INDHCI: Indonesian Districts Health Care Information Model

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Abstract. Indonesia as the fourth most populated country in the world has inadequate information health care treatment. Moreover, the health index of the population of Indonesia is still relatively low compared to other countries. Medical record for example, no national medical record health information systems integrated which answer challenges to decision making services soon. Provincial health office no have medical record data which doctor need and adequate of information system for decision making to medical action. Indonesian district healthcare information based on raspberry (INDHCI) will be started of Indonesian district and concern in hospitals service healthcare, doctor and patient can communication. Will be built collaboration on district where need to integrate all hospitals healthcare data such as medical record, health facility for hospitals service data medical record collection with public and private community health center and the ministry of health of the Republic of Indonesia. The development will implement current technology such as Near Field Communication or NFC is the development of Bluetooth and RFID in which NFC provides communication technologies using Bluetooth to connect and RFID as a wave to connect to other NFC devices. NFC allows mobile phones to store necessary data safely and reliably. The data can be sent to other phones using NFC or read by an NFC reader. Then data can be save on Data Warehouse. Data can be used as Indonesian district health care information, Indonesian health research by institution and decision Support System by doctor to serve patient any where. The Indonesian district healthcare Information Model will be built in smartphone application, using the Internet of Things (IoT).

1. Introduction
Health is one of the leading indicators of the prosperity of a nation. With advanced technological development and usage in Indonesia, it is expected to have a better health index. Conventional data service in healthcare and medical record has several disadvantages such as difficult to find because the manual of medical records writing, and moreover, it is difficult to maintain the records. Sometimes, the creating of medical records are repeated task when the patient meets with a new medic person, where the same questions will be asked, such as medicine allergy and disease’s history. Those
disadvantages can be overcome by the implementation of the Electronic Medical Record (EMR), where the completeness and accuracy data of medical records on EMR can be better than the conventional medical records[1]. Medical Records are files which contain records and documents about the patients’ identity, examination, therapy, treatment, and other services that have been given to patients[2].

A well-built EMR at least should fulfill several important electronic data storage matters, which is privacy or confidentiality, integrity, authentication, access control, non-repudiation, and availability. Medical record data that has been inputted to the EMR must be accessible whenever and wherever as needed. This requirement is difficult to fulfill because of its dependence on internet connections and the availability of server services where the EMR is stored. On internet-based EMR retrieval and processing of the data stored in the server, which can only be done online through internet or intranet network. Therefore, technology is needed to enable data retrieval and processing off-line and in conditions that allow data stored on mobile devices to be sent to the server for broader interest. Technology, which can provide these needs, is Raspberry Pi-based Near Field Communication (NFC). Through NFC, data can be retrieved and processed off-line, and at some time, the data can be sent to the server for broader interest.

Moreover, NFC-based medical records also allow the data to be used by health services anywhere and anytime, regardless of where the medical record was first made. Some Electronic Medical Record researches are carried out by [3], [4], and [5]. In [3] the benefits of EMR which facilitated administrative personnel in retrieving patients’ information, whereas in [4] and [5] it was stated that EMR was advantageous for patients because it increases the efficiency of the health services process. The development of NFC-based medical records was developed by [6], [7], and [8]. These three types of research use RFID cards to store medical record data and medical transaction.

2. Theory Thing and Previous Research

Indhci is an application which consist of health care information and medical records are files which contain identity, history, physical determination, laboratory, diagnosis, and medical treatment of a patient recorded both in writing or electronically. When it is storing electronically, it will require a computer by utilizing database management. The definition of the health care and medical record is not just a registration activity, but it must be seen as a system of implementation starts from health care information, registration, services, and remedial actions which are received by patients, after that files store up and issue the files from the storage when somebody needs it for their purposes or other purposes.

Indonesian District Healthcare is a healthcare practice application which supported by computer technology running on the internet which can applied in a smartphone or recognized. There are many other words for INDHCI implementation, and they are: 1. Information about the area affected by a disease outbreak. availability of medical personnel, hospitals and patients 2. Clinical Decision Support System (CDSS), where providing digital information for a healthcare professional to use in diagnosing or patient treatment of Indonesian district. 3. Telemedicine, where physical and psychological diagnosis and treatments at a distance. 4. Consumer health informatics, where using digital medical information. 5. Health knowledge management, where healthcare data are processed in term of tacit and explicit knowledge. 6. Health informatics or Healthcare Information Systems, where a specific application which built to serve healthcare business processes such as appointed scheduling, patient data management, work schedule management, and other tasks in healthcare administration. 7. E-mental health, web-based application which built to help patient, society and health worker for recognizing and curing of a patient with mental health problems[26]

According to the Medical Practice Law in the explanation of article 46 paragraph (1) what is meant by medical record is a file that contains records and documents about the patients’ identity, examination, treatment, actions and other services which have been given to the patients. Some types of medical record data can be in the form of text (both structured and narrative), digital images (if already applied digital radiology), sounds (such as heartbeat), videos or biosignal ones such as
electrocardiogram (ECG) records[12]. Regarding medical records, inevitably, we will look at 2 (two) essential parts that need to be considered, namely: Patient Record and Management. The patient record is information recorded both in writing and electronically about health and disease conditions of the patient. Generally, patient records are individual; there has never been a health record of several people collectively in a medical record. The second part is related to management. Management is a process of processing and compiling health and disease condition of the patients in order to become useful information for responsibility in terms of management, finance, and the condition of the patient’s health development.

Meanwhile, the smartphone continues to grow, and the addition of various features make this communication device becomes multi-function. One of the features which are currently starting to be embedded in a smartphone is Near Field Communication (NFC). This device allows smartphones to communicate with other mobile devices without going through a cellular network at a distance of about 4 cm. NFC smartphones can also read data which is stored on smart cards (NFC tags) and many smartphones have been equipped with NFC. In 2015 around 247 million smartphones were equipped with NFC[14]. Near Field Communication (NFC) is a new wireless connectivity technology with a short-range radius, which evolved from a pre-existing process of combination of interconnection and contactless identification technologies.

Products with NFC capabilities will dramatically simplify the way to interact with other NFC-based products because NFC offers a fast connection both in exchanging information or payment securely. The regular communication between 2 devices that support NFC occurs when they are at a distance of 0 to 10 centimeters[16]. A simple gesture or touch can initiate an NFC connection. Another advantage of NFC is that it is compatible with Bluetooth or Wi-Fi. NFC and Bluetooth are communication technology with short communications ranges, which have been integrated with cellular phones. The principal supremacy of NFC compared to Bluetooth, is that the communication set-up time, which is very fast. If a Bluetooth device needs to do the process manually to identify another Bluetooth device, the connection between 2 (two) NFC devices can be done instantly (<0.1 seconds)[16]. The maximum NFC data transfer is 424 Kbps, lower than Bluetooth at 721 Kbps. NFC has a communication radius that is closer than Bluetooth, which is less than 10 centimeters. Its provides better security and makes the NFC very suitable for crowded areas. Unlike Bluetooth, NFC is compatible with the RFID that already existed. Another difference with Bluetooth is the type of network used. NFC network is point-to-point while Bluetooth is point-to-multipoint. The advantages of NFC over RFID are NFC can be used for two-way communication and installed on smartphones [17]. In addition, NFC is also equipped by devices that are able to regulate secure elements. [18]. These advantages make NFC suitable for storage and exchange data safely through the smartphones such as e-payment applications [18] and [19] or e-wallet[20], medical records [6], and health services [21] and [22].

In this implementation we used Raspberry Pi 3 where it is an ATM card-size micro computer developed by the Raspberry Pi Foundation, UK [24]. This single-board computer was developed with the aim of teaching the basics of computer science and programming for students all over the world[25]. Although microcontrollers have physical properties such as Arduino, which is better known for prototyping projects, but it is not likely with the Raspberry Pi which is very different from most microcontrollers, and is actually more like a computer than Arduino. The Raspberry Pi consists of many important hardware parts with several important functions. The main part of Raspberry Pi is the processor. Each Raspberry Pi has a Broadcom BCM2835 chip that embodies an ARMv8 Quad-core CPU. The chip has a 700MHz clock speed and 32-byte system. The Raspberry Pi has an SD card slot for SD cards that act as a storage which includes all the operating system and other files stored on the SD card. HDMI Port is used as audio and video output. An HDMI to DVI (Digital Visual Interface) converter can be used to convert HDMI to DVI signals which is usually used by a monitor. Raspberry Pi requires a 5V DC voltage supply through micro SD. This device also has a RCA composite video connector for video output and 3.5 mm stereo jack for audio output. The Raspberry Pi has 26 GPIO pins that help to connect to low-level peripherals and expansion boards.
3. Propose IDEA
Architectural design presents the basic framework of software systems that are built. Information system development architecture of health care and electronic medical record based on web and android-based Near Field Communication (NFC) which is shown on the following figure 1.

3.1 Systems Architecture

![System Architecture Diagram]

Figure 1. System Architecture

Many researches have been conducted on Electronic Medical Records and other related researches. In an effort to overcome the problems surrounding health care EMR, a literature review is needed as one of the methods of research that will be carried out. Among them are shown in

Table 1. Previous research metric

| Writer                        | Title                                                                 | Methodology               | Result                                                                 |
|-------------------------------|-----------------------------------------------------------------------|---------------------------|-----------------------------------------------------------------------|
| Agung W. Setiawan, Nedya Utami, Taufiq R. Mengko, Adjidrayanto, 2014 | Implementation of electronic medical record in community health center towards medical big data analytics application | Big Data, web base       | Integration with big data medical analytics applications are used in Decision Support System. |
| A Supriya, S Ramgopal, Sara Mohan George, 2017                      | Near field communication based system for health monitoring           | Near Field Communication (NFC) | How the technologies can be used to meet the challenges in health care management. |
| Noor Cholis Basjaruddin, Kuspriyanto, Edi Rakiman dan Mikhail Bagus Renardi, 2017 | Development of Near Field Communication (NFC)-based Electronic Medical Record | Near Field Communication (NFC) | Medical record information system helps doctors, paramedics to do the diagnosis, therapy, and patient’s treatment. |
| Reza Firtono, Deddy Triyanto, Tedy Rismawan, 2017                     | Prototype of a Puskesmas patient’s treatment card using RFID card.    | Near Field Communication (NFC) dan Web Base | Prototype of the patient treatment card and the storage of the patient’s medical record data using RFID reader and RFID card as the patient’s card. |
3.2 Use Case Diagram

![Use Case Diagram](image)

**Figure 2. Use Case Diagram**

3.3 Class Diagram

![Class Diagram](image)

**Figure 3. Class Diagram**
4. Result and Analysis

4.1 Prototype display of the first page on Patient Menu.

![Prototype display of the first page on Patient Menu](image)

**Figure 4.** Main Menu of INDHCI (Indonesian District Health Care Information)

4.2 Display of Admin Login Page.

![Display of Admin Login Page](image)

**Figure 5.** Admin Login of INDHCI

4.3 Display on the Patient Menu in Admin.

![Display on the Patient Menu in Admin](image)

**Figure 6.** Patient Menu in Admin
4.4 Display of the Patient Medical Record Menu.

![Patient Medical Record Menu](image1)

**Figure 7.** Patient Medical Record Menu

4.5 Design of the patient’s Login Page.

![Patient and outpatient Login Page](image2)

**Figure 8.** Patient and outpatient Login Page
4.6 Prototype Android display of the first page on Patient Menu

![Prototype Android display of the first page on Patient Menu](image)

Figure 9. Dashboard on android

4.7 Display of Admin Login Page.

![Display of Admin Login Page](image)

Figure 10. Admin page on android

4.8 Design of the doctor Login Page

![Design of the doctor Login Page](image)

Figure 11. Doctor login
5. Conclusion
Along with rapid population growth the need for health services that is quite high in Indonesia has become a priority. The need for health services is currently unsatisfactory because health education information and service information are not fast enough. However, with fast information technology, Indonesia has great potential to use cellular health as a tool to improve health services throughout the Indonesian archipelago specifically in the districts. The health service-based application framework for the district is designed for district-level information services which will then be continued at the central level. Technological advancements such as telemedicine (e-health and mobile health), information about disease outbreaks in the district, suspect outbreaks of disease to personal health records form the basis of this application, each of which we explain in this paper. Indhci is intended to provide information on health care education for district residents, assisting health service providers / medical practitioners in the welfare of the community. In addition, the making of this application aims to assist health care providers / medical practitioners and patients in managing and managing consultation appointments. Furthermore, people can use Indhci to educate themselves about their medical / medical history. In the future, this application will be developed by providing the latest news in the medical and health fields and emergency button features reporting on the quality of medical services, health information and online payment processing and consultation. With this application, we hope to improve the level of health of the population in Indonesia especially the districts.

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