messaging Service (SMS) among pustu, puskesmas, and DHO to the EWARS server at the national level each week. [31,41-42]

In Indonesia, the vital registration system is a responsible of the Ministry of Home Affairs (MoHA). In 2010, the MoH and MoHA established a join decree for death reporting from the civil registry office or health facilities to the DHO, and the DHO to PHO with copy to MoH. [31]

In 2013, Indonesia implemented the Indonesia Mortality Registration System Strengthening Project (IMRSSP) that is collaboration between the National Institute and Health Research and Development (NIHRD), MoH, Central Bureau Statistic or Badan Pusat Statistik (BPS), and the DGCDCEH. This project used a representative sample from selected provinces (Jakarta, Central Java, Lampung, West Kalimantan, Gorontalo, Papua, Bali, and East Nusa Tenggara) to produce outcome indicators such as Crude Birth Rate, Total Fertility Rate, Crude Death Rate, Infant Mortality Rate, and Maternal Mortality Rate. [31]

The NIHRD also arranges various health surveys to accompaniment incomplete vital registration through SIKNAS. Those surveys are Household Health Survey (Survey Kesehatan Rumah Tangga / SKRT) that is conducted once every 3 year, National Health Survey (Survey Kesehatan National / Surkernas) in once every 3 year, Primary Health Survey (Riset Kesehatan Dasar / Riskesdas) in once every 3 year, and Health Facility Survey (Riset Fasilitas Kesehatan / Risfaskes) that has been conducted in 2011 and 2019. [31,43-45]

In addition, BPS and The National Agency for Population and Family Planning or Badan Kependudukan dan Keluarga Berencana Nasional (BKKBN) conduct the Demographic Health Survey (Survey Demografi Kesehatan Indonesia / SDKI) to provide health indicators estimation of population, family planning, maternal and child health, and health reproductive that is conducted in once every 4-5 year. [31,46-47].

Currently, Indonesia has regulated policies and guidelines of eHIMS and EMR implementation. However, EMR is not mandatory as eHIMS,[28-29] and both eHIMS and EMR implementation grow slowly. [31]

Chapter 2: Problem Statement, Justification, Objective, Methodology
2.1 Problem Statement

HIMS is crucial in decision making and enforcement of health system. However, only 50% of the countries worldwide informed the cause of death to the World Health Organization (WHO) in 2014, and more than 100 countries do not conscientiously calculate birth and death. [48] Also, only few developing countries have robust HIS due to lack of prioritizing in data processing system. As a result, reliable and timely information are not available or out of date. [49]

In the hospital, conventional HIMS leading to the poor quality health information (unreliable, unavailable, incomplete, inaccurate, untimely, outdates, and overlapping / redundancy)[7], information is inconsistent, and quality of health services is inadequate.[49] The available information is not sufficient to support decision making, [7] cannot be used to identify problems, and for monitoring and evaluation.[49] Besides, it need a huge data storage space. Health workers also are

demotivated due to overburdened by excessive data reporting demand without improper incentive, supported by sufficient coordinated sub-system,[49] and availability of feedback on the data reported from the higher level.[7,50]

Inadequate skilled staffs, hardware and software are main factors why hospitals are still practicing manual data processing rather than move to electronic.[27,49-50] Health workers are not trained appropriately in data processing, analyzing, and data collecting.[7] Also, there is a shortage in experts in statistic, public health, biomedical knowledge, HIMS and information technology,[49] Besides, financial constraint such as high budget on data processing facilities (hardware, software, electricity, internet, data security).[27,49-50]

To those hospitals with eHIMS are also still facing issues such as financial constraint in maintenance of the system and lack of system structure, organization and data management, as well as unintegrated system.[27,49-50]

Inadequate organization include management support and coordination become an issue in the implementation of eHIMS. eHIMS is more focus on the use of computer technology rather than an organization of information handle. Also, insufficient coordination of the line managers and provider of the health facilities in reporting and its transmission.[7]

In addition, eHIMSs are unintegrated within department in the hospital and between one hospital to another, or from low-level program to the higher.[7,27] The eHIMSs are not uniform, and some are designed separately base on needs and more focus on the program rather than whole health system, for instance, focus on one specific disease (e.g. Tuberculosis), particular service (e.g. family planning), or management sub-system (e.g. drug management information system), instead of confronting management system comprehensively.[7,27] As results, HIMS is not working properly leading to poor quality health information.[7,27,49-50]

2.2 Justification

eHIMS in Indonesia is still quite challenging even though the information technology has been developed from Sabang to Marauke. In Indonesia, applications for data recording, collection and report has been built. However, none of these are similar and well integrated. Every application in each institution has its own forms, datasets, and code designs. This brings a huge impact on data compilation between and within health system levels (central, district, and above level). Most medical records used in Indonesian hospitals are paper-based, and the use of information technology for electronic medical records is inadequate. [31]

Indonesian MoH has established SIKNAS and SIKDA since 2002. However, as an impact of decentralization, every hospital both in district and province can choose their own format system to develop their own SIKDA, producing in several formats, database and software even within the same district/municipality. Some hospitals have limited computer facilities, and data processing is still manually. Additionally, private hospitals have a slow reaction and often do not even submit their report. As a result, data become challenging to be recapitulated, overlapping, and unavailable.[31]

In 2018, total number of hospital across Indonesia was 2818. However, the average percentage of hospital report submission to the MoH through online reporting system that is called online hospital information system or System Informasi Rumah Sakit (SIRS) online website was only 36.87 percent, and the most hospital that did not submit their report to the MoH was private hospitals. The highest percentage of hospital report submission was Aceh (73.24%), and the lowest was Papua Barat (5.78%).[51] Also, from the total hospital, only 50 % implement electronic HIMS, 45 % of hospitals did not run electronic HIMS yet, and 5% of hospitals operated electronic HIMS but were not working properly, those were still utilizing manual medical record and manual data processing.[37]

In addition, those hospital that are implementing eHIMS are not well integrated within systems in the hospital itself, or from one hospital to another, and from low health system level to higher, and vice versa. Although HIMS in the hospitals in Indonesia is still far away from ideal and facing some challenges on management,

human resource and infrastructure that are inadequate and costly, research regarding this issue is rarely conducted.

2.3 Objective

2.3.1 General Objective

To critically analyze the transition to electronic HIMS in Indonesian hospitals including its form and function in improving quality health service, hospital management, and health reporting in order to provide recommendations for HIMS development intervention strategies in Indonesia.

2.3.2 Specific Objective

1. To explore key factors influencing eHIMS transition in hospitals in Indonesia
2. To perform descriptive analysis of HIMS data from one hospital in South Sulawesi to better understand the quality issues in a manual HIMS setting.
3. To analyze the short-term and long-term outcomes of eHIMS implementation on the health service delivery and reporting function in Indonesia
4. To provide recommendations for hospitals in Indonesia to improve eHIMS implementation.

2.4 Methodology

This study is a qualitative explorative, using literature review and desk study that was triangulated by a semi-structured interview and secondary data (HIMS data / reports from one purposively selected hospital.

2.4.1 Literature Review

Literature that were used in this study are publish articles include national and international peer review, grey literatures, and policy documents which obtained by using google, goggle scholar, PubMed, and Vrije Universiteit (VU) library database. Website of World Health Organization (WHO), and Indonesian MoH also used to acquire reports, policy guidelines in improving this thesis. The keywords were used in single words or combination. (Table 1)

Relevant free full-text literature studies in English and Bahasa that were conducted in Indonesia, and published from 2009 to 2019 were include in the literature review. However, some policies such as decrees, regulations and guidelines related to implementation of eHIMS were selected from 2000 to 2019. The time setting was selected due to limited number of studies on this topic in Indonesia. This time setting provided a broad scope of relevant articles to answer research objectives. Most data presented in the background and justification are based on report of WHO and Indonesian MoH. Those reports provide recent and reliable information related to eHIMS implementation in Indonesia.

All articles were reviewed by scanning the tittle and contents, then exclude articles that were not relevant to this study. Relevant articles were analyze and included in the reference. Articles of study regarding eHIMS implementation in hospitals were in include, while those were conducted in clinics, primary health center, and health office were exclude. Unpublished study, published earlier than 2009, incomplete articles, and study regarding architecture design of eHIMS were also exclude in this study.

Total articles found in the searching process were 99,169, then narrowed down by the inclusion and exclusion to only 34 relevant studies.

Literature	Database search	Keywords (Boolean "OR" or single term)
Publish articles in Journals (Peer Review)	Google, Google scholar, PubMed/Medline, and VU Library.	Hospital information system, health information management system, health information system, electronic medical record, electronic health record, sistem informasi manajemen rumah sakit, rekam medis elektronik.
Local and International Statistics and program reports, policies, guidelines, and grey literatures.	WHO, Indonesian MoH	Permenkes sistem informasi rumah sakit, Health information management system.

Table 1. Search Term

2.4.2 Semi-structure Interview

A semi-structured interview conducted to six expert staffs of health information management in the hospital across Indonesia as key players in the eHIMS implementation in order to avoid bias, and to have better understanding of eHIMS implementation. Respondents are selected by using purposive sampling. Those staffs were from 3 government hospitals and 3 private hospitals that have been implementing eHIMS since 2007 and EMR since 2010. This interview developed a topic guide as a tool for interview, (Annex 2) and the duration was one hour each session conducted via skype that were recorded. The interviews were audio-recorded, transcribed in the local language (Bahasa Indonesia), translated into English, and coded and ordered based on the research themes before analyzing it. These six respondents were notified a week before the interview if they agree to participate, confirmed by informed consent. (Annex 3)

2.4.3 Data Quality Analysis

This study conducted secondary data analysis from one purposively selected hospital that was also one of the hospitals interviewed in this study. It aimed to measure the quality of data that has submitted to the MoH and DHO.

Data quality analysis in this study adopted from Data Quality Review (DQR) of WHO combined with data quality dimension by The Organization for Economic Co-operation and Development (OECD) as follows: [52,32]

a. Accuracy, the degree to which the data correctly estimate or describe the quantities or characteristics. [53]
b. Timeliness, the number of submitted reports from hospital to the MoH and DHO by the reporting required deadline.
c. Completeness to measure whether all data report completely. It is defined as the number of report received divided by the total number of report expected for a specific time period. The rate of completeness of 100% indicated all report submitted. [52]
d. Coherence, the data logically connected and consistency. This was done by compare data in the hospital and reported data to DHO and MoH, and to examine the trends of the report over time whether specific data value in a particular period are extremely high or low to other data value or it can be defined as an outlier.[52]
e. Relevance, measuring the relevancy of the data to the needs of the hospital and manager in the higher level
f. Accessibility, data is ready and accessible by the hospital manager and MoH
g. Interpretability, the data is understandable, usable, easy to analyze.

This analysis used Microsoft excel based-tools to analyze data from 2016 to 2018 and performed by evaluating the percentage of SIRS report submission, identify the outlier trends of Non-Communicable Diseases (NCDs), and compare reports in the same period as follows:

a. Profile hospital report compared to SIRS report
b. In-patient morbidity report compared to SIRS report
c. In-patient morbidity report compared to surveillance report

2.5 Theoretical Framework

To further understanding of implementation eHIMS in Indonesia includes the influencing factors and its impacts, the PRISM (Performance of Routine Information System Management) framework utilized as a guide tool to organize systematically the analysis, findings, connections, and interrelation factors in the discussion chapter, as well as to assist in develop conclusions and recommendations. This conceptual framework was chosen, because it systematically designed the structure of eHIMS from the beginning data process until the outcome.

This framework consist of five main components; input, processes, outputs, outcomes, and impact. The improvement of health system performance and health status are quantified by the data quality and information that are produced by a good eHIMS as well as supported by essential determinants (technical, organizational, and behavioral factors).

This framework also includes 4 tools to look at those three key determinants. Those are diagnostic tool to identify the HIMS performance, processes, and strengths and weaknesses of HIMS determinants. Others tools are HIMS overview and facility /office checklist, Organizational and Behavioral Assessment (OBAT), and Management Assessment Tool (MAT) (figure 1). [6]
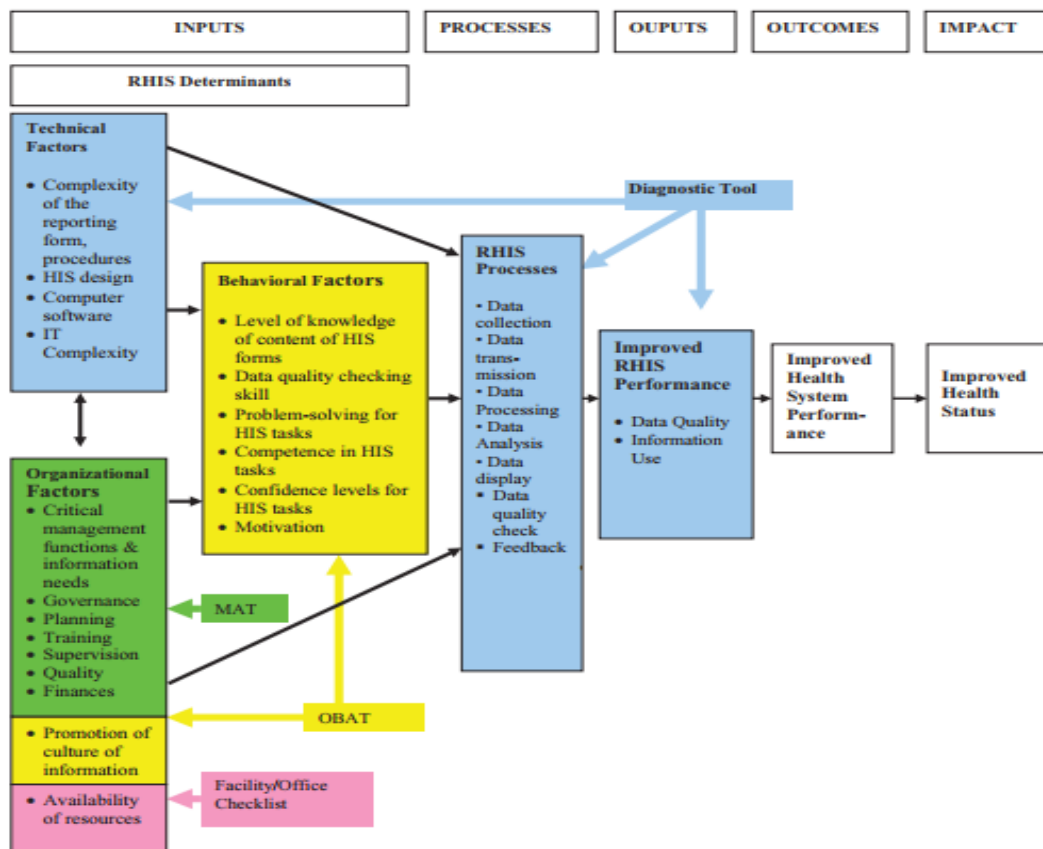

Figure 1. PRISM (Performance of Routine Information System Management).[6]

OBAT   : Organizational and Behavioral Assessment   MAT   : Management Assessment Tool
RHIS   : Routine Health Information System   IT   : Information System

2.6 Ethical Consideration

        The interviews established after respondents agree to participate, verified by the informed consent (annex 3). Those were in the local language (Bahasa Indonesia). Data of respondents were confidential with anonymous as respect the respondents' privacy, they also can withdraw information at any time, and it will be destroyed after this study.

        Regarding the use of HIMS data from a hospital, a letter of approval was submitted to the hospital to allow the use of the data in this study.

2.7 Quality Assurance

        Several approaches used to assure the quality of the study process, such as collect data from the literature, interview, and analysis data reporting. Informed consent, interview guide, and transcription used local language and were translated back to English. Before the study commences, all equipment and instruments were tested their quality function, and data collections were reviewed soon after the interview and discussion to prevent missing information.

Chapter 3: Findings

        Total articles found in the searching process were 99,169. However, it was only 31 articles and 3 policy documents that were relevant to the objectives of this study. These articles selected from 2009 to 2019, and include study regarding eHIMS implementation at the hospital in Indonesia. Other articles that published before 2009, incomplete, and related to eHIMS architecture design were excluded.

        27 of articles are national journals, and 4 of them are international journals. Also, it includes 30 peer reviews, and 1 non-peer reviews. Methodology in those articles were 16 qualitative studies, 8 quantitative studies, 6 case studies, and 1 grounded theory. Data collection used were 1 literature review, 21 interviews, 11 questioners, 13 observations, and 1 desk study. (Table 2)

Type Of Journal	National	(54) (55) (56) (57) (58) (59) (60) (61) (62) (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (76) (77) (78) (79) (80)
	International	(10) (81) (82) (83)
Type of Articles	Peer Review	(10) (54) (55) (56) (57) (58) (59) (60) (61) (62) (63) (64) (65) (66) (67) (68) (69) (70) (72) (73) (74) (75) (76) (77) (78) (79) (80) (81) (82) (83)
	Non-Peer Review	(71)
	Policy Documents	(22) (28) (29)
Type of Study	Qualitative	(54) (56) (62) (63) (64) (65) (68) (71) (72) (73) (74) (75) (80) (76) (81) (82)
	Quantitative	(57) (58) (59) (60) (61) (67) (70) (78)
	Case Study	(10) (55) (66) (69) (79) (83)
	Grounded Theory	(77)
Data Collection	Literature Review	(81)
	Interview	(54) (55) (57) (60) (61) (62) (63) (64) (65) (66) (67) (69) (76) (78) (79) (71) (75) (80) (81) (82) (10)
	Questioner	(56) (58) (59) (66) (67) (69) (70) (75) (78) (79) (81)
	Observation	(54) (57) (62) (63) (68) (69) (72) (73) (74) (75) (76) (77) (79)
	Desk study	(83)

Table 2. List of Literatures

3.1 eHIMS Determinants
3.1.1 Technical factors

Technical factors of eHIMS implementation are including the complexity of eHIMS reporting forms and procedures, eHIMS design, and computer software and IT complexity. [6]All technical factors found in the literature of this study can be seen in the table 3.

Technical Factors Implementation	References
Complexity of the reporting forms and procedures	(71) (73) (77) (81)
eHIMS design	(64) (66) (67) (71) (72) (73) (74) (75) (77) (79) (81)
Computer software	(10) (54) (56) (58) (61) (62) (63) (64) (65) (66) (67) (71) (72) (73) (76) (77) (79) (81)
IT complexity	(55) (56) (74) (77) (83)

Table 3. Technical factors of eHIMS implementation by articles

All eHIMS described in the literature found that eHIMS implementation in Indonesian hospitals was not optimal due to imperfect and complexity of the eHIMS form.[64,66-67,71-75,77,79,81] Also, unsuitable eHIMS form to hospitals' and SIRS' report forms.[71,73,77] Hospitals still used paper-based medical record, and implemented the eHIMS incomprehensively based on its components such as information system of out-patient, in-patient, and emergency unit, laboratory, radiology, billing, and reporting system in the medical record unit.[10,54,56,61,58] eHIMS also was unconnected to other institutions.[10,58,61,71,74,77,79-81] Although hospitals were able to integrate their eHIMS to other institutions, the integration was only to BPJS and MoH to submit SIRS report.[58,72]

A study from Semarang showed that 21 of 23 hospitals implemented eHIMS. However, most of them applied eHIMS components only for patient registration, billing, and reporting. (Figure 2) Additionally, it is only 26% of them provided exchange information with other institutions. Those data exchanges were mostly data of demographic patient related to reimbursement claim and reporting (47%). Also, only 35% of hospitals implemented integration eHIMS to all units within the hospital. It means that those hospital applied various applications in the hospital, or utilized stand-alone application to support the health care services.[56]
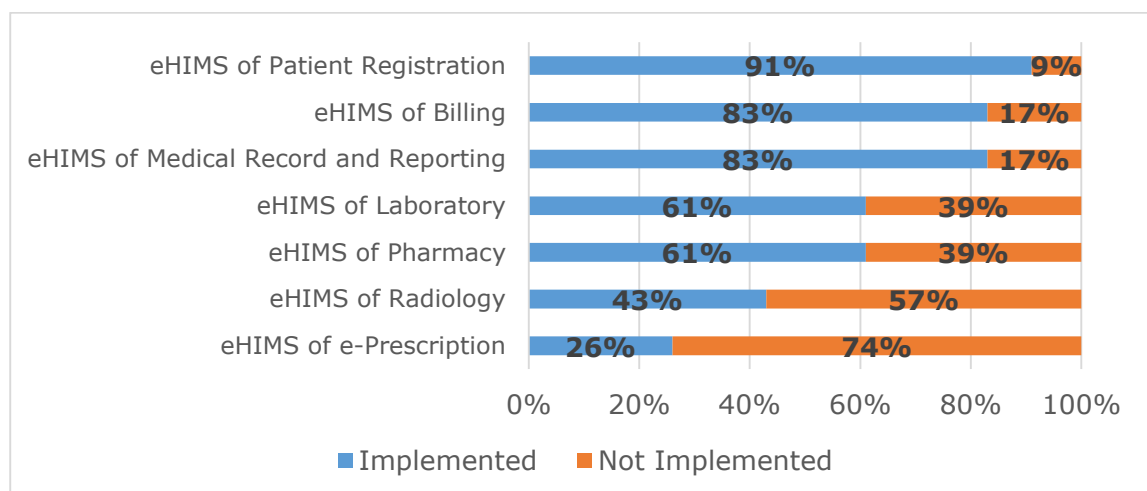

Figure 2. eHIMS implementation at the hospitals in Semarang [56]

Similarly, a study in Jogyakarta also revealed that 48 of 57 hospitals implemented eHIMS that most for administration purposes. (Figure 3)[58] Moreover, a study of 7 hospitals across Indonesia in 2017 showed that only 10 % of doctors in 2 of hospitals used

electronic prescription in the emergency unit to accelerate medicine administration. It was due to there was no legal policy regarding electronic prescription.[10]
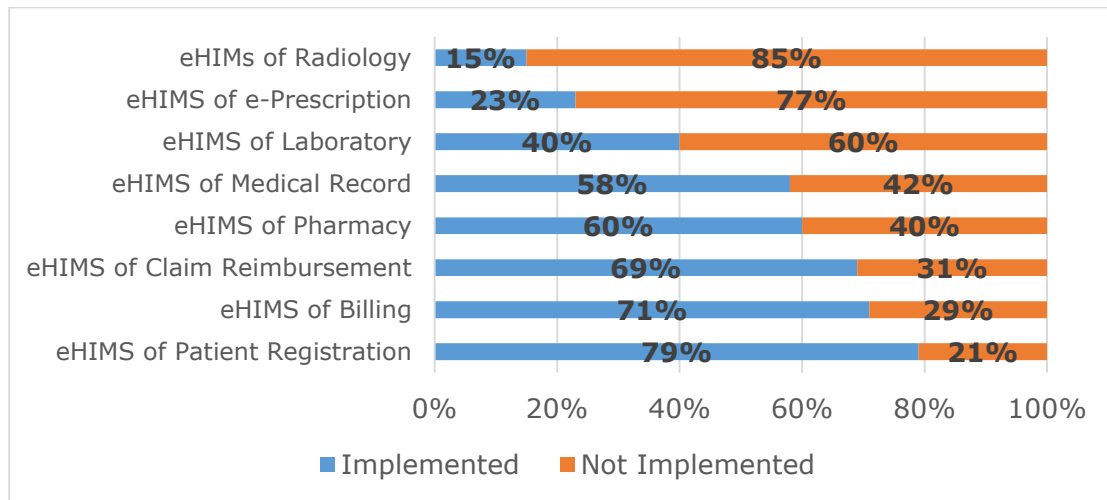
Figure 3. eHIMS implementation at the hospitals in Jogyakara [58]

Interview to six HIM staffs in this study found that two of hospitals implemented eHIMS includes EMR and e-Prescription. In these hospitals, eHIMSs integrated to BPJS and MoH. However, EMR was not comprehensively implemented. The interview as follow:

> *"We have applied EMR. However, the implementation is not totally electronic because we still use paper-based medical records. EMR is only applied in the out-patient and in-patient unit. The outcome of the EMR also still need to be printed out and put it together with the paper-based medical record."*

Interview in this study also showed that one of hospitals implemented all component of eHIMS, and those eHIMSs integrated each other, but not to BPJS and MoH. Contrarily, one of the hospitals implemented eHIMS only in registration, out-patient department, billing, laboratory, and radiology. However, eHIMS of billing unintegrated to others eHIMSs, while eHIMS of registration integrated to eHIMS of out-patient, laboratory, and radiology, but unintegrated to BPJS and MoH.

In addition, two other hospitals implemented eHIMS only in the registration and billing, and these eHIMSs unconnected to BPJS and MoH. (Table 4) an interview to one of them as follow:

> *"We used to implement eHIMS, but since we discontinue our contract to the third party that designed the eHIMS, the system stopped working, except in the registration unit of BPJS patients and billing."*

Name of Hospital	Type of implementation								
	Implemented all component include e-prescription and EMR	Implemented all component except e-prescription and EMR	Implemented only several component with paper-based medical record	Implemented only in registration and billing	Integrated to all eHIMSs in the hospital	Integrated only in few units	Unintegrated to all eHIMSs in the hospital	Integrated to MoH and BPJS	Unintegrated to BPJS and MoH
WS	√				√			√	
AB	√				√			√	
PK		√			√				√
GW			√			√			√
TK				√			√		√
KH				√			√		√

√ = applicable

Table 4. Interview results on implementation and Integration of eHIMS

Hospitals described in the literature also found that although hospitals implemented eHIMS, it cannot support the SIRS report due to unintegrated process, poor migration of basic data, unavailability of a data center, different report form and media saving, and insufficient technology to convert specific data globally.[77] Hence, data processed manually such as converted it to excel.[54,61-67,71-73,76,77,79]

A study in Jogyakarta showed that from 82% of hospitals that implemented eHIMS, only 56% of them applied diagnosis codification standard as an essential system for electronic data exchange comprehensively, completely, and consistency. Other hospitals applied different codification standard.[58]

Furthermore, some hospitals provided inadequate infrastructure such as hardware, server and client as terminal computer to support robust eHIMS.[55-56,74,77,83] Although the hospitals had sufficient computer, the eHIMS implementation was not optimal due to an incomplete application,[64,66,71-75,77,81] and instability of network and electricity.[56,66,70,73,77,79,83] These findings supported by an interview which stated that computers are available in all unit of the hospital, but they are not facilitated by the eHIMS.

> *"Computers spread to all units include in-patient units, but without eHIMS. Those computers use for typing only."*

A survey in 23 hospitals in Semarang found that computers were available in each installation in all hospitals, and most were in the patient registration station. However, only 74% of hospitals had a server, and 43% of hospitals facilitated by broadband internet connection. Also, only 22% of hospitals had a video conference for communication within medical practitioners, hospitals, MoH, other organizations.[56] Furthermore, only 17% of eHIMSs can be accessed from outside the hospital. The accessibility of information by the staffs in the hospital limited for specific users as a data protection form. It counted 61% hospitals applied data security such as user name / ID user and password for accessibility, and only a few hospitals used modern identification technology such as chip, biometrics, and digital signature. In force major situation, 35% of hospitals were able to recover their data with good data backup.[56]

Interviews in this study found that only 2 of hospitals have a good eHIMS design which is supported by adequate facilities and technology. (Table 5) One of the interviews as follows:

> *"The eHIMS features in our hospitals are perfect, understandable, and suitable to SIRS report form. All facilities are also available include video conference for clinical consultation between doctors in hospitals, other hospitals both national and international hospitals. Unfortunately, our eHIMS cannot provide multimedia clinical results."*

Name of Hospital	eHIMS Design			Technical Facilities					Technology				
	Perfect form	Understandable form	Form is suitable to SIRS Report form	Sever is Available	Excellent internet connection	Data center is available	Sufficient Computer	Good electricity	Video conference	Good data migration	Good data back up	Data security	Type of data security
WS	√	√	√	√	√	√	√	√	√	√	√	√	ID User and Password
AB	√	√	√	√	√	√	√	√	√	√	√	√	ID User and Password
PK	x	√	x	√	√	x	√	√	x	x	√	√	ID User and Password
GW	x	√	x	√	√	x	√	√	x	x	√	√	ID User and Password
TK	x	√	x	x	x	x	x	√	x	x	√	√	ID User and Password
KH	x	√	x	x	x	x	x	√	x	x	√	√	ID User and Password

√ = Yes, X = No

Table 5. Interview result on eHIMS design, facilities and technology.

3.1.2 Organization factor

Organizational factors of eHIMS are all management activities of eHIMS includes critical management function and information needs, governance, planning, training, supervision, quality assurance, finance, promotion of information culture, and availability of resources.[6] All technical factors found in the literature of this study can be seen in the table 6.

Organizational factors	References
Critical management function	(10)(54)(55)(71)(72)(76)(81)(82)(83)
Governance	(10)(28)(29)(54)(77)(82)
Planning	(10)(68)(73)(77)
Training	(54)(71)(80)(82)
Financing	(65)(74)(77)(82)
Supervision, quality assurance and organization structure	(54)(56)(58)(59)(64)(65)(66) (71)(72)(76)(77)(79)(80)(83)
Availability of resources	(56)(83)

Table 6. Technical factors of eHIMS implementation

Literature in this study described that the eHIMS implementation in Indonesian hospitals influenced by management and ownership decision, whether it was a private or a government hospital.[77,82] Government hospital managed by MoH, Ministry of Education, Indonesian National Armed Force or Tentara National Indonesia (TNI), Indonesian National Police or Polisi Republik Indonesia (POLRI), province and district government. The private hospital managed by a foundation or a company.[37]

In government hospitals, all legitimacy form include funding and transparency of financial record can be with long bureaucracy process.[82] So that, hospitals tend to modify their eHIMS with minimum expense.[77] Contrary, private hospitals manage their financial source more independently and flexibly. They are preferable for the principle of efficiency and effectiveness using eHIMS to optimum the quality of health service.[82]

Hospitals described in the literature found that unintegrated eHIMS in hospitals is influenced by financial constraint.[65,74] Therefore, eHIMS implementation started from particular components and continuously developed comprehensively based on hospital finance.[74]

Interview to 3 government hospitals and 3 private hospitals in this study also found that budgeting of the eHIMS in these hospitals depends on the hospital ownership budget procedure. (Table 7) 2 of government hospitals managed by district government have similar statement as follow;

> *"This hospital maintain eHIMS step by step, started for administration such as registration and billing and will be expanded to other units depends on the district government budget that takes time"*

On the other hand, two of private hospitals stated that although they developed eHIMS progressively, the budget management is quite flexible. Additionally, one of private hospital claimed that eHIMS and EMR implementation in the hospitals directly managed by the company. The interview as follows;

> *"eHIMS in this hospital has been implementing since this hospital established in 2010. It managed by our company, and it was adopted similarly to other branch hospitals, which is under the same ownership and management across Indonesia."*

Name of hospital	Type of Hospital	Ownership	Status Accreditation
WS	Government / teaching hospital	MoH	Accredited
AB	Private hospital	Company	Accredited
PK	Private hospital	Foundation	Partially Accredited
GW	Government hospital	District Government	Partially Accredited
TK	Government hospital	District Government	Partially Accredited
KH	Private hospital	Foundation	Non-Accredited

Table 7. Hospital management and ownership

Before 2017, the Indonesian government through the MoH policy stated that all hospitals both government and private hospitals had to implement eHIMS. However, there was no punishment for hospitals in their absence to fulfill the regulation.[77,82] Nevertheless, there was no requirement for a standard and uniform application. So that, every hospital designed their own eHIMS with very effectively and efficiency cost.[82,65] Hospitals often purchased or rented eHIMS from a vendor[77] without involving users in designing, [73 and without a similar vision of eHIMS design between the vendor and hospital as well as unclear eHIMS plan and mapping.[68] Hence, the output of the system was not relevant to the hospital needs.[73,75]

Furthermore, hospitals had inadequate eHIMS regulation, poor management, and insufficient policy regarding the IT planning related to health (e.g. cost standard and clinical pathway procedure).[10] The eHIMS was often implemented without sufficient time transition, socialization, training, and reward and sanction to health workers in eHIMS implementation.[54,71,80,82]

In Addition, Standard Operation Procedure (SOP) and IT policy were unavailable. [10,54-55,71,81,83] If they were available, the implementation was improper, and without clear job description.[72,76] Moreover, eHIMS organization structure such as eHIMS team and IT unit, controlling, evaluation and monitoring, supervision, and IT management were only available in few hospitals.[54,56,58-59,64-66,71-72,76-77,79-80,83]

A study in Jogyakarta showed that IT unit plays a crucial role in the eHIMS implementation. The study found that statistically, hospitals that have IT unit was 4.93 more likely to optimize the eHIMS usage for administration compared to hospitals without an IT unit. Also, hospital with IT unit was 7.38 more likely to use the eHIMS for clinical purpose than hospital without an IT unit. (1) However, IT governance-related policy from the MoH was inadequate. Thus, the IT unit position and its requirement in every hospital were still various.[10]

In Semarang, a survey to 23 hospitals showed that 90% of hospitals had an IT unit to organize the eHIMS with average 7 IT staffs in a team (maximum 19 staffs and minimum 2 IT staffs from different educational backgrounds).[56]

A study at a hospital in Sleman also found that controlling and procedure of eHIMS in the hospital performed by the head of IT unit. The head of IT unit controlled the system daily. He performed Root Cause Analysis (RCA) of problems and reported it to the director. He also received reports regarding eHIMS issues from all units and conducted weakly / monthly meeting to discuss those problems. Director and head of the IT unit reviewed reports gradually or incidentally. Also, they evaluated the quality service every three months. However, eHIMS in this hospital was still poor due to technical and behavioral factors. [79]

In 2017, Indonesian government through KARS finally established a policy which emphasized eHIMS as a requirement of a hospital accreditation status,[28] followed by the MoH policy in 2018 which mandated this status as a requirement for sustainability contract between hospital and BPJS.[29] These two policies challenged Indonesian hospitals to develop their eHIMS to be more organized.

Interview in this study found that all hospitals followed the MoH regulations regarding eHIMS implementation. They also had SOP and clear job description, engaged users in the eHIMS designed, and trained them to apply the eHIMS. However, one of hospitals had no IT unit/team, and 2 of the hospitals did not perform controlling, monitoring, evaluation, and feedback regarding eHIMS and data reporting. (Table 8)

This interview also found that two of hospitals (GW and TK) received partially-accredited status due to incomprehensive eHIMS, and one of them was not accredited yet. (Table 7) Interview to KH as a hospital that will be evaluated by KARS on August 2019 as follows:

> *"We are planning to be evaluated for accreditation by KARS in August, and eHIMS implementation is one of the requirement to be accredited. So that, we are developing our eHIMS comprehensively, installing, and simulating to all users. It will launch in August 2019."*

Name of hospital	Organizational factors					
	Following the MoH policy	SOP & Job description are available & implemented	IT unit/team is available	Training is available	eHIMS Planning engaged the user	Controlling, monitoring, evaluation, and feedback are available
WS	√	√	√	√	√	√
AB	√	√	√	√	√	√
PK	√	√	√	√	√	√
GW	√	√	√	√	√	x
TK	√	√	x	√	√	x
KH	√	√	√	√	√	√

√ = Yes
X = No

Table 8. Interview results regarding organizational factors.

3.1.3 Behavioral Factors

Behavioral factors are all eHIMS implementation factors related to health workers as users of the eHIMS in the hospital, such as nurses, doctors, and HIM staffs. Those include the level of knowledge of eHIMS form, Data quality check-in skill, problem-solving for eHIMS task, competence in HIS task, the confidence level for eHIMS tasks, and motivation.[6] All behavioral factors found in the literature of this study can be seen in the table 9.

Behavioral Factors of Users	References
Level of knowledge of all users in the hospital regarding eHIMS form	(60)(71)
Data quality skill of HIM staffs	(10)(54)(58)(61)(65)(68)(69) (72)(73) (74)(76)(80)(81)(83)
eHIMS problem solving for eHIMS task by HIM staffs	(83)
Competence of HIM and IT staffs in eHIMS task	(10)(54)(56)(58)(72)
Confidence level of user for eHIMS task	(10)(54)(58)(60)(61)(65)(66)(68) (69)(72)(73)(74)(76)(77)(81)
Motivation	(2) (3) (4) (5) (6) (7) (8) (9) (10) (7) (3) (9) (7)

Table 9. Behavioral factors found in the literature

Hospitals described in the literature found that Indonesian hospitals are lack of IT and HIM graduate,[10,54,56] and insufficient number, skilled, and trained health workers in data processing and IT.[10,54,58,61,65,68-69,72-74,81,83,76,80]Also, the head of HIM unit was often from another graduate that had high grade to be assigned as a manager in the division.[54]

A study at a hospital in Brebes found that 31 of 33 health workers in all units of the hospital did not know about SIRS reports. All of them never receive training and simulation of eHIMS implementation. It was only 12% of them perform data entry every day, and most data entry in every unit performed by nurses. Also, only two staffs with HIM graduate assigned in data reporting. So that, 72% of them expected the hospital assigned a certain staff for data entry in every unit.[71] A study in Tegal also found the same expectation among 33 of 99 health workers. They claimed nurses or doctors could not treat patients while input data to the system.[57]

Interview in this study found that all hospitals had a sufficient number of staff, and all of them understood the content of eHIMS form. The number of staffs with HIM and IT graduate in all hospitals were various. In 3 of hospitals, HIM graduate at the HIM unit was less than 50%, and one of the hospitals had a lack of trained and IT skilled staffs. (Table 10) an interview of this hospital as follows;

> *"Most of our staff in the HIM unit are not HIM graduate and untrained staffs that working base on the instruction of the head of HIM unit. We also do not have IT staffs. So that, eHIMS problems are handled by a staff who has experience in IT."*

A study in Jogyakarta found that the availability of IT graduates associated with the eHIMS implementation. The likelihood of eHIMS implementation by IT graduates in the hospital was 10.22 higher than hospital without IT graduates (OR=10.22, α=0.05, P=0.0001).[58]

A survey to 23 hospitals in Semarang showed that 90% of hospitals had an IT unit that engaged 19% staffs from HIM graduate, and 62% staffs from computer science graduate.[56] These staffs were responsible for maintaining eHIMS.[72] However, eHIMS in hospitals often had a complicated application, inadequate infrastructure, and technical problems such as an error that was leading to less benefit of the eHIMS and user satisfaction, acceptance, and resistance of eHIMS implementation.[10,56]

Data analysis using the Structure Equation Modelling (SEM) in a study that aimed to develop model of an eHIMS user acceptance which emphasized on technical and organization factors in hospitals across Indonesia found that human, technology, and organization significantly influenced the opinion of users regarding the ease of eHIMS use and eHIMS benefit (p<0.05).[10]

Several studies in Indonesia also found that eHIMS implementation influenced by user satisfaction and benefit of the eHIMS. In this regard, health workers tend to implement eHIMS if they were satisfied by the eHIMS benefits such as increased their work performance, and it was comfortable, flexible, understandable, and uncomplicated. [10,66,67,69-70,75,78,82]

Lack of awareness and manual culture of the health workers were other issues of eHIMS implementation. Health workers tend to be less aware of entering data accurately and completely into the eHIMS.[10,54,58,61,65,68-69,72-74,76,81] They even often postponed to accomplish their report, and took the previous report to be submitted as the latest report. [54] These findings supported by an interview to one of hospitals as follows;

> *"The reporting staffs often come late and gossiping rather than finishing their report. They also often to input data inaccurately and incompletely. They do not care about their task."*

In addition, health workers were not able to operate the eHIMS, and they were not adaptable with the electronic system due to manual data processing culture.[66,68,74,77,81] Also, they had a high dependency to a vendor for IT problem solving,[83] and resisted to apply the eHIMS due to improper socialization and training.[64,82]

Regarding EMR completion, doctors were difficult to allocate their time to enter data into the EMR leading to incomplete information.[10,69,82] In 2016, a case study in Indonesian hospitals found that workload and adaptation to a new technology resulting resistance to fill out the system, particularly to those were lack IT skill such as doctors.[10] They often delegated their colleague to input or change data into the system and shared their password for accessibility.[10] They sometimes need to be forced by their senior to apply the system.[82] Additionally, they were more interested in adopting eHIMS if they perceived that their colleagues already used eHIMS. They will be less competitive and old-fashioned if they unfollow the current trend.[82]

Findings above supported by interviews in two hospitals with EMR in this study. Interviews found that EMR implementation in those hospitals was improperly, and paper-based MR is still applied due to a manual culture of doctors in applying the system. (Table 10)

> *"Our data processing is almost totally electronic, and we have sufficient budget to implement eHIMS comprehensively include EMR. However, some doctors resist to use EMR because they prefer to write than type data into the EMR, and argue that paper-based is faster than electronic. That is why we still use both manual MR and EMR."*

A study to analyze the association between the role and knowledge of doctors and completeness of EMR by using spearman test in Tangeran showed that there was strong association between the role of doctors and the completeness of EMR (p value = 0.000 < 0.05, r=0.484), and IT knowledge of doctors had significant association with completeness of EMR (p value = 0.000<0.05, r=0.676).[60]

The completeness of medical record was not only a problem in the EMR, but also in the manual medical record setting. Interview to 3 hospitals with the manual medical record in this study claimed low awareness of doctors leading to incomplete medical records, which demotivated reporting staffs to process data. (Table 10) An interview from one of them as follows;

> *"According to the SOP, doctors have to complete a medical record at least two days after patient discharge. In reality, they complete it in a month and more. Hence, we cannot process the report timely, especially without good eHIMS. Our reporting staffs tend to overwhelm and demotivate because of this issue."*

Name of Hospital	Behavioral Factors								
	IT competence in IT unit/HIM unit	HIM competence in the HIM unit	Knowledge able with the eHIMS form	Skilled staff in data quality & IT problem solving	Sufficient number of staff	Trained staff	Low awareness	Manual culture (for EMR only)	High motivation of user
WS	20 staffs	60 of 85 staffs	√	√	√	√	x	√	√
AB	4 staffs	9 of 11 staffs	√	√	√	√	x	√	√
PK	1 staff	5 of 13 staffs	√	√	√	√	x	NA	√
GW	2 staffs	8 of 53 staffs	√	√	√	√	√	NA	x
TK	0	8 of 32 staffs	√	x	√	x	√	NA	x
KH	4 Staffs	11 of 13 staffs	√	√	√	√	√	NA	x

√ = Yes
X = No

Table 10. Interview results regarding behavioral factors

3.2 Data Processing

Data processing is all activities in producing information, such as data collection, transmission, processing, analysis, display, quality check, and feedback.[6] Data processing found in the literature showed in the table 11.

Data Processing	Reference
Collection	(54)(61)(62)(63)(64)(65)(66) (67)(71)(72)(73)(76)(77)(79)
Transmission	(63)
Processing	(54)(61)(62)(63)(64)(65)(66) (67)(71)(72)(73)(76)(77)(79)
Analyzing	(54)(61)(62)(63)(64)(65)(66) (67)(71)(72)(73)(76)(77)(79)
Displaying	(54)(61)(62)(63)(64)(65)(66) (67)(71)(72)(73)(76)(77)(79)
Quality check	(64)
Feedback	(64)

Table 11.Data processing found in the literature

Data processing in Indonesian hospitals were both manually and electronically. Hospitals described in the literature found that in some hospitals, data in the eHIMS need to be converted to Microsoft Excel.[54,61-67,71-73,76-77,79]In other hospitals, eHIMS cannot display reports and accurate information. Hence the hospitals collected data manually from register books of related units every day, monthly, and annually. These data were recapitulated in Microsoft excel and modified according to hospital report form include surveillance and SIRS report. All reports are saved in a folder before printed it out or imported them to the SIRS report system of MoH, http://sirs.yankes.kemkes.go.id/sirs/login.php[63,84] without quality check, and feedback from the manager regarding the report quality.[64] List of SIRS report and its sources can be seen in table 12.[4]

Report Code	Name of Report	Source	Type of Report Period
RL 1.1	Hospital primary data	Hospital establishment certificates, Register book of workforce and Census of in-patient	Annual
RL 1.2	Hospital service indicator	Census of in-patient	Annual
RL 1.3	Number of hospital bed	Census of in-patient	Annual
RL 2	Data of workforce	Register book of workforce	Annual
RL 3.1	In-patient service	Register book of in-patient	Annual
RL 3.2	Emergency unit service	Register book of emergency service	Annual
RL 3.3	Dental and oral health service	Register book of dental and oral health	Annual
RL 3.4	Obstetrics and gynecology service	Register book of obstetrics and gynecology	Annual
RL 3.5	Perinatology service	Register book of perinatology	Annual
RL 3.6	Surgery service	Register book of surgery	Annual
RL 3.7	Radiology service	Register book of radiology	Annual
RL 3.8	Laboratory service	Register book of laboratory	Annual
RL 3.9	Medical rehabilitation service	Register book of medical rehabilitation service	Annual
RL 3.10	Special service	Register book of laboratory, in-patient, out-patient, and other related units	Annual

RL 3.11	Psychology service	Register book of psychology	Annual
RL 3.12	Family planning service	Register book of psychology	Annual
RL 3.13	Drug procurement and prescription	Register book of drug procurement and prescription	Annual
RL 3.14	Referral	Register book of patient referral	Annual
RL 3.15	Payment method	Register book of payment	Annual
RL 4a	Morbidity data of in-patient and cause of injury	In-patient morbidity report	Annual
RL 4b	Morbidity data of out-patient and cause of injury	Out-patient morbidity report	Annual
RL 5.1	Out-patient attendance	Out-patient registration book	Monthly
RL 5.2	Out-patient case	Out-patient registration book	Monthly
RL 5.3	10 top rank of disease at in-patient unit	Morbidity data recapitulation of in-patient	Monthly
RL 5.4	10 to rank of disease at out-patient unit	Morbidity data recapitulation of out-patient	Monthly

Table 12. List of SIRS reports

Interview in this study also found that data processing in 6 hospitals are electronic and manually. 2 of hospitals almost totally processed data automatically with good management such as validation and feedback. (Table 13) The interview as follows;

> "Our data processing is still semi-electronic because all data automatically processed by eHIMS, but we still put code of diseases and procedures manually in the manual MR and input them to the eHIMS. However, once data entered to the eHIMS, it is automatically processed by the system to become reports as we need."

On the other hand, one of hospital processed data automatically, but data need to be converted to excel files to be modified related to hospital and SIRS form. 3 other hospitals totally perform manual data processing with similar data collection method as mentioned in the literature above. The interview as follows;

> "The eHIMS cannot provide reports, and the medical records cannot be a main source of reports because they are incomplete, and submitted late to HIM unit. Hence, we collect data from all units every day or every month, compile, and process them manually in Microsoft excel to become reports."

Name of Hospital	Data collecting, processing, analyzing, and displaying			Quality Check/ validation	Feedback
	Electronic, except MR, and without modification with excel	Electronic, except MR, and with modification with excel	Manual		
WS	√			√	√
AB	√			√	√
PK		√		√	√
GW			√	X	X
TK			√	X	X
KH			√	√	√

√ = Yes X = No

Table 13. Interview results regarding data processing.

3.3 Output, Outcome, and Impact.

eHIMS provides quality of data and information to improve the health service quality and health system performance in order to achieve the improvement of health community status.[6] Output, outcome and impact of eHIMS found in the literature showed in the table 14.

	Aspects	Literatures
Output	Quality of data and information use	(56)(64)(66)(69)
Outcome	Improve quality of service	(10(57)(66)(72)(64)(65)(64)(69)
	Improve hospital management and decision making	(56)(66)(69)(72)
	Improve health system performance	(56)
Impact	Improve health status	(69)

Table 14. Output, outcome, and impact of eHIMS

eHIMS described in the literature found that good eHIMS increased the quality of health service, hospital management, and health information for decision making.[57] In billing, eHIMS was essential for accuracy and transparency of hospital cost.[56] In the registration unit, the eHIMS accelerated patient registration process. It could print out the ID card and identity label of patients, reduced workload of staff, and validated entry data. It provided data easily, more complete, and faster.[64-66,72] eHIMS controlled prescription, examination results, and disease coding.[66] Also, it easily coordinated all department in the hospital,[72] provided accurate and timely reporting for hospital management and decision making in DHO, PHO, and MoH.[56]

A study at a hospital in Jogyakarta found that that the EMR in the hospital was meaningful as documentation, and communication between medical practitioners. It supported clinical decisions, measured the improvement of patient health status, reduced unclear prescription, health personnel efficiency as well as provided timely data.[69]

Interviews in this study found that adequate eHIMS was in 3 of hospitals. It produced good output, outcome and impact. The interview as follow;

> "With *eHIMS, patients do not need to spend their time in a long queue to get our service. Once data of the patient enter into the eHIMS, it will automatically transmit to other related units. It increases our staffs' performance and reduce workload, and provide data for right decision of patient treatment, and prevent prescription mistakes. With EMR, information can be easy to read compare to doctor's handwriting in the paper-based medical record."*

A study in Indonesian hospitals 2017 found that although the users were not satisfied with the eHIMS quality, they still used it to assist them in their task because they believed that the eHIMS had short and long term benefit. High quality eHIMS assisted doctors in identifying patients' health problem, and provided effective health treatment, procedures, and service.[10]

eHIMS described in the literature also found that implementation eHIMS incomprehensively in some hospitals triggered medical record duplications. One patient can have more than one medical record number, or several patients can own one medical record number.[82] Also, it influenced inefficiency of the health service to the patients, particularly in peak hours. Poor eHIMS also produced incomplete, invalid, inaccurate, redundancy, time-consuming, and outdated information.[10,55,59,64-66,70,72-73,82]

A study in Jogyakarta found that in the registration unit, poor eHIMS increased the health service response time, leading to increase patient dissatisfied percentage up to

98%, and increased staffs workload.[79] Also, 56% of reports were not submitted timely and completely[76] due to manual data collection.[81]

Interview in this study found that 3 of hospitals with manual data processing difficult to achieve quality data and good health service to patients. The interview as follows:

> *"Manual data processing is very time consuming and makes us very overwhelmed to provide data timely, and in this hospital, it is common to see patients attend to the hospital very early morning to avoid long queue."*

Hospital with paper-based medical record and data processing resulting not only poor quality data and health services, but also need large storage of documents. Without good management of filing, medical records will be difficult to save, retrieved, and even vanish.[56] An interview support this findings as follow:

> *"We do not have enough space to store all medical records. Some of them are kept in the box outside the storage room that are uneasy retrieved. If we cannot find the old medical record of recurrent admission, we replace it with the new one, but doctors complain because they cannot decides the best treatment for their patients without patients' medical histories."*

In addition, Lack of the usage of terminology standard in the eHIMS also hampered electronic data exchange that is essential to strengthening the referral system between the health facilities, and accelerate the claim reimbursement to the hospitals.[58] Besides, poor eHIMS was difficult to control, monitor, and evaluate hospital revenue per unit annually. It was also difficult to achieve good governance, include leaked of medical budget and financial.[82]

3.4 Data Quality Analysis

Data quality analysis in this study defined as an activity to measure the quality of data that has been submitted to the MoH and DHO. The quality dimensions that were measured in this study are completeness, accuracy, coherence, timeliness, relevance, accessibility, and interpretability.

3.1.1 Completeness

The completeness verification in this study aimed to measure the number of reports received and report expected for a specific period. It also to identify whether all variables of the data report are complete. The rate of completeness of 100% indicated all report submitted.[52]

Table 15 below shows that since 2016, the hospital has not reported the RL 1.1 to MoH, and the completeness percentage of report submission has fluctuated from 84% – 90%.

Year	Submitted SIRS Report (RL1.1 – RL5.5)																									%
	1.1	1.2	1.3	2	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13	3.14	3.15	4a	4b	5.1	5.2	5.3	5.4	
2018	x	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	x	x	√	√	√	√	88
2017	x	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	96
2016	x	√	x	√	√	√	√	x	x	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	84

√ = Submitted
X = Not submitted

Table 15. The SIRS report submission

An interview to the hospital found that all data that have not submitted to MoH were incomplete until now, and reports sometimes submitted incompletely to MoH. It indicates that the high report submission percentage is not a guarantee the quality of the data. The submission percentage may high, but the quality is low. Furthermore, a low submission percentage with high incomplete report worsen data quality.

3.1.2 Accuracy

The accuracy is the degree to which the data correctly estimate or describe the quantities or characteristics.[11]

This analysis found that diagnoses in the in-patient morbidity report are unspecific that leads to unspecific diagnoses code as a key to fill out RL 4a report. This issue occurred because it used report from in-patient unit instead of the medical record as a crucial valid key source of the report. The interview to the reporting staff as follow;

> *"We know that the valid data source for this report is medical records, but medical records are incomplete and submitted in weeks or months after patients discharge, that is why we use data from in-patient unit"*

In addition, monitoring, and evaluation from the coordinator of HIM unit and the higher manager in this hospital are unavailable. (Table 8) It indicates that inaccurate data source, and unavailability monitoring and evaluation combined with lack of knowledge and awareness in data processing are a bad practice of HIM that trigger a poor data accuracy.

3.1.3 Coherence

The data in this study is coherence if they are logically connected and consistent.[11] It was done by comparing original data and reported data, and examined the trends of the report over time whether specific data value in a particular period are extremely high or low to other data value or it can be defined as an outlier.

a. The coherence between SIRS report and profile hospital report 2016 and 2017

This analysis found that the percentage coherence of submitted SIRS reports and hospital profile report in 2016 and 2017 was 75%. (Table 16)

Hospital Intern report	Year	Submitted SIRS Reports (RL1.1 – RL5.4)																									%
		1.1	1.2	1.3	2	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13	3.14	3.15	4a	4b	5.1	5.2	5.3	5.4	
Profile Hospital Report	2016	NA	√	√	**X**	√	√	NA	NA	NA	NA	**X**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	√	√	NA	NA	75
	2017	NA	√	√	**X**	√	√	NA	NA	NA	NA	**X**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	√	√	NA	NA	75

*NA = Data is not applicable to be compared
√ = Data is coherent
X = Data is incoherent

Table 16. The coherence between SIRS report and hospital profile report

b. The coherence between SIRS report and in-patient morbidity report 2016 and 2017

This analysis found that the percentage coherence of submitted SIRS reports and in-patient morbidity report in 2016 and 2017 was 33%. (Table 17)

Hospital Intern report	Year	Submitted SIRS Reports (RL1.1 – RL5.4)																									%
		1.1	1.2	1.3	2	3.1	3.2	3.3	3.4	3.5	3.6	3.7	3.8	3.9	3.10	3.11	3.12	3.13	3.14	3.15	4a	4b	5.1	5.2	5.3	5.4	
In-patient morbidity report	2016	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**X**	**X**	√	√	**X**	**X**	33
	2017	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**X**	**X**	√	√	**X**	**X**	33

*NA = Data is not applicable to be compared
√ = Data is coherent
X = Data is incoherent

Table 17. The coherence between SIRS report and in-patient morbidity report

Table 16 and 17 above shows that the coherence percentage during 2016 and 2017 remain the same, and the incoherent always occurred in the same reports. It possibly due to unavailability of data monitoring and evaluation that allow the same mistake occurred over time.

c. Comparison between in-patient morbidity report and surveillance report 2016

Table 18 below is data of new cases at in-patient morbidity report and surveillance report 2016 that obtained from the same source. The comparison between these reports done by calculates the ratio and the percentage difference between these two reports.

If the ratio = 1, the two report are exactly the same.
If the ratio > 1, the recapitulation report is higher than the surveillance report.
If the ratio < 1, the surveillance report is higher than the recapitulation report.

The result shows that the number of case and death in these two reports are different with absolute percentage different up to 186%.

The table also shows that most number of cases in the in-patient morbidity report is higher than in surveillance report, except lung TB (-), dengue hemorrhagic fever, and clinical malaria. Possible reasons for this issue are:

a. Over or under-reporting due to miscalculating. These reports are collected by two different staffs who might have different skill and awareness. Therefore, cases in the in-patient morbidity report were calculated more than in surveillance report and vice versa.

b. The number of lung TB (-), dengue hemorrhagic fever, and clinical malaria are significantly higher in the surveillance report than in the in-patient morbidity report. It is because of different procedures, although they were using the same source: in the in-patient morbidity report, data submitted by the in-patient unit to HIM unit. While, in the surveillance report, the staff attended directly to the in-patient unit to check the data and confirmed by the medical record. Hence, surveillance staff has a chance to analyze the diagnoses, check the laboratory result, and validate the accurate diagnoses.

DIAGNOSIS	IN-PATIENT MORBIDITY REPORT				SURVEILANCE REPORT				RATIO OF DEATH IN THE IN-PATIENT MORBIDITY REPORT TO DEATH SURVEILANCE REPORT	OBSOLUT % DIFFERENT BETWEEN DEATH IN THE IN-PATIENT MORBIDITY REPORT AND DEATH IN SURVEILANCE REPORT	RATIO OF IN-PATIENT MORBIDITY REPORT TO SURVEILANCE REPORT	OBSOLUT % DIFFERENT BETWEEN IN-PATIENT MORBIDITY REPORT AND SURVEILANCE REPORT
	SEX		DEATH	TOTAL	SEX		DEATH	TOTAL				
	MALE	FEMALE			MALE	FEMALE						
Diarrhea	605	618	1	1223	325	335	2	660	0.5	67	1.9	60
Typhoid Fever	363	303	0	666	154	136	0	290			2.3	79
Lung TB (+)	31	26	0	57	34	16	0	50			1.1	13
Lung TB (-)	10	6	0	16	129	83	9	212			0.1	172
Dengue Fever Hemorrhagic	157	160	0	317	183	155	2	338			0.9	6
Dengue Fever	50	58	0	108	13	8	0	21			5.1	135
Clinical Malaria	24	3	0	27	83	29	0	112			0.2	122
Malaria Falciparum	0	0	0	0	2	0	0	2				
Malaria Vivax	0	0	0	0	7	0	0	7				
Pneumonia	33	17	0	50	3	3	0	6			8.3	157
Clinical Hepatitis	1	0	0	1	21	6	0	27			0	186
Hepatitis HBSaG (+)	24	4	1	28	0	2	0	2			14	173
Measles	0	0	0	0	15	22	0	37				
Leprosy MB	1	0	0	1	1	1	0	2			0.5	67
Tetanus	2	1	0	3	3	1	0	4			0.8	29

Table 18. Comparison between the in-patient morbidity and surveillance report 2016

d. Outlier Trends of NCD 2016

    Table 17 below shows that data of five NCDs in the in-patient morbidity report from January to December 2016 are different over time. It also shows that hypertension has significantly increased in April and December. Non-Insulin Dependent Diabetes Mellitus (NIDDM) also has risen dramatically in February and August, and other diseases are unreported in April and December. Possible reasons for this issue are:

- The increasing number of hypertension and NIDDM cases due to screening activities
- Chronic Heart Failure (CHF), stroke, and asthmatic bronchial were unreported due to the holiday season.

Disease	Month												Total outlier
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hypertension	24	70	59	110	95	59	89	29	68	81	58	110	2
NIDDM	25	60	25	42	37	25	25	75	25	30	33	42	2
CHF	8	23	18	0	13	18	22	22	4	14	14	0	2
Stroke	6	12	4	3	7	4	7	11	4	10	8	0	1
Asthmatic bronchial	15	16	17	0	18	17	15	14	8	15	12	0	2
Total outlier	0	1	0	3	0	0	0	1	0	0	0	4	9

Table 19. Trends of Non-Communicable Disease 2016.

3.1.4 Relevance

Data is not relevant to the needs of the hospital and higher-level managers (DHO and MoH)

3.1.5 Timeliness

    According to information of the reporting staff of this hospital, all reports to MoH are not on time. The reports were submitted several months after the deadlines.

3.1.6 Accessibility

    All reports that were submitted to the MoH are accessible by the MoH through the SIRS website.

3.1.7 Interpretability

    All reports include the report of hospital profile, in-patient morbidity report, surveillance report, NCD, and SIRS are understandable. However, poor quality data may lead to misinterpretation.

Chapter 4. Discussion

    This thesis critical analyze the transition of eHIMS implementation includes input (the determinants), process, output, outcome and its impact. The findings show that technical, organizational, and behavioral factors influence the data processing and the outcome. All factors are interconnected to achieve quality information for decision making and improving health status.

    The discussions are arranged in line with study objectives, and start to describe key factors influencing eHIMS transition, followed by the quality issue in manual HIMS setting, and short-term and long-term outcomes of eHIMS.

4.1 Key Factors influencing eHIMS in Indonesian hospital

This study found that technical factors, organizational and behavioral influence the eHIMS implementation in the Indonesian hospitals in the last 10 years.

4.1.1 Technical Factors

eHIMS implementation in Indonesian hospitals influenced by availability of infrastructure and technology include the perfection of the eHIMS forms. These factors are determined by finance sufficiency, and management such as maintenance of the infrastructure, coordination between the hospital, vendor, and users in designing the eHIMS form as well as socialization and training to users in order to increase the acceptance of system usage.

In the eHIMS transition period, inadequate infrastructure and technology resulting in unintegrated eHIMS implementation. So far, there is no eHIMS integrated to other hospitals, DHO, and PHO. Information flows from the hospitals only to the BPJS for reimbursement claim and to the MoH for report submission. Hospitals also tend to implement eHIMS only in specific components. Hence, the data processing both in electronic and manual.

Based on eHIMS components implementation described in the findings, eHIMS in Indonesia can be categorized into four types;

- Advance eHIMS; the hospitals apply all components of eHIMS comprehensively include e-prescription and EMR that link to BPJS and MoH, but the EMR is still accompanied by manual medical records. In other words, EMR is only used to input patient data, but the outcomes are in paper-based that are compiled in the manual medical record.
- Upper-intermediate eHIMS; the hospitals apply an integrated system of all eHIMS components except e-prescription and EMR, but the eHIMS unintegrated to BPJS and MoH.
- Intermediated eHIMS; the hospitals implement several eHIMS components that partially integrated, and not link to BPJS and MOH
- Basic eHIMS, the hospital apply eHIMS only for registration, and billing system that unintegrated one another and to the BPJS and MOH.

These eHIMS implementations quite similar in Malaysian public hospitals. However, some Malaysian hospitals totally implement eHIMS components that are grouped as total eHIMS.[85-86]

Advance eHIMS facilitated by high-quality technology and adequate infrastructures such as good quality data migration, server, data center, networking, electricity, and good data security. Besides, the eHIMS forms are complete, flexible, understandable, and related to hospital and SIRS report forms. Therefore, it can provide high-quality health service, and information not only for hospital, but also to BPJS and MOH.

Similarly, in the upper-intermediated eHIMS, the network connection and electricity are also adequate, and the form of eHIMS is complete, flexible and understandable, but unsuitable to SIRS report. Consequently, health service delivery is adequate, but data in the system need to be converted to excel and modified related to SIRS requirement.

On the other hand, hospitals with intermediate eHIMS have sufficient electricity and network connection. Computers distribute in all part of hospitals, but only several of them are installed with eHIMS application. Meanwhile, in the hospital with basic eHIMS, electricity is sufficient, but the network and computer are insufficient. Computer is often available in the registration unit. As a result, these eHIMS types cannot provide a good outcome, and the hospitals processed data manually to become report for information and decision making.

4.2.2 Organizational Factors

Finance management, process management, and governance are vital organizational determinants of a robust eHIMS in Indonesian hospitals.

The flexibility of budget management, both private and government hospitals, influences the availability of resources to implement eHIMS. Private hospitals manage their budget flexibly, while government hospitals manage their budget with long bureaucracy procedure. Hence they tend to maintain eHIMS progressively as a cost-effectiveness way.

In the process management, hospitals with advance and upper-intermediate eHIMS design the eHIMS by engaging users. They also provide proper socialization and training regarding eHIMS usage. The SOP and job description are clear, and they arrange controlling, monitoring, and evaluation. Contrarily, hospitals with intermediate and basic eHIMS are often less consider them. Although these management functions are available and applicable in these hospitals, the eHIMS is often inadequate due to technical and behavioral factors.

During the eHIMS transition period in Indonesia, a policy regarding standard and uniform of eHIMS design are unavailable. Hence all hospitals design their eHIMS based on their needs with effective and efficiency cost. However, since 2018, Indonesian hospitals with partially-accredited and un-accredited status have been challenging to organize their management include eHIMS implementation to be more comprehensively as a requirement to be accredited by KARS, and to sustain their relationship contract with BPJS as a national health insurance which has the biggest member in Indonesia.

4.2.3 Behavioral Factors

Data quality skill of HIM staffs, awareness and acceptance of users are the most influencing factors of eHIMS implementation in Indonesia. Hospitals with advance eHIMS have more adequate human resources in data processing than other eHIMS categories. In the hospital with poor eHIMS, HIM staffs and IT staffs are insufficient, and health workers in data processing tend to less aware in data entry such as entry data incompletely or delay the report. As results, data often incomplete, overlapping, invalid, and untimely.

eHIMs implementation also determined by the acceptance of the health worker to use the system. Excellent performance and flexibility of the system can improve staffs' work performance and satisfaction. On the contrary, complicated eHIMS form, insufficient electricity and technology lead to a system error, and impact on less benefit of the system and increase the health workers' workload. Therefore, users will be less satisfy and resist to apply the system.

On the other hand, the distribution of HIM staffs in the hospital is often complained by the health workers. Generally, HIM staffs assigned in the HIM unit for data and reporting. Most data entry in other units conducted by nurses. So that, health workers expect hospitals to assign HIMS staffs as a data clerk in every unit of hospitals. Nurse and doctors claim that they have a high workload and difficult to treat patients while entry data to the system.

In addition, doctors play an essential role in completing medical records. Hence, hospitals establish SOP based on the regulation of MoH regarding the medical record, which emphasizes that the medical record have to be completed in 24 hours after patients discharge. Nevertheless, medical records are completed later than the deadline, and cannot become essential resources of data and reporting. Besides, the culture of doctors to apply the EMR is difficult to be changed. They are more comfortable with the manual way such as write in a manual medical record than type or enter data to the EMR, particularly to those who have a lack of IT skill. It hampers the hospital implement eHIMS comprehensive and totally electronic.

4.3 Quality issues in manual HIMS setting

a. Completeness

The data analysis found that the completeness of report submission reaches up to 96%. However, the percentage of report submission cannot measure the quality of the data, because the reports are submitted incompletely to MoH. In other words, the completeness of report submission can be high, but the completeness of data is low.

In addition, there are 25 types of SIRS report that have to be submitted by the hospitals to MoH. It is a quite huge number to be handled by a limited number and unskilled reporting staff in the manual data processing. The staff will be overburdened and demotivate to work fully responsible on their task, especially without controlling, monitoring, evaluation, feedback and proper incentive. They tend to be less aware of how important quality data is.

b. Accurate

Medical records as a key data source are incomplete and submitted to the HIM unit after the deadline. Hence, diseases are reported without analyzing medical records to find a specific and accurate diagnosis and codes. Consequently, data in the in RL 4a report can be inaccurate. In this regard, the role of doctors to complete the medical record on time and the role of reporting staff to identify specific diagnosis, and monitoring and evaluation by the HIM coordinator are essential to produce quality data.

c. Coherence

Comparison of data between reports in the hospitals and submitted reports to DHO and MoH are incoherent. The incoherent percentage remains the same and occurs in the same report over period. It indicates that although reports use the same sources, manual data processing without validation, controlling monitoring, and evaluation from the HIM coordinator, and lack of data analysis awareness worsen the quality data.

d. Relevancy

Poor quality data is irrelevant as a reference to improve quality health service, hospital management, and disease control in the hospital, and in the higher management level such as DHO, PHO and MoH.

e. Timelines

Medical records are incomplete in the deadline period, and the report submitted after the deadline to MOH. Therefore the data cannot be a reference for decision making.

f. Accessibility

All data of SIRS reports only can be accessed by the MOH from the SIRS website.

g. Interpretability

Incomplete, inaccurate and incoherence data can be misinterpreted and leading to wrong decisions.

4.4 Short-term and long-term outcomes of eHIMS implementation

In the short term, eHIMS can provide good quality health service to patients. For instance, it can decrease the waiting time of patients in the registration unit, and provide transparency hospital cost to patients in the billing unit. It can control the hospital activities, and prevent mistakes of medical examination and drug prescriptions. Besides, it provides information for medical decisions include best medical treatment, procedures and other health services.

In long term, eHIMS provide quality data (accurate, complete, coherence, relevant, timely, accessible, and interpretable) which very meaningful for disease investigation, raising awareness and intervention, and distribution of health workforce, drugs and medical devices not only in the hospital level, but also in the higher managerial level such as DHO, PHO, and MOH. Additionally, it provides information for national and global public health interventions and health system strengthening.

4.5 Reflections on theoretical framework

All contents on the theoretical framework are relevant to the study objective. They used as a guidance to comprehensively analyze the eHIMS concept. However, this study found more technical factors that need to add to the framework, such as the integration system and sufficiency electricity.

4.6 Limitation of the study

It is rarely to find studies regarding the eHIMS transition in Indonesia. Therefore, some information like problem solving for eHIMS task by HIM staffs, quality check,

feedback, and impact of eHIMS in improving health status and health system performance are limited.

In data analysis at one of a hospital, this study cannot validate the accuracy of data by using medical records as a key source of the data. It can be an area of further study.

Chapter 5. Conclusion

Hospitals in Indonesia implement eHIMS, but it is not totally electronic and incomprehensively. It develops progressively base on its component, and depends on the hospitals' budget.

Indonesian hospitals start implementing eHIMS in basic component, and continuously expanded to some components to be more completely and advance. Therefore, eHIMS in Indonesia can be categorized as basic, intermediate, upper-intermediate, and advanced eHIMS. These categories influenced by technical, organizational and behavioral factors. The better the influence factors, the better quality of the eHIMS. In the basic and intermediate eHIMS, all determinants are less adequate, and most data processing is in manual. While in upper-intermediate and advance eHIMS, the system has a flexible, and understandable design which supported by good quality technology, network, and electricity. Also, proper management, and adequate number and skilled human resources.

Furthermore, all hospitals are challenging on the completeness of medical records. Hospitals with EMR claim that EMR is not totally implemented due to lack of IT skill and manual culture of the doctors that are more comfortable with manual than electronic. In Hospitals with manual medical records, doctors complete medical records after the deadlines. Therefore, the medical record cannot become the key source of good quality data.

Good eHIMS improve the health service delivery, such as decrease waiting time of patients, avoid mistakes drug prescriptions, and measure the improvement of patient treatment and health status. Also provide good quality data that crucial for hospital decision making, public health interventions, and health system strengthening.

In contrast, weak eHIMS increase the patients' waiting time, and decrease the patients' satisfaction. Clinicians are not able to decide best continuation treatment for recurrent patients when their medical record is unavailable. Besides, it cannot display reports to provide good quality data. Therefore, staffs have to process data manually. As results, the data are incomplete, inaccurate, incoherence, irrelevant, not on time, and misinterpreted. Data cannot provide information as indicators to provide better health service and hospital management. In the higher level health systems, the data cannot provide information for public health intervention such as rapid investigation of the outbreak, disease prevention, distribution of health workers, medical drugs and equipment, and other health interventions. These issues are possible to be overcome in the next few years since hospitals are motivated to develop their eHIMS more comprehensively. It is because the new government policies emphasize eHIMS as a requirement of hospital accreditation status, and to continue the hospital contract with BPJS.

Chapter 6. Recommendations
1. Hospitals with advance eHIMS
   a. Provide regular socialization of electronic and paperless culture to health workers, especially clinicians to improve their awareness and understanding of the eHIMS importance. Therefore, data of completeness medical record percentage and its impacts can be presented during the socialization.
   b. Encourage medical committee to perform regular meeting regarding awareness of EMR and medical record completeness, regulate the policy of eHIMS and EMR to all its member.
   c. Conduct focus group discussion to all clinicians to identify the problems and solutions of EMR implementation.
   d. Provide training of eHIMS and EMR utilization to health workers with low IT skill.

2. **Hospitals with upper-intermediated eHIMS**

   a. Apply EMR and e-prescription, and integrate the eHIMS to the BPJS and MoH to optimize the eHIMS implementation
   b. Socialize electronic and paperless culture to all health workers to improve the readiness of total eHIMS implementation.
   c. Provide discussion to all users, especially clinicians regarding the EMR and e-prescription implementation to identify their readiness, problems and solutions.
   d. Provide regular training to low IT skill users.

3. **Hospitals with intermediate and basic eHIMS**

   a. Design the eHIMS with a clear plan and mapping by engaging users, and perform IT unit by engaging HIM and IT specialist with formation as follows;
      - The programmers team that engage IT specialist who responsible for designing the program
      - Implementers that engage HIM specialist who responsible to socialize, provide training, and received feedback regarding the eHIMS weakness during the implementation
      - Maintenance team that engage IT specialist who responsible to maintain, monitor, and control the technical issues of the system.
   b. Improve good governance of financial management, cost-efficient and effectiveness in order to strengthen hospital finance. Hence, the hospital will be able to provide adequate eHIMS design, technical facilities and technology to support comprehensive eHIMS implementation.
   c. Design, distribute and socialize SOP, clear job description, and guidelines regarding eHIMS implementation to all related unit.
   d. Provide training of eHIMS utilization to all users, particularly to those with low IT skill and provide feedback from the user regarding the weakness of the system as a reference to improve the eHIMS quality.
   e. Provide regular training for reporting staffs regarding quality data processing and data analysis as well as recruit HIM and IT staff base on the educational background and year experiences.
   f. Provide regular meeting to all users to identify problems and solutions of data processing. Also, to improve the commitment of the manager and all users to implement eHIMS comprehensively.
   g. Perform controlling, monitoring, evaluation, and data quality analysis. All data and report should be validated before submitted to the manager and the higher level.
   h. Persuade the medical committee to encourage doctors as its members to complete the medical record timely.
   i. Assign a HIM staff in every unit as a data clerk.

4. **Further research**

   Conduct further research regarding skill on problem-solving and data quality check of the HIM staffs. Also, the association between feedback, data quality assessment and quality data, and the critical medical record analysis to produce good information as well as the role of eHIMS in improving health status and health system performance.

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Annex 1. The list of priority disease for EWARS [42]

1	Acute diarrhea	13	Acute Flaccid Paralysis (AFP)
2	Confirmed malaria	14	Cases of dog bite potential of transmitting rabies (GHPR)
3	Suspected case of Dengue fever	15	Suspect Case of Anthrax
4	Pneumonia	16	Suspect Case of Leptospira
5	Bloody diarrhea	17	Suspect case of Cholera
6	Suspect Typhoid fever	18	Cluster of Unknown disease
7	Acute jaundice syndrome	19	Meningitis / Encephalitis suspect /Encephalitis (Acute Encephalitis Syndrome)
8	Suspected case of Chikungunya	20	Suspect case of Neonatal tetanus
9	Suspected human case of Avian Influenza	21	Suspect Case of Tetanus
10	Suspect case of Measles	22	ILI (Influenza Like Illness)
11	Suspect Case of Diphtheria	23	Suspect Case of Hand Foot and Mouth Disease (HFMD)
12	Suspect Case of Pertussis		

Annex 2. Topic Guide

Royal Tropical Institute (KIT)

The analysis of an Electronic Health Management Information System Transition in Indonesian Hospitals, 2019

Introduction

Electronic Health Information Management System (eHIMS) is a comprehensive system of patients information include health patient's history, diagnosis, examinations, billing, and others related procedures which are conducted in the hospital that play important role in decision making, management, monitoring and evaluation health problem.

The objective of this study is to critically analyze the transition to electronic HIMS in Indonesian hospitals including its form and function in improving quality health service, hospital management, and health reporting in order to provide recommendations for HIMS development intervention strategies in Indonesia.

Topic that will be addressed during this interview include factors influencing electronic Health Information Management System (eHIMS) transition in the hospital in Indonesia, the data processing, and outcome of the eHIMS.

This interview will last for about an hour, please feel free to share your opinion and thoughts.

Characteristics of respondents:

Age   :
Sex   :
Professional Background   :
Year Experience   :

Factor influencing eHIMS transition

1. Technical Factors
- Complexity of reporting form and procedures
- HIS Design
- Computer software
- IT Complexity

2. Organizational Factors
- Critical management functions and information needs
- Governance
- Planning
- Training
- Supervision
- Quality
- Finance
- Promotion of culture of information
- Availability of resources

3. Behavioural Factors
- Level of knowledge of content of HIS form
- Data quality check in skill
- Problem solving for HIS task
- Competence in HIS task
- Motivation

Data Processing
1. Data Collection
2. Data Transmission
3. Data Processing
4. Data Analysis
5. Data Display
6. Data Quality Check
7. Feedback

Outputs, outcomes, and impact

Annex 5: Inform Consent (Informed Consent Form, adapted from WHO Research Ethics Review Committee) [(87)]

This informed consent form for staff of medical record and health information in Indonesian hospital that are inviting to participate in the qualitative research "The analysis of an Electronic Health Management Information System Transition in Indonesian Hospitals, 2019".

Principal Investigator: Martina   **Organization: KIT-Royal Tropical Institute**

Part I: Information Sheet

This Informed Consent Form has two parts:
• Information Sheet (to share information about the study with you)
• Certificate of Consent (for signatures if you choose to participate)
You will be given a copy of the full Informed Consent Form

Warmest greeting, I am **Martina** I am studying **International Course in Health Development – Master of Public Health (ICHD-MPH).** Now, I am doing research on the analysis of an Electronic Health Management Information System Transition in Indonesian Hospitals, 2019. Form may contain words that you do not understand. Please ask me to stop as we go through the information and I will take time to explain.

Purpose of the research: The Electronic Health Information Management System (eHIMS) in Indonesian hospitals is quite challenging. Therefore, we would like to critically analyze the electronic HIMS transition in Indonesian hospitals including its form and function in improving quality health service, hospital management, and health reporting. You will be involved in interview for one hour. Your information is significant in making a recommendation for HIMS development intervention strategies in Indonesia.

Participant Selection: You are invited to participate in this research because we feel that your experience can contribute much our understanding and knowledge of the transition of electronic HIMS in Indonesian hospital including its form and functions.

Voluntary Participant: Your participation in this research is voluntary. You have a right to participate or not, and you can withdraw your participation at any time without penalty.

Procedures: We are inviting you to participate in this research in order to assist us to critical analyze the transition of eHIMS in Indonesia. If you accept it, you will be asked to participate in interview. This interview will be guided by me as the researcher in one hour. You will interview factor influencing eHIMS transition, data form and its outcomes.

Confidentiality, risk, benefit and reimbursement. The interview will be recorded, and will be conducted via skype, whatsaap or telephone. Only you and the researcher in the interview. We will not ask you to share personal beliefs, practices or stories and you do not have to share any knowledge that you are not comfortable sharing. If you do not wish to answer any of the questions during the session, you may say so, and the interviewer will move on to the next question. The information recorded is confidential with anonymous. The data and recorder will be destroyed in six months after this research end.

Sharing the Results: The results will be shared with ministry of health, province and district government, health province, and the health district office, hospitals, and participants. A summary report will be published in media, national and international journals.

Who to Contact: If you wish to ask question, please contact me.

Part II: Certificate of Consent

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study

Print Name of Participant:_____Signature of Participant _____

Date _____ Day/month/year

Statement by the researcher/person taking consent: I have accurately read out the information sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done. A copy of this form has been provided to the participant.

Name of Researcher_____
Signature_____
Date _____

Bahasa Indonesia version.

Format persetujuan wawancara ini diperuntukkan kepadaa staf rekam medis dan informasi kesehatan yang diundang untuk berpartisipasi dalam penelitian kualitatif "Analisis Terhadap Transisi Sistem Informasi Kesehatan Elektronik di Rumah Sakit di Indonesia, Tahun 2019".

Nama Pewawancara: Martina   Nama Organisasi:KIT-Royal Tropical Institute

Bagian I: Lembar Informasi

Lembar persetujuan ini terdiri dari dua bagian:
• Bagian informasi (memberikan informasi mengenai penelitian ini kepada anda)
• Sertifikat Persetujuan (ditandatangani jika anda bersedia berpartisipasi)
Anda akan diberi satu salinan dari lembar persetujuan ini.

Salam hangat, Saya **Martina,** saya belajar **Program Internasional dalam Peningkatan Kesehatan – Master Kesehatan Masayarakat.** Saat ini, saya melaksanakan penelitian tentang analisis pengalihan system informasi kesehatan elektronik di rumah sakit di Indonesia, Tahun 2019. Form ini mungkin mengandung kata-kata yang anda tidak mengerti. Mohon hubungi saya untuk menjelaskannya.

Tujuan Penelitian: Sistem Informasi Rumah Sakit (SIMRS) elektronik di Indonesia masih menjadi masalah. Oleh karena itu, kami ingin menganalisa transisi SIMRS elektronik di rumah sakit di Indonesia, termasuk format dan fungsinya dalam meningkatkan kualitas pelayanan rumah sakit, manajemen rumah sakit, dan pelaporan kesehatan. Anda akan diwawancarai selama sejam, dan informasi yang anda berikan akan sangat berguna untuk memberikan saran kepada pemerintah Indonesia dalam strategi pengembangan SIMRS.

Seleksi Peserta: Anda diundang untuk berpatisipasi dalam penelitian ini karena kami menganggap bahwa anda berpengalaman anda dapat memberikan kontribusi dalam pemahaman tentang transisi SIMRS elektronik di Indonesia, termasuk mengenai format dan fungsinya.

Kepesertaan Sukarela: Kepesertaan anda dalam penelitian ini bersifat sukarela. Anda berhak untuk berpartisipasi atau tidak. Anda juga dapat menarik kepesertaan anda kapanpun tanpa penalty.

Prosedur: Kami mengundang anda untuk berpartisipasi dalam penelitian ini untuk membantu dalam menganalisa transisi SIMRS elektronik di Indonesia. Jika anda setuju, anda akan diwawancarai. Wawancara ini akan dipandu oleh saya sebagai peneliti dalam satu jam. Anda akan diwawancarai menyangkut factor-faktor yang mempengaruhi transisi SIMRS elektronik, bentuk dan hasil yang diciptakan oleh system ini.

Kerahasiaan dan Risiko: Wawancara ini akan direkam, dan akan dilakukan melalui skype, whatsaap, atau telepon. Hanya anda dan peneliti dalam wawancara ini. Kami tidak akan bertanya masalah kepercayaan, praktik atau hal-hal yang tidak ingin anda berikan jika anda merasa tidak nyaman membagikannya. Jika anda tidak ingin menjawab pertanyaan pada suatu sesi, anda boleh melakukannya, dan pewawancara akan pindak ke pertanyaan selanjutnya. Rekaman informasi dalam wawancara ini bersifat rahasia dan tanpa nama. Data rekaman juga akan dimusnahkan dalam 6 bulan setelah penelitian ini selesai.

Distribusi Hasil: Hasil wawancara ini akan dibagikan ke Kementrian Kesehatan Indonesia, Dinas Kesehatan Provinsi, Kabupaten/Kota, Rumah Sakit dan peserta wawancara. Ringkasan penelitian akan diumumkan di media, jurnal nasional dan internasion.

Korespondensi: Jika anda memiliki pertanyaan, silahkan hubungi saya.

<div align="center">

Bagian II: Sertifikat Persetujuan

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Saya telah membaca semua informasi atau telah dibacakan kepada saya. Saya telah diberi kesempatan bertanya sesuatu yang tidak saya mengerti dalam surat ini, dan telah memberikan jawaban yang memuaskan. Saya juga secara sadar bersedia sukarela untuk berpartisipasi dalam penelitian ini.

Nama Peserta………………………….. Tanda Tangan Peserta ………………………………

Tanggal ………………………….. Hari/Bulan/Tahun

Pernyataan dari peneliti/orang yang mengambil persetujuan: Saya telah memberikan informasi akurat kepada peserta, dan yakin peserta telah mengerti tentang wawancara ini. Satu salinan juga telah diberikan kepada peserta.

Nama Peneliti **Martina**   Tanda Tangan………………………..

Tanggal……………………….