ORIGINAL ARTICLE

Integrated Early Warning System for High-risk Pregnant Woman: Development of Management Information System Between PHC and Hospital

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ABSTRACT

Introduction: There were fluctuatif cases of maternal death at Banyuwangi District in 2014-2018. The cases of maternal mortality needs attention considering to reduction MMR. An information system for high- risk pregnant woman is needed as a basis for decision making and Local Area Monitoring (PWS). The research aims to analyze the need for developing an integrated early warning system for high-risk pregnant woman between PHC and Hospital. **Materials and methods:** A qualitative design and action research. Primary data was obtained from interviews, observations, and FGD. Informants are Head, Midwife Coordinator, and Area Midwife of PHC, Head of Medical Service, and Head of IT Public Hospital. Secondary data from PHC and hospital documents. Processing and analysis data descriptively. **Results:** Problem identification of existing system was manual for compilation, analysis, and mapping; no integrated system between PHC and hospital MIS; referral patient data was re-entered in referral patient registration; the presence of high-risk pregnant women not yet known by the hospital; and information on the availability of maternal rooms in the hospital cannot be accessed directly by referral patients. There was an opportunity to develop an integrated MIS. **Conclusion:** There was need for developing an information system for high-risk pregnant women between PHC and hospital, that can be used by all level users, can relied on to carry out data processing, easier to produce quality information. The MIS is based on websites (web-based) and Android for an integrated early warning system to prevent deaths of pregnant women.
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INTRODUCTION

Maternal Mortality Rate (MMR) is a health indicator (1). Reducing MMR is goal 3.1 in the Sustainable Development Goals (SDGs), namely reducing the global maternal mortality ratio to less than 70 per 100,000 live births by 2030. Nationally, MMR has decreased from 346 deaths per 100,000 Live Births in 2010 (Population Census 2010) to 305 deaths per 100,000 KH in 2015 (2). The MMR is targeted to decrease to 183 per 100,000 births in 2024 (3). Various policy programs or innovation programs are launched and implemented progressively by the central and regional governments. Through the Safe Motherhood Initiative program which has received support from various parties both at home and abroad. Banyuwangi District is implementing various efforts related to achieving SDGs targets with innovative programs and policies to reduce MMR caused by various complications arising during pregnancy, childbirth and postpartum (4). Promotional movements for health promotion innovation, increasing service access and quality of health services are also strategies to realize program objectives. These programs can be a benchmark for the success of accelerating the reduction of MMR in achieving SDGs goals.

Cases of maternal death related to pregnancy, childbirth and postpartum reported in Banyuwangi Regency in 2014-2018 fluctuated, namely 22 (93.08/100,000 live births), 23 (96.2/100,000 live births), 20 (87.0/100,000 live births), 19 (82.3/100,000 live births), and 24

(102.9/100,000 live births). The persistence of maternal deaths can also be linked to the midwifery care management system, which may include the detection of high-risk pregnant women with high risk that is not yet optimal. Apart from that, there are still births by incompetent personnel (quacks) who actively help, so in this case it can also contribute to the incidence of death. Apart from that, late decision making also plays a role regarding clinical actions for mothers with complications during pregnancy, childbirth, and the postpartum period (4,5). There are still cases of maternal mortality in Banyuwangi Regency that require important attention from local stakeholders considering the reduction in MMR to support the achievement of targets in indicators of community health and nutritional status at regional, national, and global levels.

Data and information are very strategic resources for an organization, which are used as input in the decision-making process. Health management information systems (HMIS) have a high potential to serve as the foundation for effective policy decision making as a complete, disaggregated, and comparative source of information regarding health care in middle-income countries (6). An integrated information system that combines data from many sources could speed up assessment and provide the right services (7). In order to reduce MMR, an integrated information system for high-risk pregnant women is needed so that it is able to support the provision of data and information for high-risk pregnant women. The research aims to analyze the need for developing an integrated early warning system for high-risk pregnant woman between Primary Health Care (PHC) and Hospital. Comprehensive information can be used as a basis for decision making in planning, implementing, monitoring, evaluating health programs and improving Local Area Monitoring (PWS) quickly and precisely.

MATERIALS AND METHODS

Study Design

This research was qualitative design and action research. Information system development refers to the system development life cycle (SDLC)(8)(9)(7). SDLC is a multi-stage approach to analyzing and designing systems where the system has been very well developed by specific analyzer and user activity cycles. There are 5 phases used in this research. Details of each phase will be presented below.

Phase 1: Empathize
Identifying problems, opportunities, and objectives of the PHC and hospital MIS. The researchers conducted interviews, observation, and Focus Group Discussion (FGD). Informants are Head, Midwife Coordinator, and Area Midwife of PHC; Head of Medical Service, and Head of IT Public Hospital. The head of PHC will provide information about the policy, monitoring, and evaluation on the use of PHC MIS. The Midwife Coordinator will provide information about the entry, compilation, analysis and reporting of pregnant women data at the HC level. The Area Midwife will provide information about the entry, compilation, analysis, and reporting of pregnant women data at the Sub PHC/ Pustu level. The head of Hospital Medical Service will provide information about the policy, monitoring, and evaluation on the maternal services referral. The head of IT Public Hospital will provide information about implementation of hospital MIS.

Phase 2: Determine
Determine the requirements for developing a MIS between the PHC and the Hospital. The researchers conducted interviews with the Head, Midwife Coordinator, and Area Midwife of PHC, Head of Medical Service, and Head of IT Public Hospital. The head of PHC will provide information about the information needs for decision making. The Midwife Coordinator will provide information about data for input, data for compilation, data for analysis, and data for dissemination of pregnant women data at the HC level. The Area Midwife will provide information about data for input, data for compilation, data for analysis, and data for dissemination of pregnant women data at the Sub PHC/Pustu level. The head of Hospital Medical Service will provide information about information need for maternal services referral indicator. The head of IT Public Hospital will provide information about data for input, data for compilation, data for analysis, and data for dissemination of high-risk pregnant women in the hospital MIS.

Phase 3: Analyze
Analyzing MIS development needs is based on descriptive analysis. The MIS design is depicted in the Data Flow Diagram (DFD), namely the context diagram and level 0 diagram.

Phase 4: Design
Designing recommended MIS development including designing data flow charts, normalizing, and creating data dictionaries, and conducting FGDs on recommendations for developing community health center management information systems with Head, Midwife Coordinator, and Area Midwife of PHC; Head of Medical Service, and Head of IT Public Hospital.

Phase 5: Prototyping
Developing web base and Android based software. The secondary data from PHC and hospital documents that has been collected is used for system testing.

Study Location

The research was conducted at the Sempu PHC, Tulungrejo PHC, and Genteng District Public Hospital. The Sempu PHC was the inpatient PHC while The Tulungrejo PHC was the outpatient PHC. The Genteng

District Public Hospital was the second district public hospital in Banyuwangi District for medical referral from these PHC. In general, the development of a MIS between PHC and hospitals regarding pregnant women utilizes systems that are already running.

Ethical Clearance

This study was approved by the Health Research Ethic Committee, Institute of health Science Banyuwangi No. 554/KEPK/STIKES-BWI. All study-related information was kept confidential. The data collected was entered into a computer protected by a password that known by only the researcher.

RESULTS

Information system development encompasses the System Development Life Cycle (SDLC), which is a comprehensive approach to analyzing and designing systems. SDLC involves five phases. The following is the detailed explanation of each phase.

Phase 1: Empathize

Problem identification of existing system was

1. Manual or conventional for compilation and analysis data.
2. Manual or conventional for mapping.
3. No integrated system between PHC and hospital MIS.
4. Referral patient data was re-entered in referral patient registration.
5. The presence of high-risk pregnant women not yet known by the hospital.
6. Information on the availability of maternal rooms in the hospital cannot be accessed directly by referral patients.

There was an opportunity to develop an integrated MIS. The aim of developing an MIS for pregnant women is to have an early warning information system for referrals for high-risk pregnant women both at PHC and hospitals. So that high-risk pregnant women are ready to be handled by PHC and hospitals.

Phase 2: Determine

The requirements of information for developing a MIS between the PHC and the Hospital based on the aim of developing MIS for pregnant women were:

1. Number of pregnant women detected by KSPR (Health Workers) per village.
2. Number of pregnant women detected by KSPR (Community) per village.
3. Number of pregnant women aged < 20 years per village.
4. Number of pregnant women with pregnancies < 2 years apart per village.
5. Number of pregnant women with > 4 children per village.
6. Number of pregnant women aged > 35 years per village.
7. Hospital referral pregnancy with 24 pregnancy risk registers.

Phase 3: Analyze

The need for a management information system between PHC and Hospitals in Banyuwangi District is based on input, process, and output components. The information system developed can be used by users (Child and Maternal Health Outpatient Clinic/Poli KIA in PHC, Sub PHC/Pustu, Village Partum Cottage/ Polindes, Private Practice Midwife/BPM, the community, Genteng Public Hospital staff, District Health Office, Al-Huda Private Hospital, Krikilan Bhakti Husada Private Hospital, and Healthcare and Social Security Agency/ BPJS Kesehatan) easily, can be relied on to carry out data processing, and makes it easier to produce information on pregnant women high quality risk (on time, valid, and in accordance with needs). The information system data flow diagram that will be developed is presented in Figure 1 below.

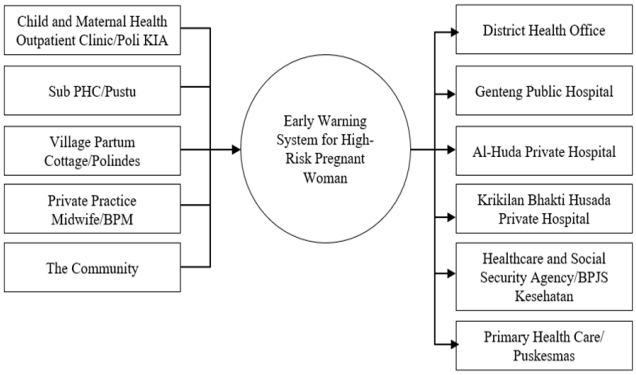

Figure 1: Context Diagram of Developed Integrated MIS.

The information system for pregnant women is implemented at the PHC (Child and Maternal Health Outpatient Clinic), Pustu, Polindes, BPM, the community, Genteng District Public Hospital, and the District Health Office. The data providers in this system are the PHC (Child and Maternal Health Outpatient Clinic), Pustu, Polindes, BPM, and the community. Meanwhile, the output of the system is disseminated to the District Health Office (Family Health Division), PHC (Head, Midwife Coordinator), Genteng District Public Hospital (can directly access information), Al-Huda Hospital, Bhakti Husada Krikilan Hospital, and Healthcare and Social Security Agency.

Phase 4: Design

The MIS for pregnant women developed is website and Android based. The minimum specifications for hardware (personal computer) required to operate a website-based information system application for pregnant women are as follows.

1. 1 Ghz processor for Intel Celeron
2. RAM of 512 MB
3. 20 GB hard disk

Meanwhile, the minimum hardware (smartphone)

specifications required to operate the Android-based pregnant women MIS application are as follows.
1. Processor of 598 Mhz
2. RAM of 512 MB
3. Display of 480 x 800 pixels
4. Internet connectivity, namely GPRS/EDGE/3G/HSDPS

Development of the MIS for pregnant women between PHC and hospitals in Banyuwangi District is recommended as follows. There are 2 types of users are data entry and information access. Users for data entry are PHC (Child and Maternal Health Outpatient Clinic), Pustu, Polindes, BPM, and the community. Users for access to information are Puskesmas (Child and Maternal Health Outpatient Clinic), Pustu, Polindes, BPM, community, hospitals, and District Health Office.

Phase 5: Prototyping
The prototype MIS for pregnant women developed is website and Android based is presented in Figures 2 below.

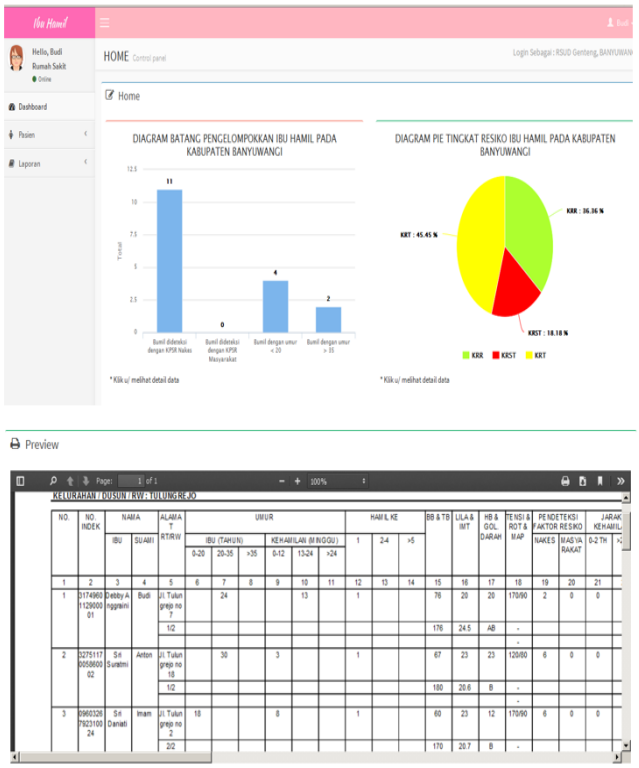

Figure 2:Dashboard of Data Analysis and Cohort Reporting.

DISCUSSION

Health information systems struggle to provide the data required to track key health indicators, like the primary causes of hospitalization or death (10). This study aimed to analyze the need for developing an integrated early warning system for high-risk pregnant woman between PHC and Hospital. The health management information system development refers to the SDLC. The HMIS innovation for pregnant women was developed, which is website-based and android-based system with standardized data and requirements to track the maternal health conditions include pregnancy risk factors, develop maternal cohort reports, and queries based on a comprehensive management information system.

In the first phase of the SDLC (11), the result indicated that users reported that conventional for compilation, analysis data, and mapping, lack of data integration as the main problem with the existing information system. That can impact on the spend time to updating data, monitoring, and decision making of pregnant woman health status. Whereas since automation and accurate record-keeping have replaced many human tasks, information technology has contributed to increased productivity (6)(12)(13). Another problem with the existing information system was referral patient data was re-entered in referral patient registration. This is particularly crucial, especially in pregnancy-related data, because the records, once lost during an earlier trimester, cannot be obtained in a later stage of pregnancy. The lack of a systematic means of recording previous histories leads to patients being asked the same questions regarding their pregnancy/medical history during each encounter (14). Another challenge of existing system is lack of support for health workers in assessing hospital's capacity and making direct referrals to hospitals that can admit patients (15).

Several health systems face greater challenges in collecting and sharing data, have fewer resources to develop integrated systems, and are less integrated (16)(17). A prototype is a realistic representation of the preliminary version that allow send-users to understand the idea's feasibility before testing through the iterative cycle (18). The pregnant woman integrated health information system developed can be used by users easily, can be relied on to carry out data processing, and makes it easier to produce information on pregnant women high quality risk. The previous study found that it is feasible to implement a web-based surveillance system that offers action-oriented responses accessible from different electronic devices. This system can effectively monitor and evaluate the health and survival of mothers and newborns at both hospital and policy levels (19). Another study results that Android-based tracker capture app that electronically manages maternal and child health (MCH) data was conducive to enhancing capacity in MCH data management for providing necessary MCH services (20)(21).

The usage of current application and system designs that can display data for daily tasks are essential to the efficient use of information systems (22)(23). It is necessary to reform health information systems with more patient data—both in terms of quantity and quality—to create an information system that integrates all subsystems with well-defined workflows and to restructure data so that it is more logically organized (24)(25). Data quality is significantly depend on technology (6). Dependable,

pertinent, and comprehensive data plays a crucial role in enhancing organizational efficiency and serves as a fundamental element in making informed decisions (13) (26). Good quality of MIS data is crucial for identifying areas requiring improvement, monitoring progress, and evaluating intervention aimed at addressing existing gaps (27). Good examples exist of the use of data for evidence-based decision-making leading to better health (28)(29).

CONCLUSION

The processing of pregnant women's data at the PHC still relies on manual recording in the daily recapitulation books of each midwife's area and the pregnant cohort. Data compilation and analysis are also done manually. Hospital MIS has not been integrated with PHC MIS, so it will take time for high-risk pregnant women referrals. There was need for developing an information system for high-risk pregnant women between PHC and hospital, that can be used by all level users, can relied on to carry out data processing, easier to produce quality information. The MIS is based on websites (web-based) and Android for an integrated early warning system to prevent deaths of pregnant women. The weakness of this study is that prototype testing has not been conducted at the user level in PHC and hospitals. Therefore, in the next study, prototype testing, system evaluation based on testing results, and system implementation are necessary. The implementation of the pregnant women MIS requires policy support from banyuwangi District Health Office.

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