

Using District Health Information System (DHIS2) for Health Data Integration in Special Region of Yogyakarta

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Abstract A number of applications have been used for managing health data and information and tend to be fragmented between health programs in health offices. In consequence, the analysis and interpretation process becomes difficult since the data is scattered in separate sources. One of the solutions offered as an effort to synchronize and integrate health data in Indonesia is through implementing District Health Information Software (DHIS2). DHIS2 is an application that emphasizes data integration at the health office level. Faculty of Medicine, Public Health and Nursing UGM has been partnered with the Special Region of Yogyakarta Health Office to carry out community service activities in the context of utilizing DHIS2 for health data integration in the province. The implementation of DHIS2 was divided into 4 stages, namely workshop on data availability, socialization, and training of DHIS2; data mapping and customizing DHIS2; implementing health data integration; and dissemination, supervision, and evaluation. Six health offices were the target of community service activities in the province. DHIS2 has facilitated health office staff to analyse and visualize health information that is used for decision making and advocacy. This community service activity supports the government's efforts to provide one-stop data and contributes to strengthening health information systems both nationally and regionally.

1. INTRODUCTION

The availability of high-quality health information is very important for the success of health systems development. A number of health data and information are scattered in each health program and have used various tools and applications in collecting, analyzing, reporting, and visualizing health data. Some of them are managed vertically by several units in the Ministry of Health of Indonesia, and are often isolated in each program, such as maternal and child health (MCH), immunization, nutrition, tuberculosis (TB), human immunodeficiency virus (HIV/AIDS), and malaria.

In Special Region of Yogyakarta, the data collection and reporting of TB, HIV/AIDS, and malaria program uses electronic information systems that have been developed at the central level. Other health program data are reported in excel format or web-based applications that develop at the province or district level.

The disintegration of health data causes problems of data accessibility and quality (Jorn Braa & Sahay, 2012). It becomes an obstacle when the data is used for planning, monitoring, and evaluating health program achievements in an integrated and sustainable manner.

For example, the TB program and the HIV/AIDS program are linked to planning, monitoring, reporting, and the program implementation itself. Another example is the MCH and immunization programs which have the same target population and the data can be used to validate each other's program achievements.

Without the support of good health information systems, it will be very difficult to get health data and information quickly and accurately. For this reason, the existence of a computer-based health information system has now become a major need. The local and central governments themselves have made various ongoing efforts in order to build a health information system in Indonesia in the last three decades (Soemitro, 2016). This is marked by the emergence of various health information system applications that have been developed at various levels, both nationally and locally. Every program and institution that provides health services is trying to improve its data recording and reporting model with special applications, both online and offline. Besides giving positive results or having more structured data and health information, it turns out that this condition also has a negative impact on increasing the burden of recording and reporting by health workers in the regions because the various applications are not connected to each other, resulting in repetition of work. The data sources available between programs are separate, thus extending the process of data analysis and interpretation. This is typically the case in developing countries (AbouZahr & Boerma, 2005; Stansfield *et al.*, 2006), including Indonesia (Braa *et al.*, 2017).

In order to synchronize and integrate various health information applications in Indonesia, the Ministry of Health adopted the District Health Information Software 2 (DHIS2). DHIS2 is a free software developed by the University of Oslo (UiO) which is open source using a data warehouse approach with data from various sources (Braa *et al.*, 2007). DHIS2 provides various features for data management, validation, analysis, and visualization of health data. This web-based technology can be integrated with mobile applications and supports the integration of various information and communication technology platforms. The Ministry of Health has implemented a pilot DHIS2 in 10 districts or cities and expanded in 50 other districts or cities in Indonesia (Pusat Data dan Informasi Kemkes RI, 2018).

The DHIS2 supports the flow of health data both vertically and horizontally and facilitates the scalability and sustainability of the information system. The DHIS2 is customizable according to local needs which can be controlled easily. DHIS2 is able to integrate various potential data sources for various health programs, with various recording and reporting methods, either web-based, Microsoft Excel file, or paper. In addition, data can be accessed more easily, covers all the needs of health indicators, and can be monitored and analyzed up to the community or Community Health Center (Pusat Kesehatan Masyarakat [PUSKESMAS]) level. DHIS2 supports the flow of health data both vertically and horizontally, thereby facilitating system scalability and sustainability.

The implementation of DHIS2 is expected to help information users to obtain more comprehensive, structured, and presented data as needed, thus simplifying the decision-making process. Thus, the implementation of DHIS2 is expected to help information users to obtain more comprehensive, and structured. Furthermore, the data presentation is also needed which simplifies the decision-making process.

2. METHOD

The action research approach was used for the implementation of community service activities. A team from Faculty of Medicine, Public Health and Nursing (FK-KMK) and Vocational School of Universitas Gadjah Mada (UGM) worked to implement health data integration using DHIS2. Through the action research the team could apply theory into practical implementation where the results provided a more contextual understanding of the change process (Adalety, Poppe, & Braa, 2013; Baskerville, 1999; K. Braa & Nielsen, 2015; Andargoli *et al.*, 2017).

The community service was carried out at 6 health offices, namely: Yogyakarta Special Region Health Office, Kulon Progo District Health Office, Bantul District Health Office, Gunungkidul District Health Office, Sleman District Health Office, and Yogyakarta City Health Office. The community service activities were carried out from May to October 2018 which consisted of four stages of activities as follows:

1. Needs analysis, outreach and training

During this stage, the team together with health office staff identified program-based health data sources and electronic information systems that have been used in each health office. Analysis of business processes, data flows and program-based data capture forms that have been used by each health office was carried out to produce health data standards and a uniform reporting flow. Available health information system resources were identified to support the possibility of electronic data integration. Activities at this stage were managed with a serial workshop of strengthening regional health information systems with the main target were health program managers for health information systems, HIV/AIDS, TB, malaria, immunization, nutrition, and MCH.

2. DHIS2 customization and preparing data integration

The results of the needs analysis that have been identified were then used to customize the DHIS2 application. First, the team developed the health data standards in the form of blueprints for the organization unit, data elements, and health data indicators that will be integrated. Subsequently, the team developed a data integration module for all targeted health programs. The health data integration process was documented in the form of a standard operational procedure (SOP), so that it can be used for scaling up to other health programs, including creating user manuals for data integration for end users.

3. DHIS2 implementation

After customizing the DHIS2 application, the next step was to import the 2017 health facility based data for one full year for each predetermined health program.

Comma Separated Value (CSV) importing method was mostly used to integrate spreadsheet-based data into DHIS2 applications. Data analysis and visualization were developed according to the availability of data in each district. From the results of the visualization, a standard dashboard was made to show the output of data integration from various health programs.

4. Dissemination and evaluation

The integrated health dashboard in each health office was discussed and disseminated internally inviting different health program managers in the form of serial workshops. Evaluation was carried out during the workshop with the aim of assessing the challenges and opportunity of the DHIS2 implementation as well as discussing the potential for sustainable development and implementation.

3. RESULT AND DISCUSSION

3.1 Data source and introduction DHIS2 at the health offices

Workshops on the availability of health data were conducted at the Yogyakarta Special Region Health Office and 5 District Health Offices (6 in total). The workshop invited health program managers and health information systems managers at each level to identify availability of health data, method of data collection and key indicators of health program monitoring and evaluation.

3.1.1. Yogyakarta Special Region Health Office

The workshop was held on 18 May 2018 in Hall A of the Yogyakarta Special Region Health Office. The workshop was opened by the head of health services and attended by several health program managers in Yogyakarta Special Region Health Office and Health Information System (HIS) staff representatives from the district health offices in Yogyakarta Special Region. There were two types of data collection method, namely spreadsheet and electronic data capture as web-based applications. Program-based data with spreadsheet format that available included Human Resource for Health (HRH), morbidity data from puskesmas and hospitals, nutrition, and MCH. Meanwhile, the available electronic information system included an integrated Immunization Information System (Sistem Informasi Imunisasi Terpadu [SIMUNDU]), an Integrated Disease Surveillance System (Surveilans Terpadu Penyakit [e-STP]) and Family Health (Kesehatan Keluarga [KESGA]).



Figure 1. Workshop on Data Availability at Provincial Level

3.1.2. Sleman District Health Office

The workshop was held on 9 July 2018 in Hall C of the Sleman District Health Office. The workshop was attended by 15 staff from the health service office and two representatives from the Puskesmas in the Sleman area. The available health program reports include Health Human Resources (Sumber Daya Manusia Kesehatan [SDMK]), Health Promotion (Promosi Kesehatan [PROMKES]), Clean and Healthy Living program (Perilaku Hidup Bersih dan Sehat [PHBS]), mental health, KESGA, and health Data sources available from the Bantul Health Office included immunization, maternal and child health (Pemantauan Wilayah Setempat-Kesehatan Ibu dan Anak [PWS-KIA]), Acute Respiratory Illness (Infeksi Saluran Pernafasan Akut [ISPA]), and diarrhoea.



Figure 2. Workshop on Data Availability in Bantul District Health Office

3.1.4. Kulon Progo District Health Office

The workshop was held on 11 July 2018 in the Kulon Progo Health Office Hall and was attended by 24 staff from the health office and puskesmas in the Kulon Progo area. The available health data include maternal health, elderly health, occupational and sports health, as well as health profiles.

3.1.5. Yogyakarta City Health Office

The activity was carried out on 12 July 2018 at the Yogyakarta City Health Office Hall. This activity was attended by 22 staff from the health office and puskesmas in Yogyakarta City. Sources of available data include MCH (covering maternal health, postpartum services, family planning, child health, the elderly, and school health programs) as well as nutrition routine reporting.

3.1.6. Gunungkidul District Health Office

The workshop was held on Friday, 13 July 2018 at the Gunungkidul District Health Office Hall. This workshop was attended by 16 staff from the health office and representatives of the puskesmas in Gunungkidul District. The available data sources were health profiles, MCH (mother, children, elderly, family planning), nutrition and disease control program. Nutrition program includes under 5 nutrition services that consist of identify under 5 years target population, ownership of child monitoring book, number of under 5 years who are weighed

and under 5 who are gain weighed (SKDN); vitamin A supplementation; and iodized salt monitoring. While disease control program includes reporting of diarrhea cases, upper respiratory illness, dengue haemorrhagic fever and leprosy.



Figure 3. Workshop on Data Availability in Yogyakarta Health Office

Even though not all health programs could be identified during the workshop series, it could be seen that many health programs were managed by the puskesmas and the health office, each of which collects data on a regular basis. Table 1 shows health data collected based on health programs at the health office and puskesmas. Various data collection tools were used at the puskesmas level which complement each other. However, some of them overlap which causes data capture duplication on different tools (spreadsheets and web-based applications).

In addition, it was found that several of the same dataset have different formats of spreadsheets amongst district health offices. It had an impact on the quality of data and the method of integrating data from multiple health programs from multiple health offices. Integration of data into a data warehouse such as DHIS2 without intervening existing data collection tools is perceived as a strategy to identify all public health data and strengthen health management information systems. However, there are many non-technical issues that hinder the use of DHIS2 such as political, cultural, social and structural infrastructure and human resource (Dehnavieh *et al.*, 2019). For example the systems was seen as another burden of data entry among health staff event though the data was imported from existing systems.



Figure 4. Workshop on Data Availability in Gunungkidul District Health Office

Table 1. Program-based data at the health offices and puskesmas

No	Program	Data sets	Number of Data Element	Data Collection Tools
1	Family health program	Services for pregnant women, postpartum mothers, family planning, elderly health, child health, school health program (Usaha Kesehatan Sekolah [UKS])	229	Spreadsheets, Kesga Apps
2	Nutrition program	Under 5 nutrition services (SKDN), vitamin A supplementation, use of iodized salt	91	Spreadsheets, Integrated Nutrition app
3	Disease control and surveillance	Diarrhea, DHF, ARI, Leprosy, Immunization	142	Spreadsheets, eSTP app, SIMUNDU app
4	Health profile	Primary health center profile, LB1, LB4 reports	544	Spreadsheets
5	Health services	Occupational health, sports health, environmental health	105	Spreadsheets
6	Health promotion	Clean and healthy life behaviour (Perilaku Hidup Bersih dan Sehat [PHBS])	118	Spreadsheets
7	Health resources	Human Resources for Health (HRH)	32	Spreadsheet, SI-SDMK app

Abbreviations

- Kesga App : Application of monitoring family health program
- DHF : Dengue haemorrhagic fever
- ARI : Acute Respiratory Infection
- eSTP : electronic integrated surveillance systems
- SIMUNDU : Immunization information systems
- LB1 : Monthly report number 1
- LB4 : Monthly report number 4
- SI-SDMK : Human resource information systems for health

It was exacerbated by the absence of leadership and there was no supervision from the high level of health office staff of this activity.

4.2 Preparing Health Data Integration

After conducting workshops at the provincial and 5 district health offices, the next process was preparing data integration. From the results of the workshops on data availability, it was known that the health offices have various data reporting based on different programs. In this period of community service activities, the implementing team decided to choose priority data sources to be integrated, namely MCH, nutrition, mental health, immunization (SIMUNDU), and eSTP.

Various activities have been carried out to support the process of integrating available data sources into DHIS2, including:

1. Documenting the report format in one Google Drive folder (one district or one city folder) to make it easier to find data sources and combine data in the DHIS2 application
2. Create an index file of data sources collected from workshop activities at the district or city health offices, as well as provinces.
3. Develop a blueprint for DHIS2 DIY based on the existing format by mapping the data elements of each program from different Health Offices in order to achieve standardized data. Creates a new data element if it is not already available in DHIS2. Documenting the indicators used per program to make it easier to analyze and visualize health data in the dashboard. The data structure can be accessed at the following link [DHIS2 Blueprint](#).

DHIS2 was used to facilitate weak and poorly integrated health information management systems (HMIS) at the province and district level. DHIS2 was recognized as an open source system that has a critical role to functioning HMIS over the existing system (Karuri, *et al.*, 2014). Summary of data elements can be seen in [Table 1](#).

There were 2 types of duplication found, duplication of data elements between different forms (same data element but collected in different forms), and duplication due to different periode of data collection

(same data element but collected in monthly versus yearly). It was found 147 out of 1,261 data elements were duplicated (13.17%). Using the DHIS2, the metadata of HMIS was well documented and avoided duplication.

3.3. Implementation of health data integration

The concept of DHIS2 implementation in health offices emphasizes the data integration, analysis and visualisation rather than data collection. At the national level, DHIS2 has been integrated with several electronic information systems at the Ministry of Health, including the integrated tuberculosis information system (sistem informasi tuberculosis terpadu [SITT]), the HIV/AIDS information system (sistem informasi HIV/AIDS [SIHA]), data communication applications (komunikasi data [KOMDAT]), human resources for health (HRH), and Indonesia health program through family approach (program Indonesia sehat dengan pendekatan keluarga [PIS-PK]). The activity implementation team consisting of 7 members collaborated with the Yogyakarta Special Region Health Office and 5 districts health offices to integrate program-based data that has been identified and collected from previous workshops. After identifying the quality of data from the perspective of completeness, level of data (puskesmas based-data), it was decided that integrated program-based data in this stage includes data on MCH, nutrition, immunization, morbidity, and mental health.

[Figure 1](#) presents an overview of data integration. Data sourced from electronic systems at the central level has been integrated automatically using a Web Application Program Interface (API). At the regional level, the process of integrating program-based data into DHIS2 was carried out using the import from comma-separated values (CSV) file, considering that the reporting format in each health program and each health office is different from one to another.

This data integration at the regional level supports the Ministry of Health's policy in implementing the one health data application (aplikasi satu data kesehatan [ASDK]) by utilizing the DHIS2 platform.



Figure 5. Data integration platform using DHIS2 in Yogyakarta Special Region where the data source can imported from existing information systems, integrated in the central database and used it to visualize health information inform of graphic, maps and tabular view

Following the data integration process, data integration modules and guidelines were also created by the implementation team which would later be utilized by program managers at the health office in integrating data in the current and future years. The implementation of DHIS2 emphasized data visualization and health information dashboard. Visualizations can be in the form of tables, graphs, or maps. Each health office has created a dashboard based on the health program. The dashboard can be accessed at the address <https://inahmis.id/>

4.4. Implementation and evaluation

There were several challenges in implementing health data integration with DHIS2 that were encountered. The data availability workshops at the health office were expected to be attended by health program data managers as the health program data could be integrated into DHIS2. However, in practice, not all health program data managers can participate in workshop activities. This causes variations in data availability to be limited to a few health programs. On the other hand, there are more data sources available than expected with different reporting formats from one district to another, so that the process of mapping data sources takes longer. The implementation team must match variables or data elements between one health program reporting format in one district and another. This difference in the format between districts will affect the integration mechanism that will be implemented. Data integration will be carried out after the data source mapping is complete.

The data availability workshop also coincided with DHIS2 socialization and training. Capacity building was focused on the visualization available in DHIS2. Unfortunately, capacity building activities can only use data that was already available in DHIS2, such as HIV/AIDS data, TB data, and KOMDAT data which contains priority health data. In addition, program managers already have their own mechanism for visualizing health information. Some health programs even have a standard for what visualizations should appear. However, there are several other program managers who still have difficulty choosing the right type of visualization in displaying health information. After the data is successfully integrated, capacity building is needed for health program data holders for data analysis and visualization.

Activities using DHIS2 in Yogyakarta Special Region were monitored and accompanied by the UGM team. The team is available for supporting technical assistance either remote assistance or site visits. Monitoring and evaluation of the use of DHIS2 ideally carried out periodically. A WhatsApp group has been created to facilitate remote communication of DHIS2 implementation in Yogyakarta Special Region. The group consisted of the DHIS2 team from UGM and health program data managers from 6 health offices in the Yogyakarta Special Region. The group is meant to update information and assist troubleshoot problems faced by health service staff. Ideally, the health office need to actively engage in HMIS strengthening efforts within the context of access and use routine health data for decision making (Sahay, Rashidian, & Doctor, 2020).

4. CONCLUSION

Community services conducted in collaboration with health offices in Yogyakarta Special Region have achieved health data integration through DHIS2 application. A number of health data were identified in each program manager that has used different formats and tools of data capture. Health data integration activities as an effort to support the health offices were faced with the problem of standardizing health data and disintegrating health management information systems. The DHIS2 application is expected to become a data warehouse that connects various sources of health data at the district and puskesmas level on an ongoing basis. Data integration module and user manual have been developed to accommodate the utilization of DHIS2 as the data warehouse. For the next steps, workshop series should be conducted to ensure the DHIS2 governance at health offices. It is also necessary to conduct further capacity building on data use and analysis using DHIS2 for the program managers and officers to strengthen the health data management for decision making.

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CONFLICT OF INTERESTS

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome. We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We have agreed that the corresponding author is the sole contact for the editorial process who will communicate with the other authors about progress, submissions of revisions and final approval of the manuscript.

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