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DEVELOPING A WEB-BASED INFORMATION SYSTEM IN DETECTION OF HIGH-RISK PREGNANCIES IN SEMARANG, INDONESIA: ADDIE MODEL

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ABSTRACT
A web-based information system in this study was developed using ADDIE (Analysis, Design, Development, Implementation, and Evaluation) instruction model to facilitate the monitoring and reporting the existence of high-risk pregnancies in Semarang. The evaluation of the system revealed that web-based information system was very effective in terms of completeness, ease, timeliness, accuracy, and conformity with p-value <0.05. This innovation is expected to contribute positively to reduce maternal mortality rates in Indonesia, especially in Semarang.

Keywords: high-risk pregnancy, web-based system, Addie model

INTRODUCTION
Health is one of the main components in the Human Development Index (HDI),[1] which can support the creation of healthy human resources to the success of health development, as well as to create awareness, willingness, and ability to live healthy through maternal health efforts before pregnancy until childbirth.[1]

Pregnancy is a normal phenomenon that occurs because of the meeting of sperm cells with egg in the fallopian tube, and then attached in the endometrium, which will develop into a fetus, taking 280 days or 40 weeks.[2] High risk in pregnancy is a state of pregnancy that is deviated from normal, which directly leads to maternal and infant morbidity and

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death.[3] Maternal Mortality Rate (MMR) is used in maternal mortality monitoring, about six to eight percent of pregnant women fall into the high-risk category during their pregnancy.[4] Thus, women with pregnancies at greatest risk is a great concern for health workers, especially to manage their birth and health decision plans regarding reproductive care services.[5]

According to WHO, the world's Maternal Mortality Rate (MMR) has reached 289,000.[6] While the rate of MMR in Indonesia is also still high.[1] In 2015 there were 35 cases of maternal deaths in Semarang City, Indonesia, with a total of 77.3% high-risk pregnancies women.[7] Based on the Maternal Perinatal Audit, indicated that 55.7% of these death cases could have been prevented.[7] However, efforts that have been made by the Health Office of Semarang City to suppress the MMR is by the establishment of Health Surveillance Officers (GASURKES). [7] It is expected that, as health surveillance officers, they could do systematic collection, analysis, and interpretation of health-related data needed for the planning, implementation, and evaluation of public health practice, as well as document the impact of an intervention, or track progress towards specified goals, and allow priorities to be set and to inform public health policy and strategies.[8]

However, the data collection and analysis in the Health Surveillance Program is still in manual based using excel computer program, which may provide the risk of double input, error, and loss of data, as well as a delay in the report due to many entered-data more than one sheet. In this case, there is an absence of a system that can further facilitate midwives to coordinate the implementation and reporting of high-risk pregnancy detection. Therefore, this study aims to propose the solution which will let the health system be more useful and effective for health workers by developing web-based information system to facilitate the monitoring, detecting and reporting of the existence of high-risk pregnancy in Semarang city using Instructional systems design (ISD).

INSTRUCTIONAL SYSTEMS DEVELOPMENT (ISD)

The instructional systems design is a systematic method of development of education and trainings programs for improved student performance.[9] The ISD process involves five steps: analysis, development, design, implementation, and evaluation (ADDIE). The concept of ISD has been around since the early 1950s, ADDIE first appeared in 1975. It was created by the Center for Educational Technology at Florida State University for the U.S. Army and then quickly adapted by all the U.S. Armed Forces. The military, having a large number of instructional designers, greatly influenced much of the corporate world to adapting the ISD or ADDIE model.[10]

DEVELOPING WEB-BASED INFORMATION SYSTEM USING ADDIE MODEL

This was a Research and Development (R&D) study following the instructional system design with analysis-design-development-implementation-evaluation (ADDIE) model to develop web-based information system in detection high risk pregnancy.

Analysis

This step is to analyze characteristics of the systems, the needs and limitations of the system, and formulate health workers need.[11] In this study, the analysis has already been implemented by in-depth

interview with five health surveillance officers in five community health centers in Semarang City, which its result indicated that there was a slow process of detection of high risk pregnancies by excel format manually. They all agreed that they need innovation using web-based system.

Design

Where an outline and description of the system and storyboard are created. Module, software program, instrument to assess the quality of system modules are designed and determined.[12] In this study, the development of web-based information system (Indonesian version) was the result of the analysis step, which aimed to help and facilitate the health personnel as the implementer of the program. The system was developed using local web server (PHP), which this program could be operated directly on the computer. Besides, the research also developed an instrument to measure the completeness, timeliness, accuracy, and conformity with Likert scale, namely Strongly Agree (5), Agree (4), Simply Agree (3) Disagree (2), and Strongly Disagree (1). The instrument has been validated using expert judgment (Midwives) and been tested to 15 respondents. The instrument showed good validity result.

Development

In the development phase, instructional designers and developers create and assemble content assets blueprinted in the design phase.[11] In this phase, the designers create storyboards and graphics. The web-based system was described in the following figures:

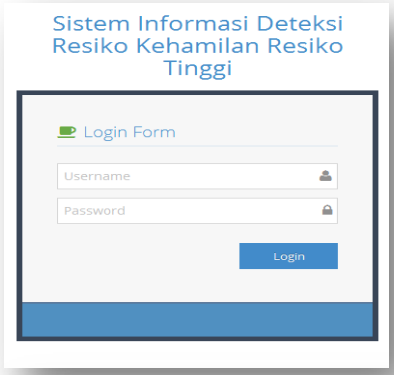

Figure 1 *Log In* page

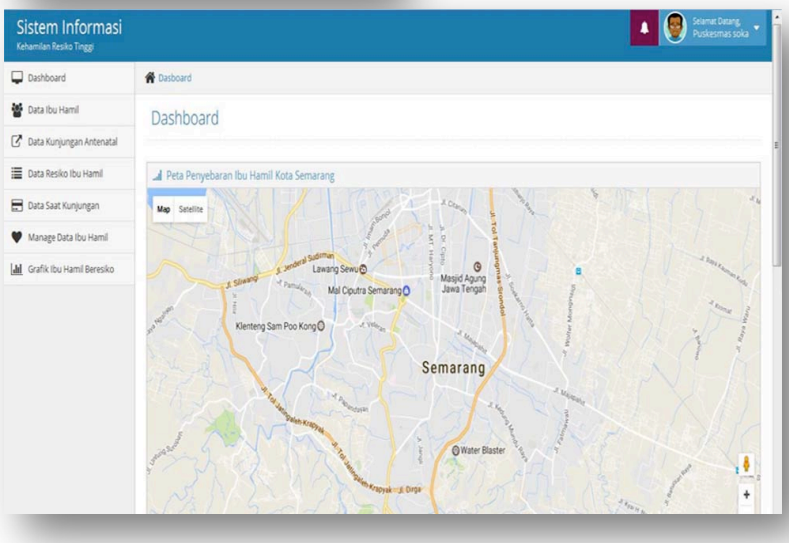

Figure 2 *Main Menu* Page

The main menu display as shown in Figure 2 presents maternity data menu, antenatal visit, maternal risk, visit data, maternal data management, and charts of risk pregnant women. This display menu is used as a tool for user menu

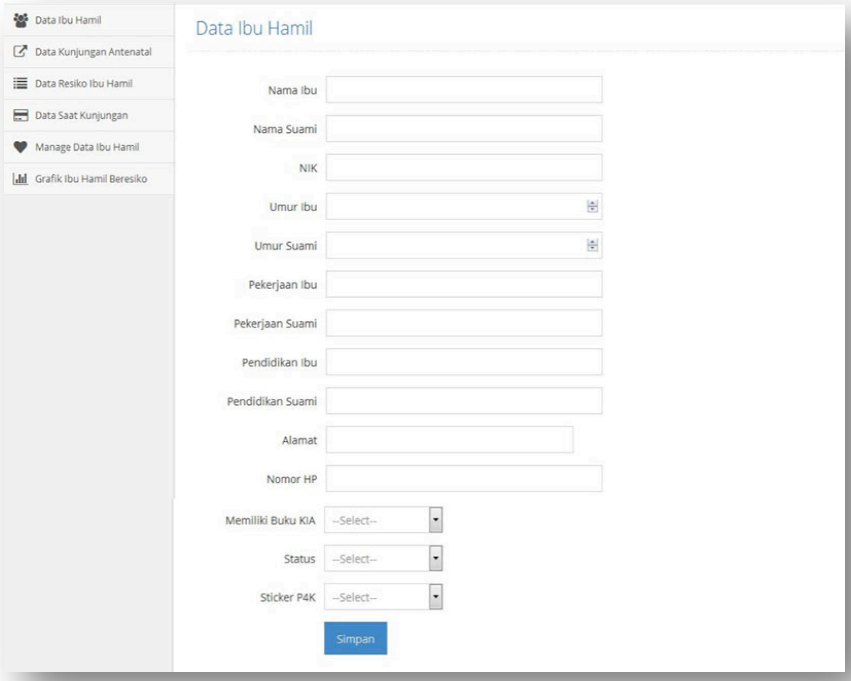

Figure 3 Demographic data of pregant women

This includes the demographic data such as name, age, working status, education, address, contact, husband data, and the ownership of maternal book

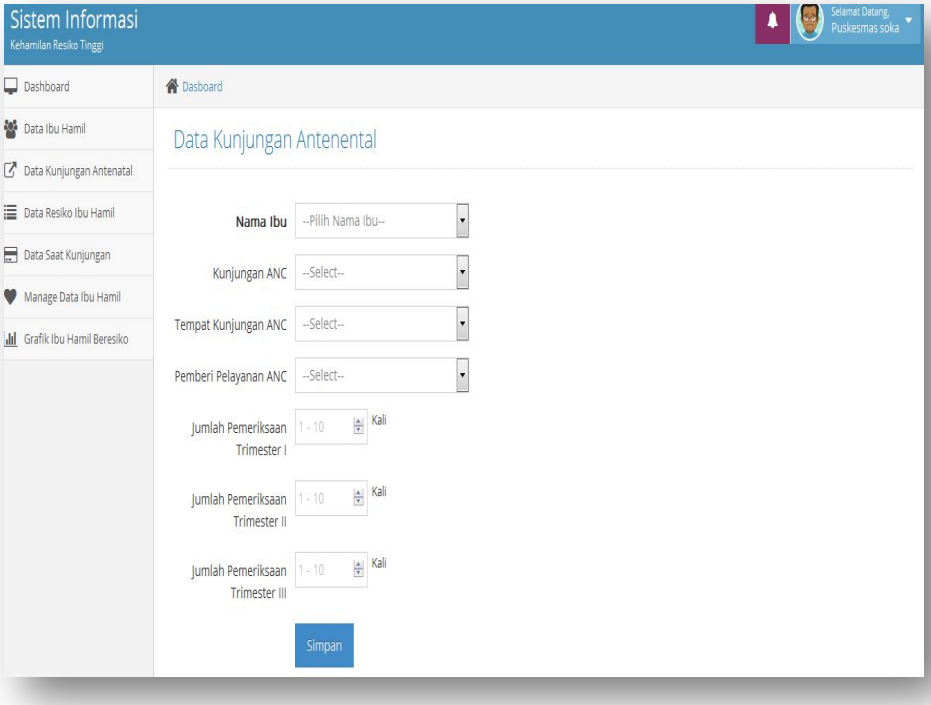

Figure 4 Antenatal visit

This contains a history of maternal ANC visits during pregnancy, consisting of places where the mother performed ANC, who was the ANC service provider, and the number of checks during the first trimester until the third trimester.

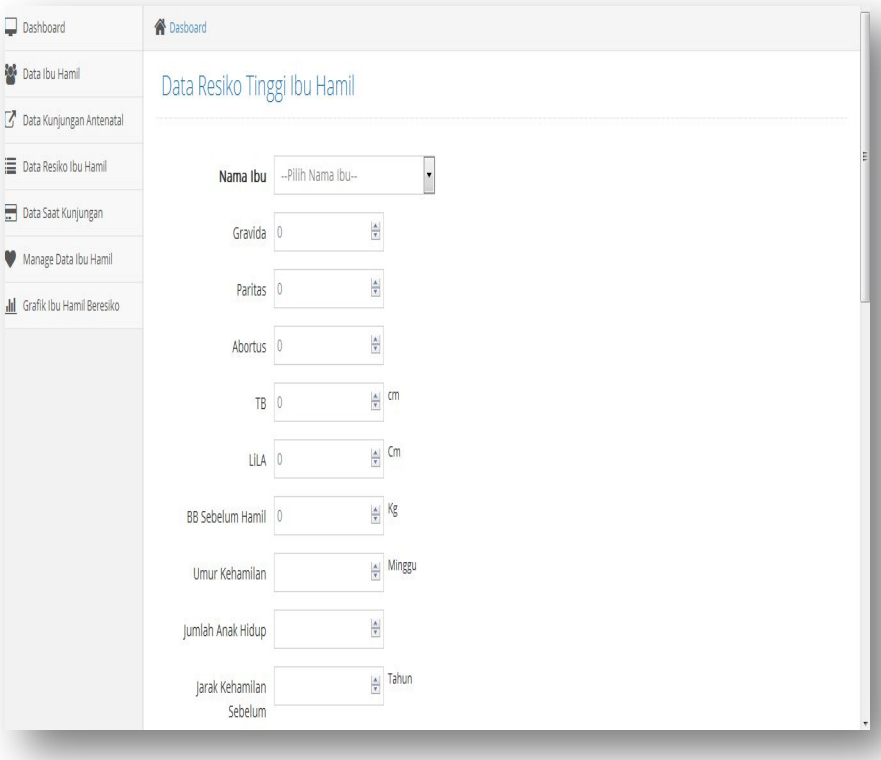

Figure 5 First page of high-risk pregnant women

This is a menu of the process of entering all types of pregnancy risk factors experienced by pregnant women. The outcomes were grouping of pregnancy risk based on Poedji Rochjati score that had been modified by the researcher.

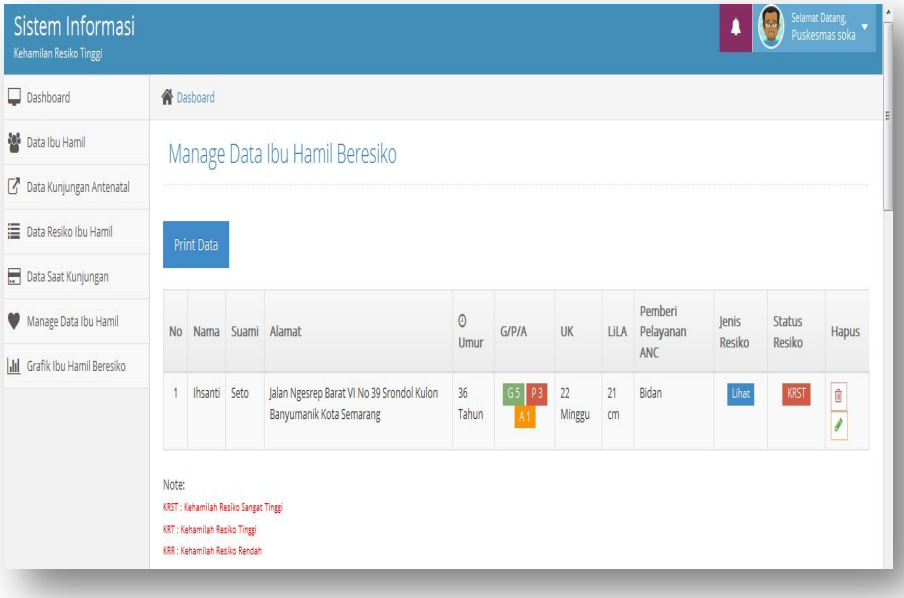

Figure 6 Admin database

This contains a database of all pregnant women at high risk

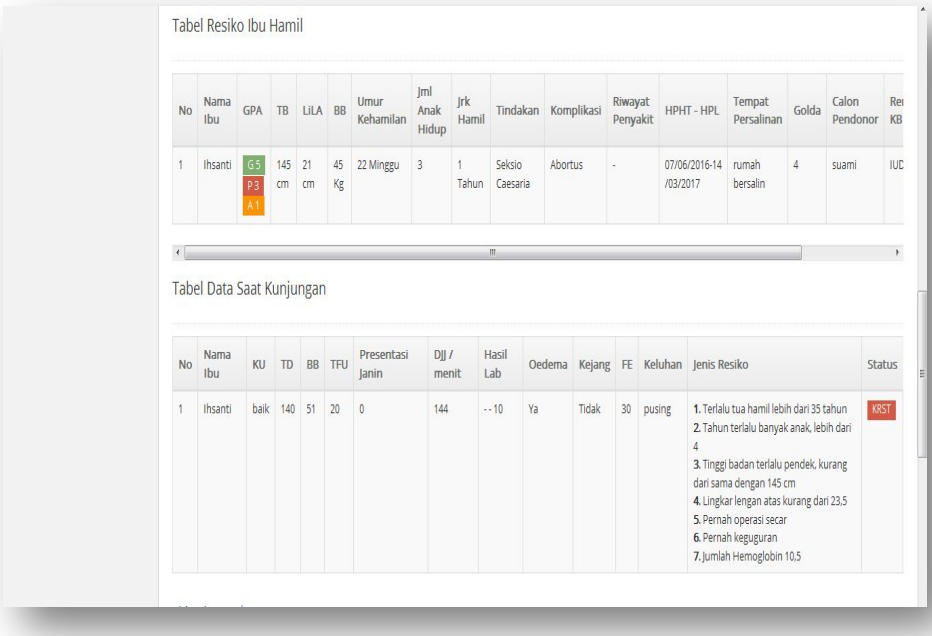

Figure 7 Admin database for data collection during visit and grouping of type of pregnancy

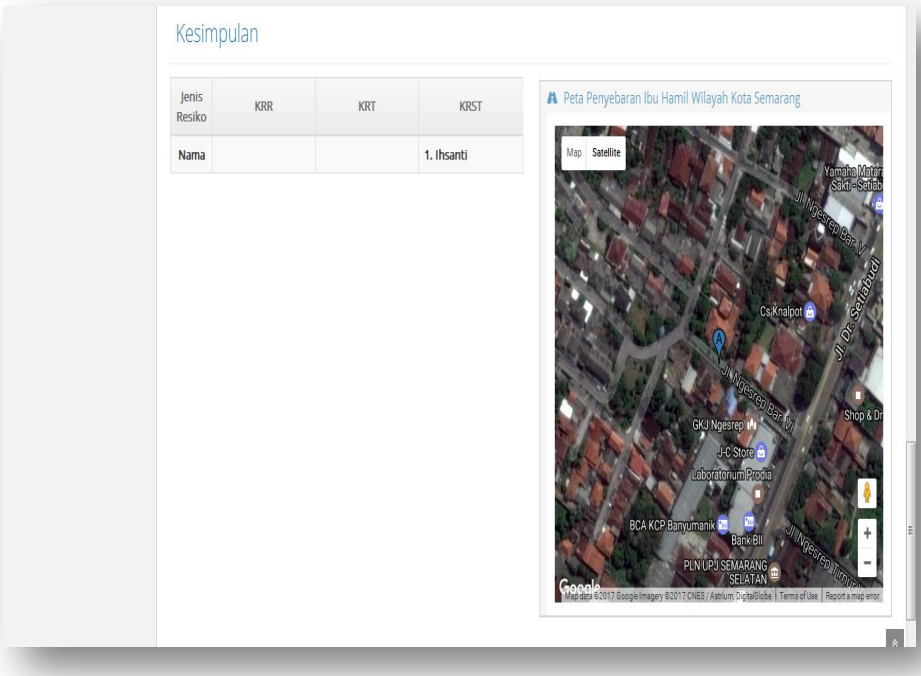

Figure 8 Map of the spread of pregnant women in Semarang

Implementation

The *implementation* phase includes the testing of prototypes to respondents.[12] In this study, the web-based system had been implemented to 10 respondents (5 midwives and 5 health surveillance officers) selected using purposive sampling.

Evaluation

The web-based system has been evaluated using Likert scale that has been developed in the designed step. The evaluation was conducted using pre-experimental design with one group pretest-posttest. Descriptive statistics and Wilcoxon test were performed for data analysis.

Table 1 Completeness value before and after using web-based system

Quality of web-based system	Before	After
Completeness		
Data is complete and detailed	30 (25%)	40 (33.33%)
Able to know the spread of pregnant women	20 (16.67%)	35 (29.17%)
Able to know the number of pregnant women at risk through the graph	20 (16.67%)	34 (28.33%)
Total	70 (58.33%)	89 (74.17)
Ease		
Reporting can be easily set up from existing files	28 (14%)	30 (15%)
Reporting available at the health center can be accessed easily by health officers in the office and the field	20 (10%)	33 (27.5%)
Easily updated with database	20 (10%)	30 (15%)
The existing reporting system facilitates coordination	27 (22.5%)	28 (23.3%)
Existing systems can automate high-risk pregnancy detection	20 (10%)	36 (30%)
Total	115 (57.50%)	157 (78.50%)
Conformity		
Available data: Can produce an information appropriate to the needs of midwives and health officers in high-risk pregnancy detection	30 (37.5%)	34 (42.5%)
Report: Information is generated according to the needs of midwives and health officers in high-risk pregnancy detection	30 (37.5%)	35 (43.75%)
Total	60 (75%)	69 (86.25%)
Accuracy		
There are no multiple entries for the same data	28 (17.50%)	35 (21.88%)
Data processing can be done correctly	26 (16.25%)	30 (18.75%)
Able accurately perform detection	20 (12.50%)	40 (25%)
Information about pregnant women produced can be trusted and free from the element of error	20 (12.50%)	30 (18.75%)
Total	94 (58.75%)	135 (84.38%)
Timeliness		
Presentation of report results can be made according to the scheduled date	27 (33.75%)	35 (43.75%)
Diagnosis of pregnancy at risk can be done appropriately	26 (32.50%)	37 (46.25%)
Total	53 (66.25%)	72 (90%)
Time speed		
Time speed in diagnosis	42 minutes	31 minutes

Table 1 shows better results of the quality of web-based system in term of completeness, ease, conformity, accuracy, timeline, and time speed after using the system in detection of high-risk pregnancies.

Table 2. Difference of quality of web-based system related to completeness, ease, conformity, accuracy, and timeliness using Wilcoxon test

Evaluation aspect	Before	After	P-value
Completeness Mean ±SD Min-max	 4.20 ±0.422 4-5	 3.10 ±0.876 2-5	 0.018
Ease Mean ±SD Min-max	 10.80 ±0.632 10-12	 15.90 ±0.738 15-17	 0.005
Conformity Mean ±SD Min-max	 6.00 ±0.000 6-6	 6.90 ±0.738 6-8	 0.014
Accuracy Mean ±SD Min-max	 9.40 ±0.699 8-10	 12.90 ±1.595 10-14	 0.007
Timeliness Mean ±SD Min-max	 2.70±0.483 2-3	 3.50 ±0.527 3-4	 0.011

Table 2 shows that there were significant differences before and after using the web-based system in terms of completeness, ease, conformity, accuracy, and timeliness with p-value < 0.05. It was proved that the web-based system is very effective to detect and monitor pregnant women at high risk. The function of this web based information system is to reduce the error rate, reduce the time to fix errors, speed up the timing of the provision of reports, improve system security, and increase satisfaction.[13] If the information presented is qualified, then the decision making will not be misled.[13]

Limitation of the study

The results of this study might not be generalized due to lack of respondents. Further study is needed with bigger sample size to examine the effectiveness of the system.

CONCLUSION

It can be concluded that the web-based information system was very effective to be applied in detection of the pregnant women at high risk. This innovation is expected to contribute positively to reduce maternal mortality rates in Indonesia, especially in Semarang.

Declaration of Conflicting Interest

None declared

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Author Contribution

All authors contributed equally in this study.

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