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The Potential Use of Open Data Kit Application for the Mosquito Larvae Monitoring Program to Control Dengue Vector in Indonesia

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ABSTRACT

Dengue fever is an infectious disease which has been a major health problem in Indonesia. There are numerous approaches to reduce the incidence of dengue fever in Indonesia, including the eradication of mosquito nests, establishment of the Early Warning Alert and Response System (EWARS), as well as monitoring and analyzing the high incidence areas for easier management. Data collection is an essential component of the surveillance of mosquito spread, with both policy makers and health service providers requiring accurate and up-to-date data to implement an appropriate policy to control dengue fever. The increasing use of smartphones and rapid growth of technology must be utilized for information delivery in dengue fever surveillance to support the program of mosquito larvae monitoring by larvae monitoring officers ("*Jumantik*" in Indonesian language). The Open Data Kit (ODK) is an application which can assist the data collection process, making it more efficient as well as supporting the health program. This application can efficiently map the activity of dengue fever spread, with the interactive map displaying the location of data collection points, thereby accurately presenting the information related to disease distribution based on the Global Positioning System (GPS). Thus, the utilization of ODK in the EWARS is expected to increase the efficiency and optimize the success in controlling the incidence of dengue fever.

KEY WORDS: OPEN DATA KIT; MOSQUITO LARVAE MONITORING OFFICER; JUMANTIK; DENGUE; SURVEILLANCE.

INTRODUCTION

Disease surveillance is an activity whereby disease data is collected systematically, using the epidemiological information for planning and assessing disease control. The components of surveillance activity include data collection, compilation, analysis, and data interpretation, as well as the analysis of disease spread to determine appropriate action. The main surveillance activities include case detection, case record, case confirmation, report, data analysis, as well as giving response and feedback. The main purpose of this surveillance is using the collected data to develop policies and programs to promote health and prevent disease (McNabb et al., 2002). Furthermore, data collection must be conducted repeatedly and periodically to be consistent and relevant regarding the disease incidence

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within a specific population. Data collection in the field is challenging, with various obstacles to overcome. For instance, the location may be difficult to reach, thereby slowing the data collection. In addition, it can be costly, requiring adequate human resources. Such difficulties can mean that the surveillance is incomplete, so stakeholders, such as primary health care units, health departments and other health institutions, cannot develop strategic and accurate policies in response to current health issues.

Industrial Revolution of 4.0: The development of Industrial Revolution 4.0 was marked by the emergence of cyber technology and automation technology used in combination in various fields including health. The implementation of this concept is centered on automation that can be conducted by technology without any human assistance in the implementation process. Such automation can increase efficiency in various aspects where time management is vital and required. Indeed, optimal time management will exponentially increase the quality of the work. The utilization of technology in surveillance means that the information can be delivered easily and is readily accessible by everyone at any time. Currently, electronic media has been the dominant information media used by people in accessing information. Indeed, with the appropriate management, electronic media could be a beneficial health information source, delivering information related to health problems, disease spread, the impact and the prevention efforts (Sujatmiko, 2018).

Open Data Kit: Data collection and sharing can be conducted easily anytime and everywhere through the internet. Moreover, data collection can be conducted digitally using applications, such as the Open Data Kit (ODK) (Macharia et al., 2013). ODK is android-based application developed by the University of Washington to accommodate community's requirements, which is freely and easily accessible. Currently, ODK has been applied globally for various needs, such as general election data collection, tropical rainforest observation, infectious disease surveillance, etc. Indeed, the scope of ODK usage is large and its use can be managed to adjust with the type of data collection required (Brunette et al., 2013; Hartung et al., 2010). ODK can be utilized for survey data processing in various fields including health, and has been used by Google, WHO, and USAID for data collection, reporting, and processing. ODK has a server that can be accessed anywhere if it is connected to internet, but has the advantage of data entry without any internet connection. A comparison of popular data collection applications, including features such as "program license","skip logic", "calculation", "query", "custom-field" etc. is presented in Table 1. Typically, the more features an application has, then the better the application (Steinberg and Schindler, 2019).

Dengue Fever: As a developing country with a tropical climate, infectious diseases are a major problem in Indonesia (Karyanti and Hadinegoro, 2016). Indeed, thousands of people are affected by infectious diseases every year, resulting in fatalities and huge economical loss for the country (Nadjib et al., 2019). Dengue fever is one such infectious disease and typical symptoms include sudden fever, headache, pain behind the eye, nausea, bleeding signs (positive result on tourniquet test or rumple lead), skin rash (petechial), nose bleeding, and bleeding gums. Massive bleeding can occur in severe cases, such as digestive tract bleeding in the stomach and intestine, resulting in bloody stools and vomit. Dengue

Table 1. Comparison of data collection applications based on their features

Feature	EC5	ODKv1	ODKv2	Kobo	Ohmage	SurveyCTO	Magpi	COBWEB
Active development	■	■	■	■	-	■	■	-
Open Source	-	■	■	■	■	-	-	■
Programing Language	-	Java Javascript Python	Java Javascript	Java Javascript Python	Java ObjectiveC	-	-	Javascript Python
License	-	Apache	Apache	Apache GNU	Apache	-	-	BSD3
Self-hosting	–	■	■	■	■	–	–	■
Form designer	■	■	–	■	■	■	■	-
Skip logic	■	■	■	■	–	■	■	-
Localization	–	■	■	■	–	■	–	-
Calculation	–	■	■	■	–	■	■	-
Queries	–	–	■	–	–	–	–	-
Link tables	–	–	■	–	–	–	–	-
Required fields	■	■	■	■	■	■	■	-
Validation	■	■	■	■	■	■	■	-
Building custom prompts		–	–	–	–	–	–	-

fever is caused by infection of dengue virus from the Arbovirus, which is spread through the mosquito bites (Aedes aegypti and Aedes albopictus). The dengue virus is mostly found in tropical areas, particularly in urban densely populated areas, and conditions in Indonesia are ideal for the spread of this disease-bearing Aedes mosquito. Consequently, dengue fever is a major health problem, with increasing incidence due to the high mobility of the urban population, climate change, density change and other epidemiological factors (Harapan et al., 2019; Utama et al., 2019).

Indonesia is ranked second state in the thirty countries with dengue fever endemic area (Haryanto, 2018). In 2017, the number of dengue fever cases was 68,407, of which, 493 resulted in death. There are three provinces with the highest incidence of dengue fever in Java Island, West Java had the largest number of dengue fever cases (10,061), followed by East Java and Central Java (7,838 and 7,400 respectively) (Indonesian Ministry of Health, 2018). The high incidence of dengue fever in Indonesia has caused both huge social and economic loss with around US$381.15 million was expensed in 2015 (Nadjib et al., 2019). Unfortunately, the effectivity of dengue vaccine is still questionable to prevent infection of dengue virus, therefore, the most effective prevention is by controlling the transmitter vector (Aedes mosquito) through the eradication of mosquito nests (EMN). It has been mandated in the Minister of Health Regulation number 581/MENKES/SK/VII/1992 on Eradicating the Dengue Fever and the Minister of Health Regulation number 92 Year 1994, which emphasizes the prevention effort by eradicating mosquito nests to control dengue fever.

Control of Dengue Fever: To optimize the prevention of dengue fever by EMN in Indonesia, the target location of EMN must be on target, effective, and efficient. The location of large populations of mosquitoes and high risk of dengue fever must be prioritized for intervention to prevent dengue fever, thereby reducing the incidence and possible epidemic as well as huge losses. However, the mapping of such locations is difficult. Indeed, there has not been any available data about mosquito spread that could be used to detect the risk of dengue fever. The rapid development of technology and application of digital data management programs, such as ODK, could be a solution for this problem. ODK could be utilized to collect data regarding mosquito spread to guide preventive action to reduce the incidence of dengue fever as well as associated losses.

ODK for Data Collection and Reporting of Surveillance Data regarding the Dengue Vector: The early benefit of the ODK application is changing the information documentation collected (reported) from a paper-based system to a digital report of information collected in real-time, as the information collected is delivered to the server allowing reporting of the survey information collected according to the time and geographical area (Hartung et al., 2010). ODK is also useful in the surveillance effort and program evaluation, significantly reducing the time needed to report the data to regional, local, state or national levels, which is beneficial for stakeholders.

Figure 1. The design process and survey report using the ODK application

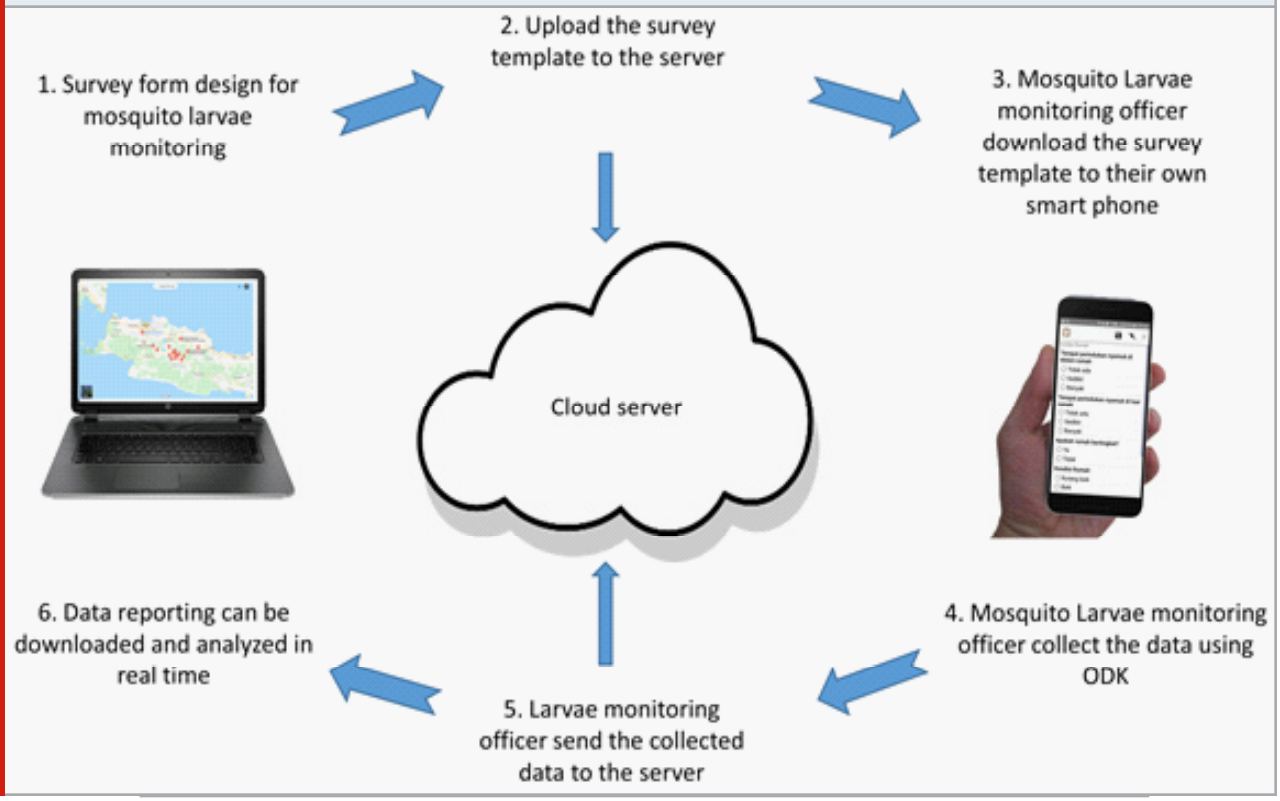
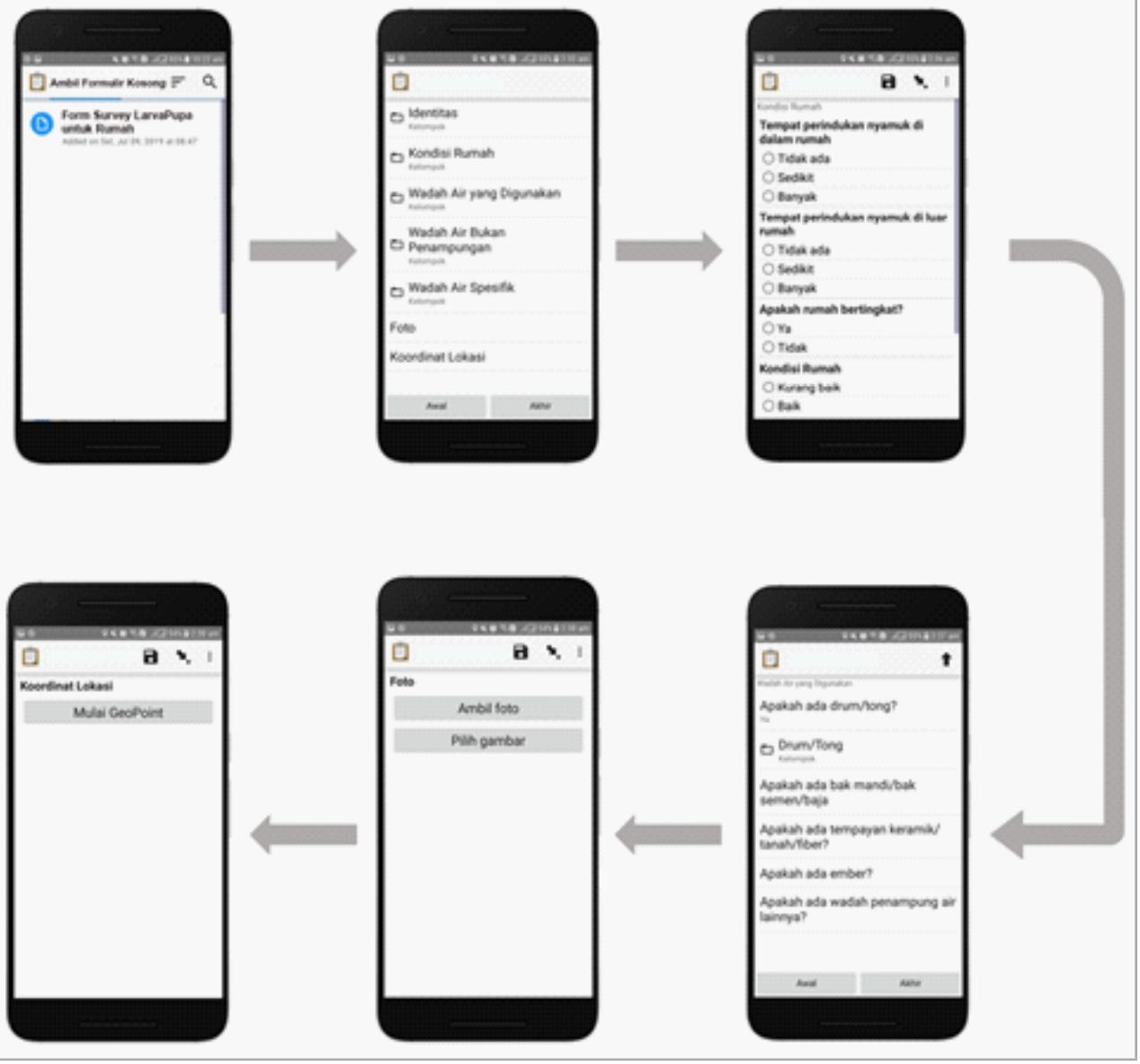


Figure 2. Display of ODK form list for Larvae monitoring Officers (*Jumantik*) in the field



Mosquito Larvae Monitoring: The government effort to prevent dengue fever involves terminating the infectious mosquito chain by spreading larvasida, fogging, and EMN, therefore, the ODK application will be useful to report helpful information to assist this effort. The survey form for dengue fever prevention can be created with the ODK application, comprising several questions to identify the risk of dengue fever spread in every house. In addition, the picture-captured and location-recorded features of ODK directly connect to the server, thus accurately identifying the area at risk of dengue fever. The ODK application can also be used for the Early Warning Alert and Response System (EWARS) and various surveillance actions periodically. Areas with large mosquito populations can be identified, so that preventive actions, such as fogging and increasing the EMN, can be conducted to prevent the incidence of dengue fever. Previous efforts to establish this system were initiated by conducting a mosquito larvae monitoring program. Mosquito larvae monitoring officers (*Juru Pemantau Jentik* / *Jumantik* – in Indonesian Language) check, observe, and eradicate mosquito larvae, referring to the technical guidelines for eradication of nests of Aedes aegypti mosquito. Their duties include socialize the EMN, check the mosquito breeder area (inside and outside the house), mobilize people to conduct EMN, and record mosquito larvae observations as well as record the conduct of EMN. These paper-based observations are used to determine high risk areas, thereby reducing the incidence of dengue fever. Therefore, the ODK application would be helpful in this surveillance, as it is simple, easy and free to use, allowing mosquito larvae monitoring officers to digitally record their observations, thereby improving the efficiency and effectiveness of the EWARS.

Survey Design in ODK: The process of ODK implementation for the EWARS begins by creating the form list which must be completed by every mosquito larvae monitoring officer. This form is created in Microsoft Excel or ODK form builder that can be accessed on the ODK website, then uploaded to the server, which can be made by us or provided by the cloud server. Every officer who has downloaded the application can then install the form list on their smartphone, so it can be displayed and completed on their phone screen. The data collected is then delivered to the server when the phone is connected to the internet, or automatically stored to be sent when there is an internet connection. The data will be displayed in real-time on the server for subsequent download or analysis by the authorized stakeholders. The data collection and reporting using ODK is presented in Figure 1.

Data Collection and Input Using the ODK: Tutorial videos can be created to help the mosquito larvae monitoring officers to understand the ODK procedures for data collection and input. The form list includes the identity of the house owner surveyed, the house condition, information about water canisters used in the house, as well as displaying the house condition in the form of a picture that can be taken directly using the phone camera, as shown in Figure 2. Specific data about the mosquito breeder is displayed for the next form list. Regarding location, every surveyor can easily record the GPS location that is integrated in the ODK application directly.

CONCLUSION

The utilization of technology can increase the efficiency and optimize surveillance activity to control the spread of dengue fever. The ODK application is freely available, relatively simple and easy to use, thereby allowing stakeholders to easily access up-to-date, accurate information regarding the spread of mosquitoes that cause dengue fever to establish appropriate policies to control and prevent the incidence of dengue fever in Indonesia.

Conflict of Interest: No potential conflict of interest relevant to this article was reported.

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