Development Intelligent E-Health Model of Indonesian Province Using Big Data

Dedy Prasetya Kristiadi[1], Alfredo Pasaribu[1], Yoas Arnest Soetopo[1], Andri Irawan[1],
Lukman Nulhakim[1] and Jawahir[2]
[1]Department of Information System, STMIK Kuwera, Jakarta, Indonesia
*[2]Department of Information System, Universitas Raharja, Tangerang, Indonesia*

Abstract: The need for public health services in a country is urgent need because the community is an important asset in a country. Therefore, the state must be able to guarantee its citizens to stay healthy with maximum service. Rapid population growth is the main reason for strengthening the poorly coordinated national health information system. In addition, the use of inadequate information systems for decision-making requires the integration of all patient data in medical records, health facilities, health workers such as doctors and experts, health financing, community participation, and health management. The intelligence model of integrated health services is a model that will be focused on the field of health services and will build collaboration in data collection with public and private health centers and hospitals, the Social Security Administering Agency (BPJS) for Health, the Ministry of Health of the Republic of Indonesia and the World Health Organization (WHO). Health service development will be built by implementing Data Warehouse, Big Data, Data mining, machine learning, knowledge management, and Decision Support systems. Application development will be built on intelligence phones, using the Internet of Things (IoT) and extracting Indonesian health information from geo-based and up-to-date social media.

1 INTRODUCTION

Indonesia is an archipelagic country that often faces major natural disasters and has an impact on casualties. Natural disasters are disasters caused by natural upheaval. For example, earthquakes, tsunamis, volcanic eruptions, floods, droughts, hurricanes, and landslides (Kesehatan, 2022a). Furthermore, the Indonesian state also often faces social disasters such as conflicts in certain areas that result in casualties. Relief for disaster victims often experiences delays in medical treatment, lack of equipment and geographical locations that are difficult to reach by medical personnel (Sosial, 2022). Casualties and injuries also of- ten occur on roads that require immediate help. The readiness of health services for medical personnel and hospitals is an urgent need to save victims. In addition, patient administration in the form of medical record administration and health insurance funding is also an inseparable need (Kesehatan, 2022b). The integration of patient data from the lowest level of health services to the central level must be developed immediately in line with population growth. Based on population administration data (Adminduk) the results of the population census (SP2020) in September 2020 recorded a population of 270.20 million. Meanwhile, the census as of June 2021, the population of Indonesia is 272,229,372 inhabitants, of which 137,521,557 people are male and 134,707,815 people are women (Negeri, 2022) and based on the Health Profile of Indonesia in 2020 has 2,985 hospitals consisting of 2,449 general hospitals and 536 special hospitals (Kesehatan, 2017b) spread across provinces and regions, cities and districts in Figure 1.

Human resources in hospitals consist of medical personnel, pharmacy staff, nursing staff, other health workers and non-health workers (Kesehatan, 2022b; Kesehatan, 2020). There are 817,145 HRK in the hospital, consisting of 569,714 health workers and 247,431 health support personnel. The data can be seen in Figure 2.
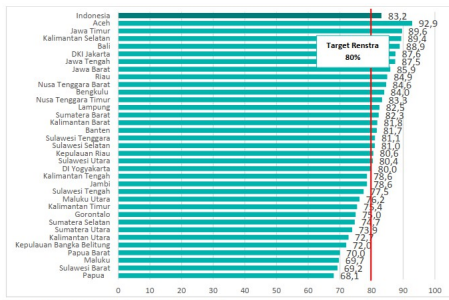
Figure 1: Hospital in Indonesian.
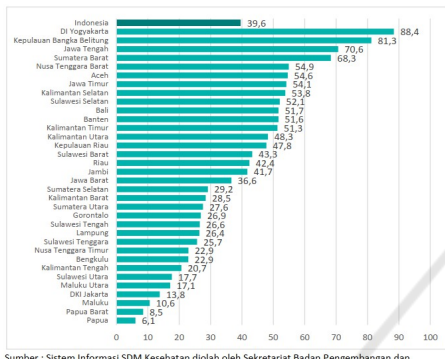
Figure 2: Indonesian Human Resources Health.

At a lower level of government, there is a commu- nity health service center (puskesmas) with the main objective of seeking first-rate individual public health with promotive and preventive actions. The num- ber of Puskesmas in Indonesia as of December 2020 is 10,205 consisting of 4,119 consisting of inpatient Puskesmas and 6,086 non inpatient Puskesmas. This is explained in Figure 3.
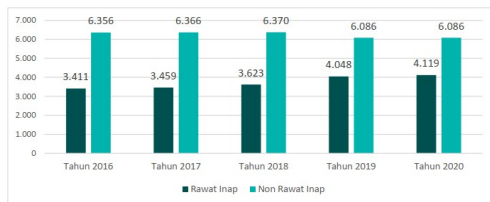
Figure 3: Inpatient and Non Inpatient Health Centers.

The ratio of Puskesmas in patients and nonpatients to sub-districts in 2020 is 1.4. This illustrates that the ideal ratio of Puskesmas to subdistrict is at least 1 Puskesmas. The data can be seen in Figure 4.

Based on the Regulation of the Minister of Health Number 43 of 2019 concerning Health Centers, the types of health workers in the Puskesmas consist of at least doctors, dentists, nurses, midwives, public health promotion workers, and behavioral sciences,


Figure 4: Puskesmas in Indonesian.

environmental health workers, nutritionists, pharma- cists and/or pharmaceutical technical personnel, and medical laboratory technology experts (Kesehatan, 2017a). The number of health workers on duty at puskesmas in Indonesia in 2020 is 434,308 people. The number and types of puskesmas health workers are calculated based on a workload analysis by con- sidering several things, namely the number of services provided, the number of residents, and their distribu- tion. This data is described in Figure 5.
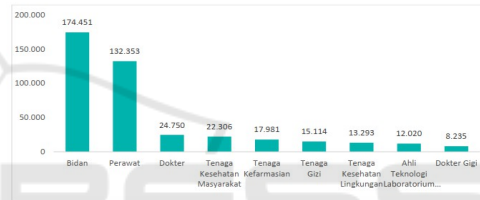
Figure 5: Health Workers at The Puskesmas.

Posyandu (Integrated service post) is a social institution that accommodates community empowerment in basic social services. The task of this com- munity institution is to provide health promotion assistance to the smallest scope of government while at the same time providing preventive measures against disease in the community. For example, maintaining maternal and child health, immunization, family planning programs, immunization, nutrition, prevention, and control of diarrhea. In Indonesia, there are around 80% active posyandu from 15 provinces that report. Posyandu data is shown in Figure 6.
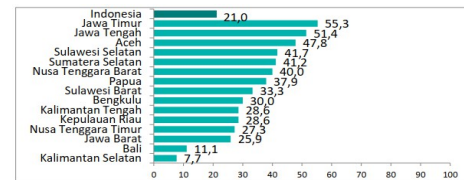
Figure 6: Posyandu at Indonesian Province.

Based on the ratio of data on rapid population growth and the distribution of health service infrastructure which includes posyandu, health centers, hospitals, medical personnel, and health insurance that is not balanced, big data is needed that allows data integration to ensure the implementation of maximum health services. The novelties of this research are:

1. Individual data collection from birth to death is a must in order to provide optimal health services.
2. Data collection on pregnant women that produces health data on birth failure, baby defects, and death. This includes health promotion, patient medical records, and outpatient services.
3. In addition, data on drug readiness, facilities such as ambulances for victims who need immediate assistance, and the readiness of health workers are also required.
4. Social media can also support this health service by providing accurate and up-to-date information about casualties due to disasters, accidents, mal- practice cases in hospitals, etc.
5. Data integration in big data can also be used to validate health insurance claims and information needed by provincial and central governments in making decisions.

2 LITERATURE BIG DATA

Big Data is a large collection of data that is very useful in the business world to store, manage, and manipulate large amounts of data at high speed according to a predetermined time to get the right information (Kesehatan, 2017b). there are five characteristics of big data, namely (Sudarto et al., 2018):
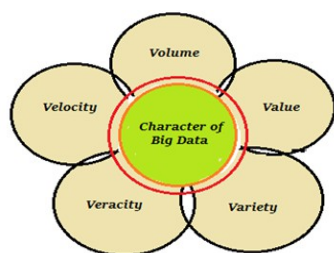
Figure 7: Big Data Character.

The character of big data consists of:

1. Having the amount of data (volume) that has been manipulated and analyzed to get optimal results (Sudarto et al., 2018). Manipulating and analyzing very large amounts of data requires a

lot of resources so it is only archived in log form (Sudarto et al., 2018).
2. Increasing the amount of data (Velocity) in a short time requires fast processing so that the data results can be used quickly (Sudarto et al., 2018).
3. Types of data (varieties) that are stored, analyzed and used. Data can be in the form of location co-ordinates, video files, or data received from various media. The data must be sequential so that it can be used maximally and quickly (Kesehatan, 2020).
4. Value is defined as the quality of valuable data, stored and used for further processing.
5. Veracity is defined as data accuracy and consistency with data source analysis.

2.1 Hadoop

Hadoop is a software framework to support applications running on Big Data (Balusamy et al., 2021). The Hadoop architecture consists of the Hadoop Dis- tributed File System (HDFS) and the MapReduce programming framework. Large files on the machine in large clusters are stored in HDFS with a sequential block model then each block is sent to the machine for error checking. The MapReduce method is used to process data allocated to each node in Hadoop (Kristiadi et al., 2020; Kristiadi et al., 2018). Hadoop core services on Big Data can be illustrated in the following figure 8.
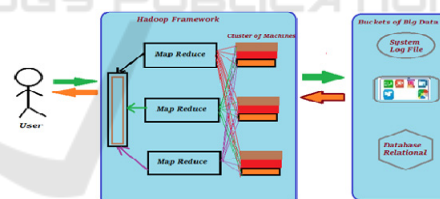
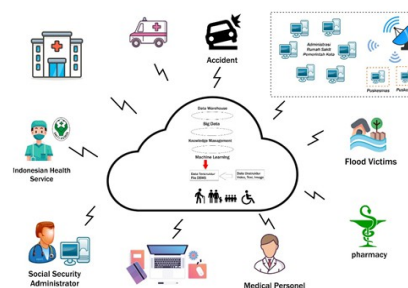Figure 8: Hadoop on Big Data.

2.2 Proposed Idea

Figure 9: Intelligence Health Service Model Design with Big Data Technology.

The need for data integration of public health services from the lowest levels of government aims to monitor, prevent and improve the health of citizens. In addition, the integration of health data supported by computer technology with internet media can help residents in remote areas and the government in terms of:

1. Areas affected information by disease outbreaks and the availability of medical personnel, hospitals, medicines, and patients.

2. Clinical Decision Support System (CDSS), which provides digital information for a health professional to use in diagnosing or treating patients in districts in Indonesia.

3. Telemedicine, where the diagnosis and treatment of physical and psychological emotely.

4. Citizen health informatics, which uses digital medical information (Balusamy et al., 2021; Kristiadi et al., 2018).

5. Knowledge management to health, namely health care data will be processed in the form of knowledge and experience that can be practiced by citizens.

6. At the village level hospital which is integrated with the provincial hospital, a special application is built for the Health Information System to serve appointment scheduling, patient data management, work schedule management, and other tasks in health administration (Kesehatan, 2020; Negeri, 2022).

7. E-Mental health, a web-based application built to assist patients, the public and health workers in recognizing and curing mental patients (Kristiadi et al., 2019; Kristiadi et al., 2021a)

8. Information on accidents that occurred in residents that occurred outside the area where they live.

9. Information on the management of deceased patients.

A medical record is a file that contains records and documents about patient identity, examination, treatment, action, and other services that have been pro- vided to patients and outpatients (Kesehatan, 2022c; Kristiadi et al., 2019) based on medical practice. While the type of medical record data in question can be in the form of text (both structured and narrative), digital images (if digital radiology has been applied), sound (such as heartbeat), video, or biosignals such as electrocardiogram recordings. The medical record consist of Patient Record and Management. The medical record is information that is recorded both in writ- ing and electronically about the health condition and disease of the patient and

Management is the process of processing and compiling the health condition and disease of the patient so that it becomes useful infor- mation for accountability in terms of management, fi- nances, and the condition of the patient's health development (Kristiadi et al., 2021b; Rui and Danpeng,2015).

An information system model that can accommodate early health services, accident, and elderly care, death, health workers, available drugs, funds, and facilities must be the main focus of an integrated system Kesehatan, 2022c). This model presents a system consisting of a file containing identity in the form of health services at the posyandu (immunization, history of toddlers, etc.), medical history, physical examination, laboratory, diagnosis, treatment of patients from accidents to deaths recorded both in writing and electronically called files. medical. Data is stored in big data with good database management. The definition of health services recorded in medical records is not just recording patient registration and services but must accommodate services before and after serving as an implementation system (Prabaswara and Saputra, 2020; Rao and Makkithaya, 2088; Rui and Danpeng, 2015). Recording of medical record health services can be started from registration of pregnant women, recording of information on health services since toddlers, health services and treatment actions received by patients, then the archive is stored. Data can be used when someone needs it for their needs or other purposes (Kesehatan, 2022d; Balusamy et al.,2021).

Integration of health services from smaller levels to higher health services such as puskesmas, and city and provincial hospitals is very much needed. The development of intelligence e-health will start by collecting patient data from an early age for pregnant women and birth data in public health services (Kristiadi et al., 2021a; Kristiadi et al., 2021b). The medical history of all patients who have been recorded will be an important document that can be shared with relevant parties who are referred for services in the city and province. In addition, patient data will be linked to the Health Social Security Administration (BPJS) (Kristiadi et al., 2021b) the Ministry of Health of the Republic of Indonesia, the Civil Registry Population Service (disdukcapil), and the World Health Organization (WHO). Furthermore, the collaboration will be extended to several local governments that implement a health system such as DKI Jakarta Province to treat patients suffering from special diseases such as cancer, Covid, etc. By enforcing service administrations such as the Healthy

Jakarta Card and the Surabaya Province with online patient registration (Leng et al., 2013), residents will also get health services at special hospitals outside the province. The application of technology involving big data and data warehouses is a major requirement (Sudarto et al., 2018) in addition to data mining, machine learning, knowledge management, and decision support systems (Kristiadi et al., 2021b; Kristiadi et al., 2018; Leng et al., 2013).

3   RESULTS AND DISCUSSION

In terms of data warehouse, this technology will help to prepare a flexible data warehouse scheme for Indonesian health services, which in turn will make decision reports fast and accurate (Kristiadi et al., 2021a; Kristiadi et al., 2021b). Big Data in the application of concepts such as capacity, speed, and variation will help in the case of bigger data volumes (Leng et al., 2013; Rui and Danpeng, 2015) in public health services in the province, using Hadoop or combined with other programs together in terms of increasing speed as data processing and retrieval performance. prompt decisions in the province (Kristiadi et al., 2019; Kristiadi et al., 2021b). Indonesian health sector. Meanwhile, diversity will show that intelligence application e-health for the province of Indonesia will handle various data. There are such as images, text, sound will be applied as input data that will be studied with intelligent technology to maintain their health (Nugraha and Aknuranda, 2088; Sudarto et al., 2018).

Intelligent technologies in the form of data mining and machine learning will be chosen to manage and find the best patterns from various data and find similar patterns (Kesehatan, 2022d; Nugraha and Aknuranda, 2088). Furthermore, knowledge management, especially in intelligence e-health, will be designed as another method to evaluate this intelligence e-health.

The use of the Internet of Things (IoT) in intelligence e-health will provide convenience in the form of ease and speed of data access, sending messages between devices containing health information because one device will be connected to another device (Negeri, 2022; Sudarto et al., 2018).

Applications based on the development of Intelligent e-health will be designed for wider e-health starting from health services in villages, cities, and provinces where e-health can be seen in demographic profiles where the community and government can open content based on their demographics. Interests such as gender, and various age groups (infants, children, adolescents, the elderly). In addition, we can choose content that contains data based on categories of diseases and outbreaks such as covid, cholera, and so on. The types of diseases will be grouped into the most infectious, the deadliest, and the disease in general (Kristiadi et al., 2019). In addition, e-health for disabilities is also developed in e- health intelligence in public health services.

The development of e-health intelligence in the provinces of Indonesia will result in an enterprise architecture that is implemented by building an e-health website for the Indonesian province. The implementation of the e-health website using a personal home page (PHP) and using MySQL is shown as the implementation of the data warehouse and database. Furthermore, to my unstructured data as information on health services and services by using social media such as Twitter, Instagram, and so on.

The healthcare model will be built into a mobile app that can be accessed with a personal cell phone. This health care assistant model will provide personalized health care advice based on illness complaints, for example: about activities carried out and nutrition needed (Sudarto et al., 2018). In addition, this application model can provide benefits such as medical test results and treatment, get quick medical action, and useful information to provide immediate help to those who are facing disasters and diseases. This health care assistant model is also useful for health workers who are helped by the availability of information about the patient's medical record and history of treatment or similar medical symptoms and can provide appropriate medical information to patients (Kristiadi et al., 2021a). Extracting health information from social media can be used to find information that can be used for further processing of health information based on user needs. Data mining from social media such as news mining must receive serious supervision to avoid unauthorized data and furthermore, unstructured data will be converted into structured data that can be used (Leng et al., 2013).

4   CONCLUSIONS

Rapid population growth has a major impact on the handling and maintenance of health. This will have an impact on economic growth and community welfare. Intelligent e-health development is an urgent need so that people can prosper and carry out their activities well. Economic development and health are synergies, where the health of the population of a

country will result in economic development and will ultimately improve their quality of life. The application of e-health intelligence for provinces in Indonesia will bridge health services from the community group, ru-ral, urban and provincial levels that are integrated into a health application. In addition, the number of health workers, facilities, and medicines can be immediately identified and completed based on the patient's need for treatment. Health services for residents who be- come patients will feel fast, comfortable, and of good quality. The benefits of having online access to secure personal health and health workers will be to provide efficient and effective health services without wrong treatment. In addition, legitimate information from social media will provide great benefits for citizens in terms of securing health services where patients and health workers will be assisted with valid data to com- bat health problems.

REFERENCES

Balusamy, B., Kadry, S., and Gandomi, A. H. (2021). Big Data: Concepts, Technology, and Architecture. John Wiley Sons.

Kesehatan, K. (2017a). The ministry of health of the re- public of indonesia, Indonesian healty program with family approach,2017.

Kesehatan, K. (2017b). The ministry of health of the re- public of indonesia, teaching materials and medical records of health information,2017. access 20 jul 2022.

Kesehatan, K. (2020). The ministry of health of the republic of indonesia.profil kesehatan indonesia. access on,13- july-2022.

Kesehatan, K. (2022a). Indonesian disaster management agency, potential threat of disaster. access on 19 july 2022.

Kesehatan, K. (2022b). The ministry of health of the republic of indonesia,2019. access on.

Kesehatan, K. (2022c). Number of doctor per 1,000 people. Kesehatan, K. (2022d). Number of nurse and midwife per 1,000 people,2022. access on 13 july 2022

Kristiadi, D. P., Hasanudin, M., Salim, J., Gunawan, M. G., Laurence, A., Chandra, A., Warnars, H. L. H. S., and Mantoro, T. (2019). Mobile patient application for outpatient. In 2019 Fourth International Confer- ence on Informatics and Computing (ICIC, page 1–6. IEEE.

Kristiadi, D. P., Hasanudin, M., Sudarto, F., and Tarmizi, R. (2021a). Indhci: Indonesian districts health care information model. Journal of Physics: Conference Series, 1764:012214.

Kristiadi, D. P., Hasanudin, M., and Sutrisno, S. (2021b). Mobile application of electronic medical record (EMR) systems using near field communication (NFC) technology. International Journal of Open Information Technologies, 9(10):68–72.

Kristiadi, D. P., Warnars, H. L. H. S., Hidayat, R. T., and Randriatoamanana, R. (2020). Big data implementation for searching unstructured data pattern as social media pattern from a news website. Solid State Technology, 63(6):1277–1289.

Kristiadi, D. P., Warnars, H. L. H. S., Randriatoamanana, R., Megantara, F., Nulhakim, L., and Zarlis, M. (2018). Big data implementation for inventory ware- house systems. In 2018 Indonesian Association for Pattern Recognition International Conference (IN- APR, page 207–212. IEEE.

Leng, C., Yu, H., Wang, J., and Huang, J. (2013). Secur- ing personal health records in the cloud by enforcing sticky policies. TELKOMNIKA Indonesian Journal of Electrical Engineering, 11(4):2200–2208.

Negeri, K. D. (2022). The ministry of internal affairs, data penduduk indonesia. access on 13 july 2022 from :.

Nugraha, D. C. A. and Aknuranda, I. (2088). An overview of e-health in indonesia: Past and present applications. International Journal of Electrical Computer Engineering, 7(5).

Prabaswara, I. R. and Saputra, R. (2020). Analisis data sosial media twitter menggunakan hadoop dan spark. IT Journal Research and Development, 4(2).

Rao, R. R. and Makkithaya, K. (2088). Learning from a class imbalanced public health dataset: a cost-based comparison of classifier performance. International Journal of Electrical Computer Engineering, 7(4).

Rui, J. and Danpeng, S. (2015). Architecture design of the internet of things based on cloud computing. In 2015

Seventh International Conference on Measuring Technology and Mechatronics Automation, page 206– 209. IEEE.

Sosial, K. (2022). Aid/help needed for victims of natural disasters/humanitarian tragedy,2022. access on 19 july2022.

Sudarto, F., Kristiadi, D. P., Warnars, H. L. H. S., Ricky, M. Y., and Hashimoto, K. (2018). Developing of indonesian intelligent e-health model. In 2018 Indonesian Association for Pattern Recognition International Conference (INAPR, page 307–314. IEEE.