Engineering kids health monitoring system in Indonesia

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Abstract. There is a healthcare program in Indonesia called Pos Pelayanan Terpadu (Posyandu). Services such as nutritional counselling, immunization service, health education and birth preparedness are conducted in the program. All the information collected from such program is still in paper-based document, called Kartu Menuju Sehat (KMS). A development of an electronic KMS (e-KMS) is proposed. This paper presents several related works on e-KMS for Indonesia. This paper derives requirements towards the most workable features for e-KMS based on the literatures.

Keywords: healthcare, posyandu, kartu menuju sehat, e-kms

1. Introduction
Healthy kids are a dream of every parent. Thus, it becomes very important for every parent to ensure that their kids are healthy. However, in Indonesia, large number of kids is still suffered malnutrition. Based on the survey by TNP2K \cite{1}, 27.5\% of kids in Indonesia, mostly in east Java, are in nutritional deficiencies. Such number of stunting is not only because the Kid healthcare service is poor, but also lack of parental awareness in kids health as they grow.

Indonesian government has a program to ensure better health-care for toddler and pregnant mother. The program is called Posyandu (Pos Pelayanan Terpadu). It normally conducts important services such as nutritional counselling and immunization service. In some cases, Posyandu also provides health education and birth preparedness. Nutritional counselling is an assessment to analyse diet and exercise. Immunization is the process of making someone is immune to infection. Health education helps people to improve their health by increasing knowledge about health. Birth preparedness is an advance planning and preparation for baby delivery.

The children information collected from such program is currently in paper-based document. The document is called Kartu Menuju Sehat (KMS). Using KMS, parents can acknowledge the status of their children in terms of condition from time to time graphically. They can also react to any recorded irregularities. However, the use of paper-based KMS, to some extent, is less reliable. Paper-based document is easy to lost or misplaced and not efficient. In some cases, parents keep forgetting to bring the KMS during the program. It becomes difficult for the officer to record and retrieve the children data regularly. Furthermore, due to different handwriting types, reading handwritten health record also becomes an issue \cite{2}.

This paper presents the need towards the development of Electronics KMS (e-KMS). Such model of KMS is proposed to digitalize children health record. In next section several previous works related
to digital KMS are presented. Such works are needed to derive some requirements for e-KMS. Section 3 presents the requirements. The summary is then shown in the final paragraph of this paper.

2. Related Work

Several studies have been performed related to the development of digital KMS. A multi-user information system has been developed by Nuraeni (2011) [3]. It is a desktop-based system that is installed in a health centre for patient data including new-born data. A web-based system was then proposed by Lestari et. al (2012) [2] to support online system. However, both implementations focus more on the general patient data.

A database system to manage children health data in healthcare centre was proposed by Indrijani (2013) [4]. The database covers all the records obtained during Posyandu. Searching patient data and reporting become easier using such database. An e-KMS was initially developed by Priskila and Wibowo (2013) [5]. There are 4 (four) forms created to input the data into KMS. Although such system is useful, graphical result and some health indicators are not supported. Patient identity is also missing in such development. Maulidia et al. (2015) proposed similar e-KMS with body weight chart as its additional features [6]. Such chart called anthropometric, is shown in Figure 1, shows children health status based on their weightage and height. It is also proposed by Sholihah and Kusumadewi (2013) [7] and Setyarini (2013) [8]. Radio Frequency Identification (RFID) is proposed by Eridani and Widianto (2014) as an identity for each patient [9]. Digital KMS that can be used on mobile platform is proposed by Windasari and Yana (2016) [10]. They developed an android app, called M-KMS, to keep the kids health records and to ease parents when accessing their kids’ data. The app has anthropometric feature and immunization history. In 2013, Bhaskoro et. al (2013) proposed posyandu cloud to provide software as a service for posyandu [11].

![Figure 1. KMS chart for kids](image)

There are also other works that proposed online KMS. KMS-Online (http://kms-online.web.id) by Javakedaton Indonesia and PrimaKu (http://www.primaku.com) by Ikatan Dokter Anak Indonesia (IDAI). Both implementations are a breakthrough in the area of children health, because it helps parents to promptly monitor their kids’ condition via Internet. They also provide some useful health articles for guiding parents when take care the children. It, thus, makes online health monitoring becomes necessary. Figure 2 shows the trend of KMS development based on the literatures.

3. Findings: Requirements for e-KMS

Based on the aforementioned literature review, there are some important points that can be derived as requirements for digital KMS or e-KMS in Indonesia. They are:

a) **Unique ID for each kid.**

Digital identification is a basic item in any application. Identity plays a role for an application, even beyond the login screen. In e-KMS, identity is needed for authentication and user profile. Authentication dictates the way a user logs into the e-KMS. Previously, a simple username and password are enough; currently the use of ID number is more feasible.
for authentication. In addition, in Indonesia, kids are now can have an ID card. By having such identification, kids profile can also be retrieved.

![Figure 2. Graph of KMS trend based on literature](image)

b) **Cloud-based data management system**
Continuous monitoring causes the need of large storage for the captured data. Yet, the number of children that are taken care in the posyandu increases. Thus, the data needs to be managed properly and the system must be maintained regularly. The emerging technology called cloud computing enables users to have computing resources off premises. The adoption of cloud technology is believably able to reduce the cost of having electronics healthcare records [14]. Cloud-based storage [12] makes users easy to deal with growing file size and cloud-based system [13] will have less maintenance stage from users’ perspective. Furthermore, managing e-KMS and its data is important especially when it comes to distributed system. Since e-KMS will be used regularly in several places, e-KMS is better to be developed as a service. Cloud-based e-KMS, that is accessible via web or mobile, is a feasible option to simplify the system and data management. By only using mobile apps, posyandu staffs can input the data and parents can immediately read it.

c) **Intelligent anomaly detection.**
Having a regular data from the kids makes anomaly detection or estimation becomes feasible task to do. Monthly weight and height data, immunization data, and other additional data that are collected during posyandu will led to a good analysis when it comes to anomaly detection and estimation. Thus, any worsened situation can be prevented earlier.

d) **Smart reminder.**
Immunization date is crucial to the kids, but parents often forgetting due to their daily business. SMS is currently popular and most widely accepted mode of reminder. There is strong consistent evidence that reminder improved rate of attendance compared with no reminders. The use of reminder, either by SMS or any type of reminder, for parents is very helpful in order to keep alerted that immunization must be performed.

e) **Specific article for each developmental milestone.**
When reaching different stage of growth, kids will behave accordingly. Behaviours such as taking a first step, smiling for the first time, and waving “bye-bye” are called developmental milestones. Children reach milestones in how they play, learn, speak, behave, and move (for example, crawling and walking). Parents, especially who just had their first child, do not
have any idea what to do to their kids when reaching certain milestone. Thus, providing some articles in the e-KMS can be a good option.

Figure 3 shows the abstract diagram of proposed e-KMS. Children data will be recorded by the Posyandu staffs to the cloud server using KMS app or Web-based KMS. Parents can view such data from web-based KMS or KMS app.

![Abstract diagram of proposed e-KMS](image)

**Figure 3.** Abstract diagram of proposed e-KMS

There are other thoughts on how the e-KMS in Indonesia might be extended, they are:

a) **Healthcare logistic prediction.**

   From the healthcare point of view, logistic becomes another issue when the posyandu program is conducted in remote area. There is only little number of staffs in the posyandu to cater a number of kids during such program. They also sometimes travel only by city car which has small luggage space. It means that they have to carry the logistic optimally. Predicting the quantity of logistics using Artificial Intelligent (AI) method, thus, should be performed.

b) **Internet of Things (IoT).**

   Monitoring is one of the most important factors of child’s growth and development. New technology called IoT enables new possibilities in the area of health monitoring. It normally uses wearable sensor technology to obtain the kids physical condition (e.g body temperature) real time. Parents will then be informed regularly about their kids either via SMS or Web-based system.

4. Summary

KMS in Indonesia is a good approach for monitoring children health. Cloud-based KMS that has kids’ identification, able to detect certain anomaly, has smart reminder, and provides some articles related to kids healthcare, is arguably able to provide better children health monitoring. Parents and healthcare officer can obtain some huge advantages from such e-KMS. In addition, the use of AI and IoT can be a good option for future e-KMS.

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