Developing and pilot testing M-health care application for pregnant and toddlers based on user experience

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Abstract. Indonesia is the country number 4 as the largest smartphone user. In addition to functioning as a social media, the use of smartphones for other purposes has begun to develop in order to facilitate the work. Similarly in the field of maternal and child health. Most of the public, pregnant mothers and checking the development of children under five, were conducted to the Public Health Center. As a service center, Public Health Center need to improve its services. Among other things, it needs to be supported with technology. The high number of queues, the length of queue time and the traffic jam, prompted the need for the development of health applications, based on mobile. The role of the user is crucial to the successful implementation of a technology. This study aims to measure whether the application of M-Health Care application, as a prototype of the application developed to meet the needs of users. M-Health Care Application was developed with a prototyping approach. While for the measurement of M-Health Care Application done by using approach of USE Questionnaire. From result of data processing got result, usability measurement value equal to 88.3%. This indicates the M-Health Care application prototype is considered satisfactory for the user. The results of this measurement can be used as a reference for the next M-Health Care application development model based on user experience.

Keywords—m-health, care, mobile, application, pregnant, toddlers

1. Introduction
Mobile applications are developed and used as utilization to process and present information. Indonesia will become the country with the largest smartphone active users, after China, India, and America. The population of Indonesia is about 250 million people is a big market. Smartphone users in Indonesia are growing rapidly. Digital marketing research institute E-Marketer estimates that by 2018, the number of active smartphone users in Indonesia will reach more than 100 million people (Wahyudi, 2015)[1].

GfK is a leading market research institute in Indonesia and one of the largest market research companies in the world. According to GfK data, smartphone penetration and digitalization process happen very rapidly in Indonesia. Recorded more than 88 million Internet users in Indonesia. Nine out of 10 internet users or (93%) access the internet via smartphone. There are more 51% dominated by young people with age ranges between 13 and 27 years old. Male users (56%) and female users (44%). The online population in Indonesia is very active. The average usage of 5.5 hours a day is spent...
accessing about 46 applications and web domains through smartphones. Online use is done via desktop at 11% and through tablets by 5% (GfK, 2016) [2].

The Global Positioning System (GPS) is a satellite-based navigation system developed by the US Department of Defense in the early 1970s. Initially, GPS was developed as a military system to meet military needs. However, it was then made available to civilians, and is now a dual use system accessible to military and civilian users. Google currently provides programming functionality provided by Google Maps, the Google Maps API. With the Google Maps API, Google Maps can be integrated into application that will be created to display maps, markers and more. By using these tools, we can develop mobile applications for various purposes, including the improvement of health services.

Innovative M-Health applications have the potential to transform healthcare in both the developing and the developed world. They can contribute to bringing healthcare to unserved or underserved populations; increasing the effectiveness and reducing the costs of healthcare delivery; improving the effectiveness of public health programs and research; preventing illness (including through behaviour change); managing and treating chronic diseases; and keeping people out of hospital [3].

Mobile communications can greatly increase public awareness of health issues. An initiative in Uganda sent out an SMS quiz on HIV awareness, which resulted in a 40% increase in people requesting free HIV/AIDS testing. In the UK, the NHS could take this a step further by adding SMS to the National Pandemic Flu Service’s existing online and telephone resources. Similarly, the NHS consultation phone line (NHS Direct) could send an SMS after a phone consultation, directing patients to the nearest clinic or surgery based on their responses [4].

Maternal and child health is the first priority. Maternal Mortality has already declined, but is still far from the MDGs target by 2015, although the number of deliveries helped by health workers has increased. This condition is probably caused by among others the quality of maternal health services that are not adequate, the condition of pregnant women are not healthy and other determinant factors. The main causes of maternal death are hypertension in pregnancy and post partum bleeding. This cause can be minimized if the quality of Antenatal Care implemented properly. Some conditions that can cause unhealthy pregnant women conditions include handling complications, anemia, pregnant women who have diabetes, hypertension, malaria, and other pregnancy factors. Other pregnancy factors include getting pregnant at too young, less than 20 years; pregnancy in old age, more than 35 years old; consecutive pregnancies, less than 2 years; and too many pregnancies. As many as 54.2 per 1000 women under the age of 20 have given birth, while women who gave birth to age over 40 years were 207[5].

One of the services in Public Health Centers is services for mothers and children. Maternal and child services include services for pregnant women. Child services include services for newborns, through neonatal medical records and immunization services. As a health service, Public Health Center need to improve health services quickly and appropriately. One of them by reducing the queue time for patients. The number of patients in Public Health Center on average can reach 100 people per day. With a registration time of 5-7 minutes per person. Administrative records are still manual, and some cases of registration time, such as losing or forgetting to bring a medical card, adding to the length of registration time. While the waiting time for treatment can reach 10-15 minutes per person. The condition of the registration time and the long waiting time of accumulation become the problem of most of the public for treatment to the Public Health Center. The distance is quite far and traffic jams, often a supporting factor in addition to the problem of waiting a long time.

One way to solve the problem is the need for the development of information technology. With reference to the number of smartphone users in Indonesia, the development of android based health applications is one of the right solutions. M-Health Care application is a mobile application. This application was developed with various features in it, one of them is registration to the Public Health Center through mobile application. This application was developed with prototyping approach. Prototype has been made communicated to the public to get input, modeling, and design appropriate, in accordance with public needs.

Research related to mobile application development for health has been done. Becker (2016) in his research on the implementation of mobile applications for mental health care. This mobile mental
health care application is quite acceptable to the public. This application is quite supportive and is a tool that can be used anytime by the user [6]. Other research done by Dwivedi et all (2015). Mobile application in the health field are applied to the use of antibiotic precision. Once implemented for one year, data shows that among users, 62% use the OS system while 38% use the Android system [7]. Mobile health applications are also implemented in Spain. Based on the research Garcia et all (2017) presented a mobile application to help training activities. This application is tested for the purpose of measuring the quality of the application as well as the acceptance of the mobile application. The results of these studies show that mental and physical health applications provide high utility values to the public [8]. The application has great potential for use [8]. On the other hand mobile applications of this mental and physical health, there is a relationship between application users, usage time, age, nationality and education level [8]. Research on the implementation of m-Health is also done by Kim et all (2017). Research conducted on m-Health interventions aimed at improving immunization programs, can effectively provide greater access to vaccine services [9]. The results of the research show that m-Health is very important. m-Health is a tool that can be used to improve the range and impact of the program vaccine [9].

One of the features that will be developed in M-Health Care application is the electronic medical records of the owners. This note contains data that is very personal and become one of the important information that must accompany someone wherever he goes. Information available on this electronic will be beneficial for both patients and other institutions, among others, the Public Health Center or Hospital. Suppose the patient suddenly had an accident, the hospital will be greatly helped by the information available on M-Health.

Mobile health applications in Indonesia are already emerging. Some of these mobile applications are Daftar Pasien, Public Health Center Mobile, Infokes Mobile, e-Health Surabaya, Poli Umim Z, Public Health Center Kuta Utara, ImunInfo. Those applications are the similar application in playstore. Summary results on the eight applications can be seen in Table 1

Table 1. Summary of M-Health Application

| Application Name       | Rating | Number of User | Description                                                                 | Weakness                                      |
|------------------------|--------|----------------|-----------------------------------------------------------------------------|-----------------------------------------------|
| Daftar pasien          | 21     | 221            | User: Public User registration Registration online Registration sort number Outpatient List New Patient List | The Service has not been in sync with real condition The data base is not good Application not working properly |
| Public Health Center Mobile | 4      | 29             | User: Nurse Data Input Patient                                               | Limited user                                  |
| Infokes Mobile         | 4,5    | 35             | User: Public Registration online Check the number of BPJS Share articles Online Consultation | There are still some validation bugs to fix |
| eHealth Surabaya       | 3,5    | 279            | User: Public Online Registration RS Check the queue number Online consultation Online complains Check the location of the hospital |
| Application Name | Rating | Number of User | Fitur | Weakness |
|------------------|--------|----------------|-------|----------|
| Poli Unum Z      | 5      | 3              | User: Nurse Integration with Pease application Record medic Input drug to the pharmacy Patient referral BPJS | Limited user |
| North Kuta Health| 5      | -              | User: Public Online registration View history visit View data health Setting | This application only be used for treatment to the North Kuta Health Center |
| ImunInfo         | 3,8    | 5              | User: Public User registration Read self data Add babydata Get informasion of vaksin Check schedule Public Health Center and Integrated service post Addimmunization data Seemap of Public Health Center And Integrate service post | |
| Loket            | 3      | 4              | Registrasi patient | |

The above application includes several mobile applications developed to support health services. Existing mobile application have not been used optimally by the public with some constraints, including feature completeness, data integration, software stability, and socialization.

This research is different from previous research. M-Health Care application developed focused on pregnant women and toddlers. The M-Health Care application is similar to ImunInfo application. The difference between M-Health Care application and ImunInfo application lies in the features. The features developed in M-Health Care application include medical treatment number, Public Health Center information, schedule of doctor information, patient visit history, information of location ambulance, facility to show the fastest route to certain Public Health Center and integrate with medical record of pregnant mother, neonate and immunization. Medical record recording pregnant women and medical record of neonate and immunization, that is different from the patient's general medical record. Medical records of pregnant women should be recorded in detail the data of pregnancy control visits until childbirth. Medical records in infants include neonates and immunizations. M-Health Care application integrated e-Neonate application and e-pregnancy application. Neonate application is a application to record neonate and immunization. And e-pregnancy is a application to recording pregnant woman.

Software quality is very important in a software [10]. The purpose of software engineering is to provide high quality software, and SPI is a recommendation approach to improve software processes and produce high quality software [11]. The role of user experience in measuring a software is necessary. Research related user experience in software one of them done by Fagan et all (2015). Fagan conducting quantitative studies on the use of messages software update messages to identify some user perceptions, experience, and beliefs about software update mechanisms. The results show that the user sometimes confused and annoyed with the appearance of update messages. This indicates a negative attitude associated with warning and update messages that appear on the software [12].

This study aims to measure, whether the M-Health Care application prototype has been developed is enough to meet the needs of users in the review of the four dimensions, including usefulness, ease of use, ease of learn, and satisfaction. To measure the four dimensions, questionare is used, using USE
Questionnaire. Prototype measurement is based on user experience, to generate input modeling and design according to user needs. Results from research to assist in developing Smart e-Health.

2. Methodology

2.1. Prototyping Approach
M-Health Care applications that will be developed are expected to be implemented in 16 Public Health Centers and used by the public. The application development stage of M-Health Care application uses prototyping approach. The prototyping development stage can be seen in Figure 1. The prototyping approach taken is throw away prototyping. Throw away prototyping selected because it is more suitable to the condition, used to reduce requirement risk, so we must validate or derive the system requirement [13].

![Prototyping Approach Diagram](image1)

**Figure 1.** Prototyping Approach

Researchers use a prototyping approach. This prototyping approach is chosen because it makes it easier to explore user needs, reduces the risk of misunderstanding between users with developed software, enhanced software development, and reduces the risk of development errors.

2.2. Research Methodology

![Research Flow Diagram](image2)

**Figure 2.** Research Flow Diagram

The M-Health Care application prototype results are presented to the public at the research site to get input, modeling, and design appropriate for the public. The location of data collection in Kemayoran area. The social background of Kemayoran people mostly traders, entrepreneur, and some are office
workers. The research flow diagram can be seen in Figure 2. From Figure 2 can be seen, the stages of research conducted are: 1) Identities the Content. 2) Select Criteria and Content. 3) Testing of Usability. 4) Analysis of Results.

This type of research is a quantitative research. Quantitative approach is chosen because based on the data distributed through questionnaires to users offline. According to (Nielsen, 2012) usability is a quality variable used to know how the interface is used [14]. The usability test was conducted by using a questionnaire. USE Questionnaire published by Arnold M. Lund in 2001. According to Lund (2001), to evaluate the usability of a product is recommended to use four dimensions of the USE Questionnaire [15]. These four dimensions are usefulness, ease of use, ease of learning, and satisfaction dimensions. Description of each dimension can be seen in Table 2 [16].

| Usability Dimension | Description |
|---------------------|-------------|
| Usefulness          | related to the usefulness of the product for the user. How much is the product useful and utilized by the user to achieve user goals. |
| Ease of use         | related to the ease of the user using the product |
| Ease of learning    | how fast a user can be operate the product until the user understands how to use it. |
| Satisfaction        | with regard to user acceptance, feelings and opinions of the product. |

To measure the four dimensions (usefulness, ease of use, ease of learning, and satisfaction) the author uses USE Questionnaire. USE Questionnaire is a tools of questionnaires. USE stands for Usefullness, Satisfaction, and Ease of Use [17]. There are three main dimensions in initial development using USE Questionnaire [17]. USE Questionnaire is used to measure the usability of the four dimensions by including 30 questions. Assessments using USE Questionnaire were conducted on a graded scale of ratings. Instrument Use Questionnaire can be seen in Figure 3.

![Figure 3. USE Questionnaire](image)

After determining the four dimensions measured, then analyzed the results of the questionnaire that spread. Results of data analysis to determine the usability level of M-Health Care application prototype based on usefulness dimension, ease of use dimension, ease of learn dimension, and satisfaction dimension. Total score usability calculation is calculated from the average of all dimensions multiplied by 100 percent.

2.3. Participant

Data collection by distributing questionnaires, followed by 31 female respondents with an age range of 20-60 years. The age distribution of respondents is: age 20-30 years as many as 19%, age 31-40 years as much as 26%, age 41-50 years as much as 48%, and age 50-60 years as much as 7%. Number of respondents who have a toddler as much as 47%.
2.4. Research Model
M The model of this research flow is illustrated in Figure 2. From the research model is made hypothesis as follows:

- Usefulness has a significant positive effect on Usability
- Ease of use has a significant positive effect on Usability
- Ease of learnings has a significant positive effect on Usability
- Satisfaction has a significant positive effect on Usability

![Research Model](image)

Figure 4. Research Model

3. Result And Discussion

3.1. Model
M This M-Health Care application prototype has the following features:

- Public Health Center Services. In this service there is a feature for the user to choose the location of Public Health Center to be the destination, get information about the Public Health Center. Information on available Public Health Center includes the types of poly services available at Public Health Center, doctor's schedule, number of available rooms, address and contact number of Public Health Center, and location of ambulance existence. In this Public Health Center service, the patient can register the medication at the targeted health center, and get the sequence number of the patient queue.
- The Maps Service, available on this service features to see the location of Public Health Center around the user, the distance that must be taken from the user location and the estimated time required from the user location to the destination.
- Service History Visit, on this service the patient can see history of patient visit to Public Health Center and polyclinic ever go.
- This M-Health Care application integrates with e-pregnancy and e-neonate applications. E-pregnancy is an application to record medical records of pregnant women and e-neonates is an application for newborn baby recording and immunization. Display of M-Health Care application can be seen in Figure 5.

![M-Health Care Application Prototype](image)

Figure 5. M-Health Care Application Prototype
The M-Health Care application to be developed has a single data base. This M-Health Care application will integrate with e-pregnancy application and e-neonate application. The e-pregnancy application is an application developed for the recording of maternity medical records, maternity record-keeping, and maternal postpartum. This e-pregnancy application also features to visualize maternal pregnancy data and prediction of mother's birth type. Is it normal or cesarean, so that should be referred to the hospital. The e-neonate application is an application for recording newborns and immunization medical records. M-Health Care applications, in addition to having the function to register, in the future will be added features for patient medical records, services to obtain information about maternal and child health, and as a media of consultation through mobile application. M-Health Care application prototype modeling can be seen in Figure 6.

![M-Health Care Model](image)

**Figure 6. M-Health Care Model**

### 3.2. Testing

The result data from the questioner is tested. The calculation results can be seen in Table 3. Table 4 shows the usability level of each dimension. The highest dimension is Usefullness as big as 89.66% and the lowest dimension is Ease of Use as big as 85.85%. Usefullness dimension has the highest value, it indicates the need of the community to use M-Health Care application. While at the lowest score is on the dimensions of satisfaction. This happens, because based on user experience in mobile application usage. The test results of each dimension can be seen in Table 4.

| Usability Dimension | Score  |
|---------------------|--------|
| Usefulness          | 89.66% |
| Ease of use         | 85.85% |
| Ease of learning    | 87.83% |
| Satisfaction        | 89.61% |

Overall ratings on each dimension get good results, with an average of over 85%. The assessment results in each dimension describe the condition of M-Health Care prototype as follows:

- Measurement results on Usefullness dimension of 89.66%, it shows has a high usability value for the user.
- The measurement result on Ease of Use dimension has value equal to 85.85%. This shows that this prototype of M-Health Care application is easy to use by user.
- The measurement result on Ease of Learning dimension has a value of 87.83%. This shows that the prototype of M-Health Care application is easy to learn by user. Users do not need to take too long u learn to use this application.
- The result of measurement on Satisfaction dimension has value equal to 89.61%. This shows the prototype M-Health Care is satisfactory for the user.
This study was conducted to determine the level of needs and usefulness of the application of M-Health Care. Of the 30 questions in USE Questionnaire, the third questioner item (It gives me more control over the activities in my life) in the Usefullness dimension has a value of 94%. This item is one indicator that represents the usefullness valuation indicator. This indicates that the prototype of M-Health Care application has usability that helps users. The smallest measurement value is on the Ease of Use dimension. In the Ease of Use dimension, the third and fourth indicator items (Is is user friendly and it requires the fewest steps possible to accomplish what I want to do with it) have a value of 81.3%. This indicates that not all users are easy and familiar in using M-Health Care applications, it needs improvement from the user interface.

| Dimensions       | Indicators | Descriptions |
|------------------|------------|--------------|
| Usefullness      | U1         | 87.3%        |
|                  | U2         | 93%          |
|                  | U3         | 94%          |
|                  | U4         | 91.3%        |
|                  | U5         | 93%          |
|                  | U6         | 91.3%        |
|                  | U7         | 80.6%        |
|                  | U8         | 84%          |
|                  | U9         | 92%          |
|                  | U10        | 91.3%        |
| Ease of Use      | E1         | 91.3%        |
|                  | E5         | 86.6%        |
|                  | E3         | 89.3%        |
|                  | E4         | 84.6%        |
|                  | E5         | 81.3%        |
|                  | E6         | 81.3%        |
|                  | E7         | 84%          |
|                  | E8         | 84%          |
|                  | E9         | 84%          |
| Ease of Learn    | L1         | 89.3%        |
|                  | L2         | 88.6%        |
|                  | L3         | 88.6%        |
|                  | L4         | 82%          |
| Satisfaction     | S1         | 87.3%        |
|                  | S2         | 82.6%        |
|                  | S3         | 87.3%        |
|                  | S4         | 87.3%        |
|                  | S5         | 82.6%        |
|                  | S6         | 90.6%        |
|                  | S7         | 90.6%        |
Total usability measurement results of 88.3%. This indicates that overall prototype M-Health Care application is quite satisfactory according to user. This indicates that the M-Health Care application prototype needs to be further developed. Although the overall value of usability is good, and each dimension has a good enough value as well, it still needs to be improved on some things. Among other things from the interface side. Therefore it is necessary to test methods to measure aspects of use from the system interface side.

4. Conclusion
Prototype M-Health Care application is tested in the public to get the right input and modeling for further M-Health Care application development. Tests were performed on five variables, including usefulness, ease of use, ease of learn., satisfaction, and usability

The test results in each dimension are: 89.66% for usefulness dimension, 85.85% for ease of use dimension, 87.83% for ease for learning dimension, and 89.61% for satisfaction dimension. This shows that from all sides of the dimension, the prototype of the M-Health Care application is quite good according to the user and its existence needs to exist.

Usability dimension of 88.3%. The usufullness, ease of use, ease of learning, and satisfaction dimensions, each has a positive effect on usability variables. This shows that the public needs this M-Health Care application and recommends its use.

The maturity of this application needs to be improved. This app needs to be added to other features. Some features that need to be developed include check the number of BPJS and integration with other application, example Family Information System applications.

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