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Development of a Sentinel Site Surveillance System to Improve Health and Nutrition Monitoring in Indonesia

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Abstract

Despite impressive economic growth in recent years, Indonesia continues to suffer from high rates of child stunting, wasting, severe wasting. To reduce childhood stunting and improve birthweight and child nutritional status, Indonesia has committed its own resources as well as received assistance through the Millennium Challenge Account - Indonesia (MCA-I) funded by the United States Millennium Challenge Corporation. As part of its MCA-I compact, University Research Co., LLC (URC) developed a sentinel site monitoring program for its Community-Based Health and Nutrition Project. This sentinel site monitoring program is comprised of a web-based system with offline capabilities, designed to improve accessibility of real-time relevant quality data at all management levels, promote data utilization for decision-making, and encourage coordination and integration of health program activities. The real time data is linked with a dynamic data base with demographic and other key health event data. Data for the sentinel site monitoring program comes from four sources: 1) a rapid census of households, 2) cyclical house-hold visits, 3) routine statistics of services at health facilities which is linked to the household data; and 4) periodic sample surveys. Field facilitators were recruited and trained to conduct census of households and collect household member data and update the household and household member data every 90 days for demographic and health events, and trained midwives to record health service data and link to the household and household member data. This approach could be successfully adapted and implemented in other low- and middle-income country settings to manage and monitor similar community-based health initiatives.

Background

Despite impressive economic growth in recent years, Indonesia continues to suffer from high rates of child stunting, wasting, severe wasting (36.4%, 13.5%, and 6.7% respectively) [1], with millions more underweight. The country is committed to addressing the poor nutrition situation, yet suffers from a lack of reliable and timely information on nutrition and other health indicators on which decision makers at all levels of the health system use to design effective nutrition policies and programs. To provide accurate and timely health and nutrition information, the Indonesian Ministry of Health is committed to conducting ongoing nutrition surveillance in all districts and is working to identify new tools and creative solutions to improve health outcomes. Indonesia has received assistance in meeting these objectives through the Millennium Challenge Account - Indonesia (MCA-I) Community-Based Health and Nutrition Project [2]. The country, both at national as well as local levels, has also committed its own funding to improve the nutritional situation among children in the country. To reduce childhood stunting and improve birthweight and child nutritional status, this project has introduced and expanded a range of demand- and supply-side nutrition interventions in 7,000 villages across 11 provinces in Indonesia.

Sentinel site surveillance is an effective public health tool for monitoring many diseases and health indicators [3-7], including nutrition [8-12]. Sentinel networks, linking participating sites to centralized data collection, have been particularly helpful in monitoring health indicators [13-15]. However, such networks are less common in low- and middle-income countries [16-18], which can lack the funding, organized record keeping, and methodological expertise needed to operationalize such networks

[18]. In 2016, MCA-I selected University Research Co., LLC (URC) to develop a sentinel site monitoring program for its Community-Based Health and Nutrition Project. The purpose of this article is to detail the development and functionality of this sentinel site monitoring program as an approach that can be adapted to track key programmatic and health indicators in a variety of country settings.

Objectives of the System

MCA-I's goal in establishing the sentinel site monitoring program was to provide a comprehensive system for data management related to the critical first 1,000 days of a child's life [19]. Specific objectives of the program were to:

1. Develop an online database system and semi-online desktop application that can generate relevant, reliable and real-time data;
2. Develop training modules for field facilitator and midwife data collectors;
3. Install the developed application onto MCA-I laptops for each midwife;
4. Migrate existing data from health facility records to the online system;
5. Maintain the database, manage the data, and assist users; and
6. Generate data reports to MCA-I throughout the data collection period.

Design Considerations and System Capabilities

URC worked closely with MCA-I and Indonesia Ministry of Health counterparts to conceptualize and develop the monitoring program database and application. Ultimately, 13 key system design considerations were identified as critical to the success of the program (Figure 1). Ultimately, URC developed a web-based system with offline capabilities for programmatic and Indonesian health system uses. Applying this system enhances accessibility of real-time relevant quality data at all management levels, promotes data utilization for decision making, and encourages coordination and integration of health program activities. This system has the capability to help program managers track critical indicators, including provider compliance and patient adherence. Furthermore, use of established client IDs facilitates stronger linkages of the household and household member data with the current health records and synchronization with other health and social monitoring systems. A flexible reporting module allows the program personnel to analyze data at any time using a user-friendly interface for data visualization and the system programming code, SQL, is open-source for managers to adapt the system to their needs.

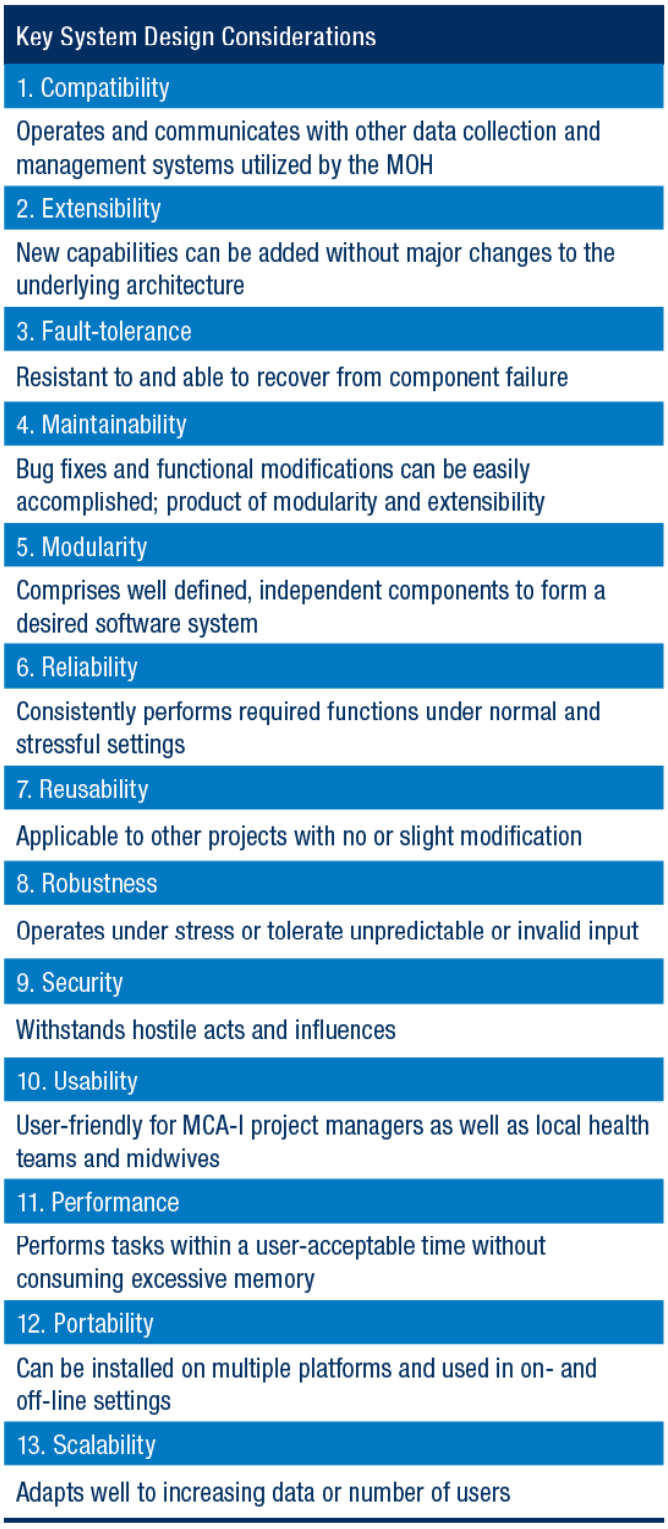


Figure 1: Key System and Design Considerations.

The monitoring system applies a combination of two approaches: 1) moving the data input, process, and output to an online platform; and 2) making a direct link between target population data and the statistics of interest, such as services, demographic events, and health events. This direct link provides the numerator and denominator to study rates and statistics of the focus population, while the online platform ensures the generation of real-time data and capability to monitor longitudinal data trends (Figure 2). These capabilities make the designed sentinel site monitoring system a Demographic Health Surveillance System (DHSS) [20]. The DHSS is a dynamic information system where demographic, health status as well as key health events continue to be linked to provide near real-time status of the family members in a household at any time.

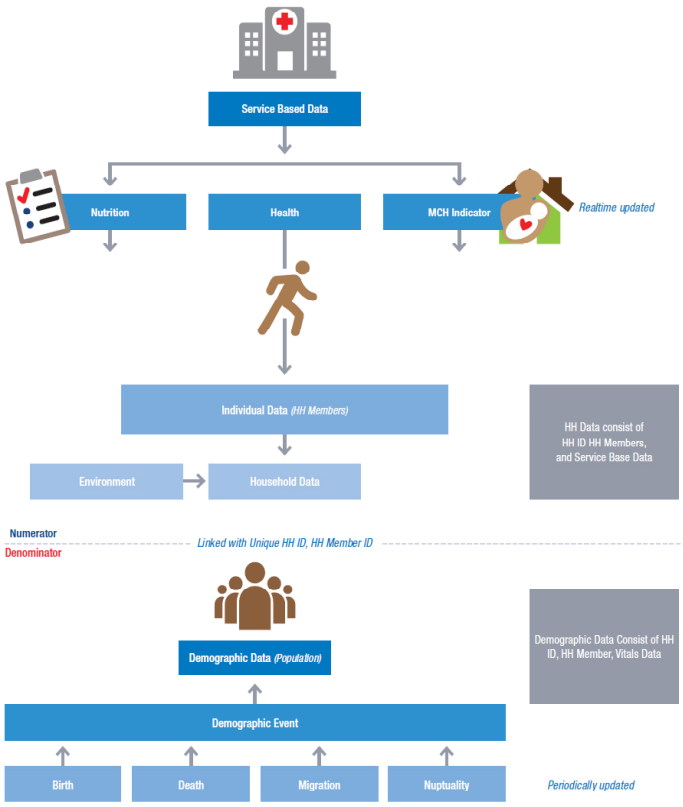


Figure 2: Conceptual Framework for the Database Structure.

The web-based application manages records of service statistics of mothers and children at village respective health centers under the sentinel site project and is hosted on a cloud server. Collected data is stored in a panel database of interlinked the household and household member data and other panel databases so that when queries are made for specific information, the system will pull the requested indicators from different panels to display the appropriate records and data visuals.

Data Collection

Data at the sentinel sites was collected at four levels: 1) rapid census of households to construct a baseline health program targeted population; 2) a cycle of household visits, to longitudinally update community and population demographic data; 3) routine statistics of services at health facilities; and 4) sample surveys of specific health topics within the system. In Indonesia, village midwives provide life-saving care and support to women during pregnancy and labor, to newborns, and to rural families. Given the village midwives' vital role in contributing to positive health outcomes at the community level, they were recruited by MCA-I to conduct real-time data collection at the clinic level. MCA-I also recruited field facilitators to collect data at the household level. Field facilitators and midwives are responsible for collecting real-time data from homes and health facilities covering populations residing in their catchment areas (Figure 3). URC installed the system application on field facilitators' and midwives' laptops and created user-friendly guides and installation software for further growth and system updates beyond the project.

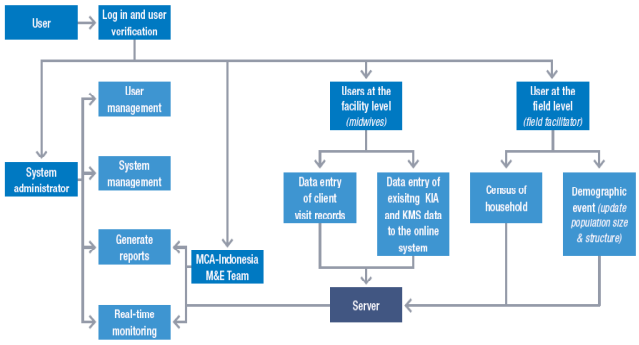


Figure 3: System Management and Data Entry Pathways.

In order to monitor changes in key health and nutrition program indicators (Table 1), the system used three data collection approaches: (1) conduct a rapid census of households to establish a baseline of key indicators of targeted household and household members, which was followed by a 90-day cyclical household visits to record demographic and health events occurring since the last visit to collect data on changes in health indicator status of and record other health events and, at the same time, update longitudinally the changing database panel of household and household member demographic data; (2) record timely routine statistics of maternal and child services at health clinics or health facilities to establish a panel database of health services statistics interlinked to other databases; (3) conduct specific surveys or studies as needed on maternal and child nutritional anthropometric status, child morbidity, health and sanitation behavior, exposure to and source of health communication messages. Socio-economic data was collected within one cycle of household visit once the household and household member demographic database has been established.

Illustrative Program Indicators
• Participation in nutrition Social and Behavior Change Communication (SBCC) activities at the village level
• Coverage of iron and folic acid supplements among pregnant women
• Coverage of micronutrient supplements among children
• Household hygiene and sanitation behavior
• Health care seeking behavior
• Immunization status for mothers and children
• Contraceptive use status among women of reproductive age
• Maternal anemia status
• Maternal anthropometric status
• Child anthropometric status
• Prevalence/incidence of childhood morbidity (diarrhea, respiratory infection, etc.)
• Maternal and early childhood mortality

Table 1: Illustrative Program Indicators.

In Indonesia, village midwives provide life-saving care and support to women during pregnancy and labor, to newborns, and to rural families. Given the village midwives' vital role in contributing to positive health outcomes at the community level, they were recruited by MCA-I to conduct real-time data collection at the health facility or clinic level. MCA-I also recruited field facilitators to collect data at the household level. Thus, field facilitators and midwives are responsible for collecting real-time data from homes and health facilities covering populations residing in their catchment areas (Figure 3). URC installed the system application on field facilitators' and midwives' laptops and created user-friendly guides and installation software for further growth and system updates beyond the project.

With this system design, program managers are able to monitor behavioral aspects related to nutritional outcomes, such as eating behavior, food choices, and handwashing, in addition to health services.

Rapid census: In 2017, a rapid census of households was conducted to collect household data, including GPS location and key demographic information on each household member (name, date of birth, sex, relation to head of household, etc.). This census allowed the team to build a cohort of individuals to track over time using unique IDs, leading to the construction of a target population and household database. At each household visit, data was geo-tagged to confirm the household location and allow for geo-mapping of data.

Cyclical updates: The DHSS application was designed to incorporate cycles of demographic data after the first rapid census visit, with data collection conducted by field facilitators on indicators for demographic data, socioeconomic data, and sanitation/behavior data. The application includes questionnaires for data collectors to enter information directly into the system and have it uploaded as soon as they have an internet connection. Routine cyclical updates are to be conducted every 90 to 180 days (90-day cycle in this system) to account for key shifts in population changes, dependent on program capacity. The system then uses a set of pre-defined algorithms to update the population and household database by evaluating demographic events that occurred since the previous visit. These demographic events include: marital change, pregnancy, pregnancy termination (aborted, stillbirth, or live birth), death (causes), in-migration, and out-migration.

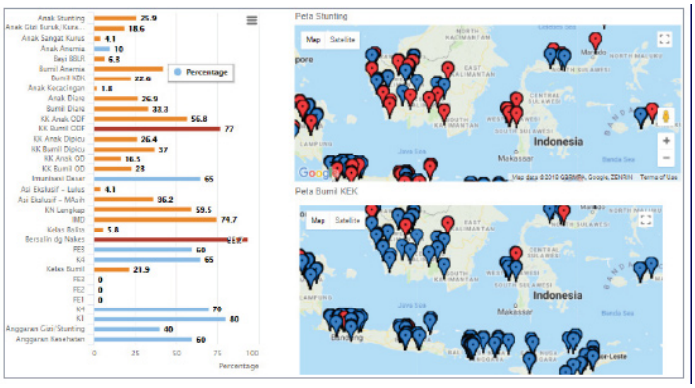
Routine health services: The URC team, in coordination with MCA-I and Survey Meter, imported data from thousands of mother and child health cards from sentinel sites to transfer health recordkeeping at these sites to the online system. To date, 8,026 mother cards and 9,778 child cards are accessible on the DHSS server and the midwives at these sites are able to use the system to update mother and child health records. As part of the DHSS application, URC developed a semi-online desktop platform that allows midwives to input data on provided laptops. Midwives can record data both online and offline; any data collected offline is saved and uploaded to the database server when internet connection is re-established. URC provided a system administrator and data manager to manage all of the data that is uploaded daily by midwives. Midwives retrieve client information for health visits using a household ID number, and the online system can recall the client's data using name and date of birth if the client does not have their ID. Information recorded by midwives is tagged with location information (geo-tagging) to confirm activity location.

Surveys: In designing the DHSS system, URC built in a module to improve capacity to conduct health surveys and receive data from several survey modules. The system application can facilitate selection of a random sample of households or household members, and ease data collection by providing electronic questionnaires and linking data directly to the system database for recall and reporting needs. This survey functionality has been used to implement multiple surveys on topics including exclusive breastfeeding, nutrition, and child morbidities.

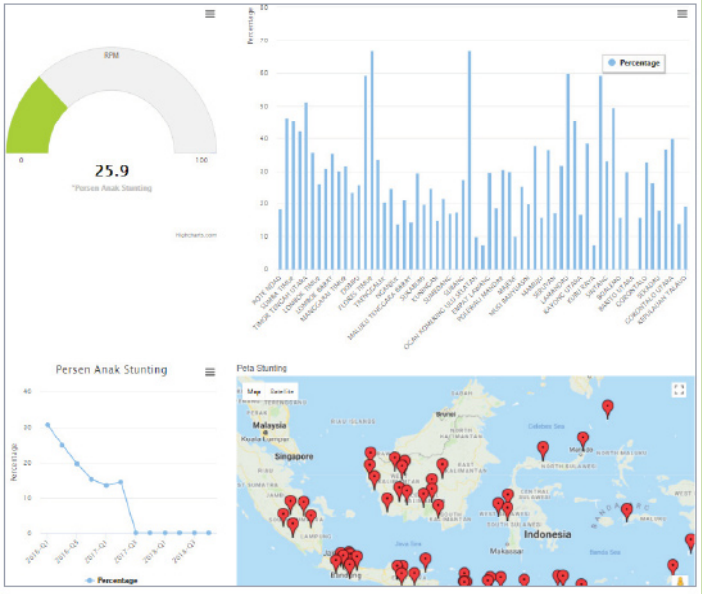
Data Presentation

URC has worked to ensure the availability and appropriate presentation of different forms of data (population data, survey data, individual health data, etc.). We developed an executive dashboard through which dynamic data visualizations and data reports are available. Through the DHSS application panel databases, the system produces standard summary reports and dynamic data visualizations as well as more specific information using querying

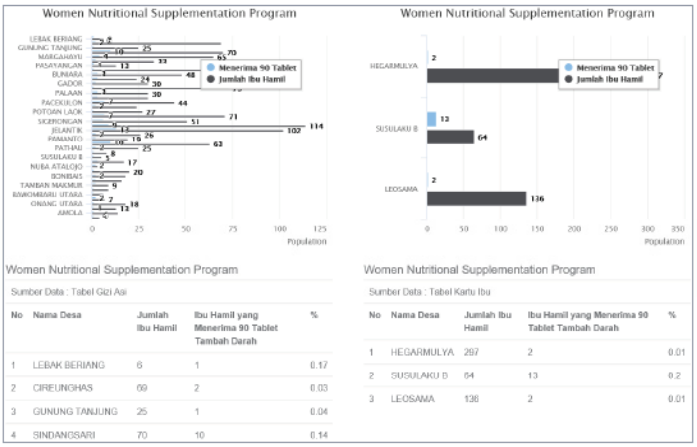
functions. This allows users to generate and display data for routine health program output and outcome indicators, health care access and utilization, and demographic and socioeconomic characteristics over time. Available data includes population structures, education status, household socioeconomic status, lists of children under age 2 or age 5, morbidity and mortality statistics, child growth, health statistics for pregnant women (including weight gain, protein-energy or chronic energy malnutrition, anemia), and utilization of both antenatal and postnatal services. Mapping tools can display household locations, pregnant women, and children. Figure 4 provides an example of data presentation output at the national, provincial, and district levels.



(A)



(B)



(C)

Figure 4: Presentation of Data at the National (Panel **A**), Provincial (Panel **B**), and District (Panel **C**) Levels.

Cost of the program and sustainability

The cost components of the on-line DHHS included: development of the software; implementation; and, continuous update of the surveillance and monitoring software and datasets. The project invested about $150,000 for the design of the DHHS software and other tools. As part of the design, the tool was piloted and modified based on the initial result, feedback from the national program and MCA-I. For implementation, front-line workers received orientation as well as a tablet/computer each to collect information in real-time. The cost of each table/laptop was about $300. If one was to use an average cost of a connected laptop/ tablet per health worker per year, it would cost about $200 a year, and if this was to be prorated per capita, then the actual costs is just few cents per year. We believe the cost of the DHSS solution is minimal and benefits derived are huge, particularly in areas with high morbidity and mortality. This tool is supplemental to DHIS and can be linked to it with ease.

Transition to Government Institution Utilization

The DHSS system is designed to function beyond the life of the MCA-I project and address the larger gaps impacting local data monitoring, evaluation, and management to promote data-driven decision making. This system, built with SQL software to adapt to any inputs and frameworks, is highly advantageous in multiple areas. Midwives trained under the project have been encouraged to utilize the system for their benefit as well as the benefit of the health system, and the current DHSS application is already providing real-time information helpful to community-

based health programs. URC has entered into a transition phase to transfer server management, maintenance, and oversight to the Ministry of Health in Indonesia. Meanwhile, the Ministry of Villages has expressed interest in adapting this system to monitor local health financing expenditures and linking these expenditures to improved health outcomes. The results derived from DHSS can also be used to target healthcare worker continuing education and learning programs.

Conclusion

The successful development and implementation of the sentinel site monitoring program under the MCA-I Community-Based Health and Nutrition Project underscores its useful as an evidence-based health program management tool. This system added capability to the Ministry of Health's existing systems by 1) linking population and health services data; and 2) recording population-level conditions and demographic events longitudinally. We hope that the Government of Indonesia and its Ministries will continue to use the online system application developed by URC/MCA-I to manage and monitor the country's community-based health programs. We also believe this approach can be successfully adapted and implemented in other low- and middle-income country settings to manage and monitor similar community-based health initiatives.

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Disclaimer

The authors views expressed in this publication do not necessarily reflect the views of the Ministry of Health, Indonesia, or the Millennium Challenge Account-Indonesia.

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