Interoperability of Health Digitalization:

Case Study on Use of Information Technology for Maternal and Child Health Services in Indonesia

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Abstract. Introduction : Introduction : Maternal and child health (MCH) is a global priority as health care innovation continues to evolve, including the use of information and communication technology. Studies showed that interoperable information systems can improve the quality of health services and at the same time facilitate the integration of data for the purpose of monitoring and evaluating the performance of health services, especially MCH. Aims : This study aims to identify various maternal and child health information systems used in Indonesia and opportunity of interoperability between systems to support continuum of care services. Methodology: Qualitative descriptive research was conducted in Yogyakarta Province from November to December 2020. This study assessed MCH applications that have been used in public and private primary health care, hospitals, health offices and in the community by identifying their functions and mapped data elements used by each application to assess potential interoperability between systems. The online focus group discussions with various application providers was conducted to explore the challenges of interoperability between digital systems. Results and Discussion : There were 18 maternal and child health information systems have been developed by the government (central and local), health facilities and private sector. The initiation of interoperability between systems has not yet occurred, except to support regular reporting at the health office and Ministry of Health level. Interoperability between information systems required efforts to improve information technology facilities and infrastructure, development of health data standards, strengthening governance and regulation and utilization of data as an effort to monitor, evaluation and continuity of interoperability between systems to support the digitalization of services and routine reporting. Conclusions and Recommendations : Digitalization of MCH services in Indonesia has the opportunity to support the continuum of care through an interoperable system. However, several enabler factors need to be prepared to support interoperability between information systems.

Keywords: health digitalization, interoperability, maternal and child health.

Introduction

Mother and child health program (MCH) is one of the basic health care programs in Indonesia and a global priority. It is an early phase of the continuum of care where mothers, newborns, and children are inseparably linked in life and in health care needs. Unfortunately, there are differences in MCH outcomes between regions that are caused by the uneven capacity of health care systems such as human resources, facilities and infrastructure,

pharmaceuticals and medical devices, and financing. In addition, the COVID-19 pandemic has also led to a decrease in maternal and child health care reporting, including immunizations, nutrition services [1], as well as reproductive health services. In addition, the regular monthly reports of nutrition programs in the health office are also under utilized for decision making. Such low data utilization is indicated due to difficulties in data accessibility [2].

Utilization of information technology in the health sector can support the availability of accurate and timely data and information. Time-consuming and less efficient manual logging should be switched to digital-based logging that can improve access to the data and better on the managing information system. Digital-based information systems provide ease of access to all stakeholders. However, a number of digital-based health information systems that have been developed need to be integrated to support better data and information management.

Policy innovation is also needed to accelerate the progress of MCH's outcomes throughout the region. With the challenge of disparity in the capacity of health care systems between regions, the regulation on digitalization of services is one solution to overcome them. In addition, the integrated health care information system, user friendliness, and accessibility require strong policy in the implementation of healthcare information systems to be able to provide the latest data and information, accurate, valid, fast, and transparent. Therefore, mapping the condition of health care digitalization, strategies and policies and alternative solutions to solve the problem need to be formulated appropriately.

Research Method

This study used a qualitative descriptive study approach in Yogyakarta Special Region which was conducted from November to December 2020. The method was appropriate to describe more comprehensive phenomena related to the current situation of digitalization of health services [3].

The study consisted of several stages: stakeholders and application identification, online focus group discussions by involving resource persons from different organizations, observation of the application by installing and exploring the features that are displayed, data analysis, and dissemination of preliminary results to reconfirm findings.

Table 1. FGD Participants

Time	Activities	FGD Participants	
		Health Sectors	**Total participants**
Wednesday, 11 November 2020	FGD with District Health Office and Health Facilities from west and central regions	District Health Office Public Health Care Regional Public Hospital Mother and Child Hospital	6 3 3 1
Thursday, 12 November 2020	FGD with District Health Office and Health Facilities from eastern regions and private sectors	District Health Office Public Health Care Regional Public Hospital Mother and Child Hospital Private sectors	6 3 3 1 3

Result and Discussion

Condition of MCH Digitalization in Indonesia

There were many applications used for data capture and reporting MCH services. We mapped about 18 applications that have been identified based on the results of discussions with various stakeholders with a continuum of care approach (Figure 1).
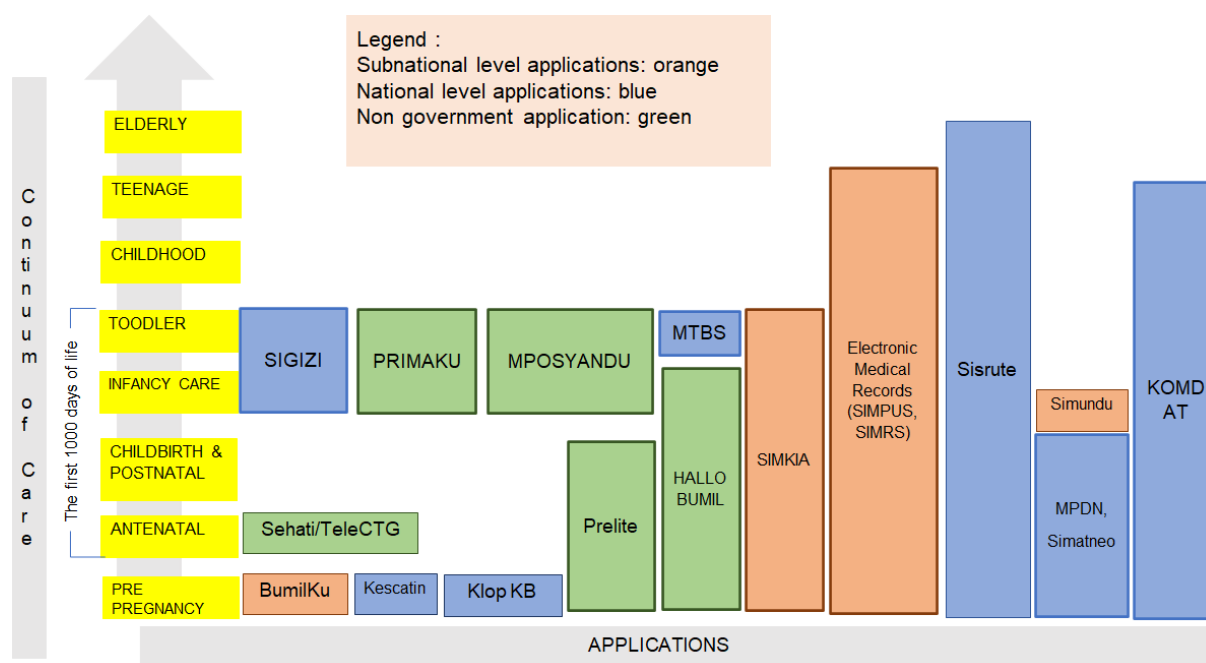

Fig. 1. Mapping of various applications related to MCH with continuum of care approach

The continuum of care approach suited to describe the number of applications that has interlink services from pre-pregnancy stage, antenal, childbirth and postnatal, infancy, toddler, childhood, teenage children, and the elderly. This mapping illustrated that there were already applications that served as a container for data collection in every journey of life. The application has two main purposes, 1). to facilitate health services (digitalization of services) and 2. to enable ease of reporting. The digitization was initiated both at the government (national and sub-national level) and private sector and health facilities. The reporting purpose was mostly initiated by the government, while health services and individual monitoring applications mostly initiated by health facilities and the private sector.

Based on our finding, the digital health intervention for MCH can be divided based on WHO classification of digital health interventions [4] for tracking patient and health information management. In addition, the digital interventions were distinguished by the main users of the system consisting of 1). clients or the community who used health care facilities, health promotion and self monitoring, 2). health workers who conduct data capture from healthcare services they provided, and 3). health data managers who responsible for routine health management information systems which includes data collection, validation, analysis, visualization, data use and dissemination.
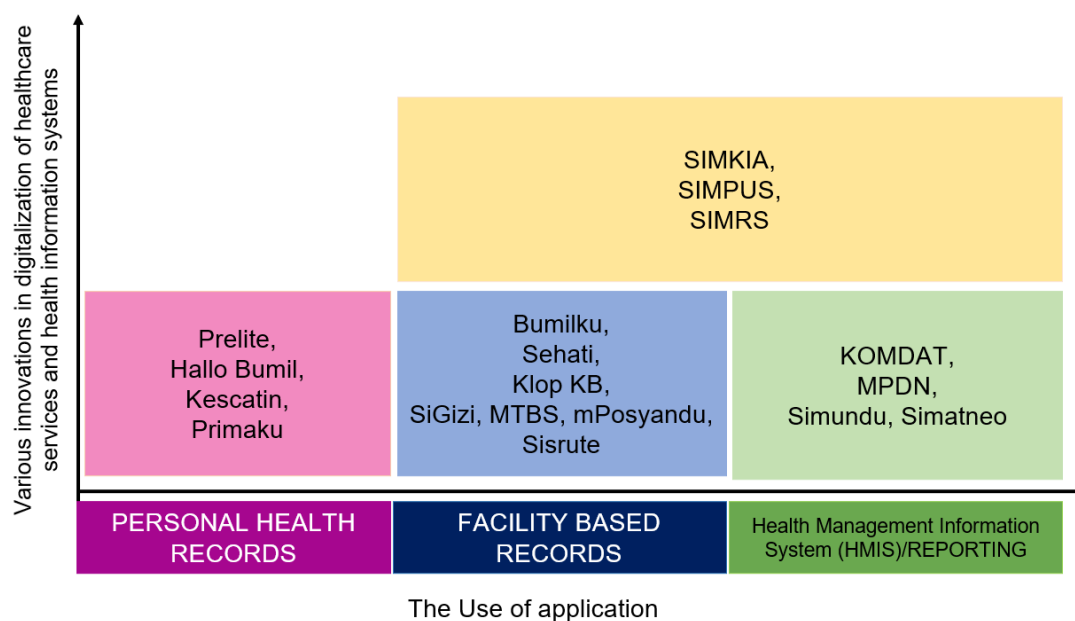
Fig. 2. Classification of Digital Health Intervention in applications related to MCH

MCH-related applications that exist today can be categorized into personal health records used by individuals / communities directly, facility based records filled by officers in health facilities and HMIS for the purposes of recording and reporting. Among these applications, there are applications that have facilitated facility-based service activities as well as for reporting purposes both comprehensively and specifically MCH.

One of the interesting things about mapping is the application has not facilitated the principle of Continuum of Care because each application is still fragmented, so that efforts are needed to make it sustainable between applications. Operational applications for service needs can also be used to fill reporting needs. Constraints due to the number of fragmented applications is the need to enter data repeatedly (double entry) by officers. For example, if there are patients visiting Primary Health Care, when going to the hospital supporting data has not been connected between health care facilities so it needs to be re-entry and may even need to be re-examined. It is certainly inefficient and increases the risk of medical and medication error.

Differences in Application Usage between Regions

In this study, we explored the use of MCH applications in different regional zones in Indonesia by grouping into several categories as in the following table.

Table 2. Comparison of the use of MCH digitalization between different regions in Indonesia [5]

Category	Regions	
	West and Central	**Eastern**
Implementation of MCH digitalization (healthcare service and information system management)	There were already applications for healthcare services and health information systems	Focus on reporting, for services were still few. Still relying on WhatsApp and paper based or not digitized.
Standard interoperability of MCH	Some subnational levels have developed a variety of	- Haven't developed many subnational level

digitalization (national and sub-national level)	applications that overlapped and there was no interoperability with national level applications. In this region the national level application was less used	applications - Already used the application from the national level but not running optimally due to limited infrastructure. Thus, paper based reporting was still used.
IT infrastructure and internet connection	Minimum internet constraints in some areas	Apart from internet access, there were still limited hardware availability

MCH-related applications that exist could be categorized into 1). personal health records used by individuals or communities that in some extent link to health facility, 2). facility based records that are used by healthcare workers in health facilities and 3). routine health management information systems (HMIS) for the purposes of data capture and reporting that are mostly used by data managers in primary health centers and health offices. Among these applications, there were applications that have facilitated both facility-based service and for reporting purposes for the MCH services.

We found that the application had not facilitated the principle of Continuum of Care because each application was still fragmented. There was no interoperability in place to ensure sustainable data sharing between applications. Some of the applications were actually collecting data that can generate necessary routine reports. However these applications did not contribute to the routine reporting. Thus, inefficient data collection appeared due to the number of fragmented applications required repeatedly data capture by health care workers (double entry). For example, if there were patients visiting Primary Health Care, when going to the hospital supporting data had not been connected between health care facilities so it needed to be re-entry and may even need to be re-examined. It was certainly inefficient and increased the risk of medical and medication error.

The difference in application usage between regions was inseparable from the resource capabilities of each region. In areas that have adequate resources to innovate technology utilization would certainly differ the level of application usage compared to areas where the condition of resources was less supportive. The western and central regions already started to develop applications independently to meet the needs of their respective regions related to the digitalization of maternal and child health services. While in the eastern zone there were still many who have not implemented the digitalization of maternal and child services so that in the process of reporting data was still done manually.

Differences between National and Sub National Initiated Applications

The national government in initiating application development generally aimed to facilitate MCH reporting systems, such as Komdat, Simatneo, MPDN, and reporting in general that support MCH such as Sisrute. Some applications aimed to facilitate services such as SiGizi and MTBS. Sub national and private governments in developing applications tend to aim to support services, such as SIMPUS, SIMRS, mPosyandu, Sehati TeleCTG, Klop KB, Primaku, Hallo Bumil, and Prelite.

The National Government played a role in facilitating tiered reporting, initiating applications to be further developed by regions, including facilitating areas that did not yet have a system. While the Sub National Government played a role in continuing the interoperable system with the national level. This indicated the implementation of a system that combines a centralized and decentralized system.

The implementation of the centralized system was developed by the national government and run to all regions under the coordination of the center. While the implementation of decentralized systems was developed by the sub national level to meet the needs of specific health services in the region. Decentralized systems must meet the

standards of interaction with other systems, but allow them to be developed without dependence from other systems. Implementation measures that combine centralization and decentralization efforts can meet the needs of health services in each region as well as needs related to reporting to the center [6].

Differences between Public and Private Initiated Applications

Currently applications developed by private parties mostly aimed to facilitate the needs of individuals or communities directly (personal health records), for example Prelite, Hallo Bumil and Primaku. This was in line with the use of personal applications that began to develop, especially among people who have good health knowledge. Some applications have been intended to facilitate services by health workers or health facilities such as Klop KB, Sehati TeleCTG and mPosyandu. While the application developed by the public more broadly covers personal needs, health facilities to recording and reporting.

The development and implementation of digital health services for the government had the main goal to provide access to fair, affordable and useful services for the entire community [7]. In addition, in developing applications private parties would have a specific purpose either referring to non-profit organizations, the commercial sector that generates profits for their owners, as well as academic institutions involved in the dissemination of knowledge through research, education and training. Collaboration between private parties and the government would have a significant impact on public health while fulfilling the principles and objectives of each private party [8].

MCH Digitalization Resources

To support the digitalization of MCH, efforts were made to fulfill the necessary resources such as facilities and infrastructure in various regions. Indonesia has carried out various infrastructure developments as a manifestation of these efforts, such as the following:

- provided internet access in the underdeveloped, outermost, isolated areas (3T) managed by the Ministry of Communication and Informatics through the Telecommunications and Information Accessibility Agency (BAKTI)
- provided Base Transceiver Station in the blank spot area managed by BAKTI. This effort has reached several underdeveloped, outermost, isolated areas in Indonesia.
- telecommunication network development projects to all districts / cities using Sea Cable Communication System (SKKL) and Fiber Optic Communication System (SKSO). The project was known as Palapa Ring.
- the planned launch of the Satellite of the Republic of Indonesia (SATRIA) in 2022 for the provision of internet

Regulatory Analysis and Technical Guidance

Various applications that have been developed for health care services and health information systems were still fragmented both from health facilities and sub national level so that not thoroughly MCH data in each developer of MCH service applications, health care facilities and regional health agencies delivered to the center. On the other hand, the national government was also developing applications for MCH reporting needs that were poorly adhered to by some areas in its charging because the sub national level has developed applications as needed, applications were less user friendly, infrastructure constraints, and human resources. Based on these conditions, regulations related to the interoperability of digitalization of healthcare services and the integration of health data in the digitalization of health information systems was necessary especially for MCH data.

MCH health services that support the Continuum of Care required collaboration between health facilities by exchanging patient data from one system to another, including personal health records used by patients or patients' families in order to monitor health independently and contribute to medical records. MCH services are a combination of institutional and community-based services that complement each other. While MCH service standards are already available and used evenly in Indonesia (MCH Books), MCH health service

digitalization technical standards that cover various needs of recording and exchanging MCH health service data have not been widely developed. For example, the interoperability of digitalization of MCH services could be [9]:

- Scheduling and appointment of MCH services at health facilities
- Recording of health services ranging from registration, anamnesis, vital signs, pregnancy status, physical examination, medical support examination, medical action, treatment, birth, neonatal registration, outcome and medical resume
- Clinical decision support system
- Public access (patients and families) to MCH service data through web portals or personal health records that are widely developed by the private sector.

- Codification standard or unique ID for various actors of MCH health services such as patient identity, codification of health facilities and codification of health workers.
- Standard codification and dictionary of maternal and child health care data that includes codification and standard terminology for vital signs, anthropometry, medical symptoms and signs, pregnancy status, diagnosis, medical support examination, medication, medical procedures, clinical outcomes and others.
- The protocol and format of electronic data exchange, for example, adopts the HL7 FHIR standard which can be xml and JSON documents [10].

The above three aspects must be managed professionally either by specialized institutions or consortiums, documented, accessible and developed continuously in accordance with the necessary changes. In Indonesia there were no institutions that formally and had a concrete responsibility to develop health data standards, develop protocols and formats of electronic data exchange and manage interoperability infrastructure between digital systems of healthcare services.

In the concept of OpenHIE interoperability (Open Health Information Exchange), in addition to standards, health data codification and electronic data exchange protocols, electronic data exchange was recommended using a centralized model (shared health records), where individual data was collected in one database system that were managed safely and reliably [11]. Australia through the concept of PCEHR (personally controlled electronic health record) is one of the countries that has a central data exchange model played by the federal government (central government) [12]. A centralized system makes it easier to connect data from different healthcare digital systems. There needed to be regulation for centralized database system managers who were not health care providers but participated in collecting individual data and were responsible for facilitating the exchange of such individual data in order to support sustainable health services (Continuum of Care). In various models of electronic data exchange, the central government had a dominant role in facilitating interoperability.

Integrated MCH Digitalization

Integration Initiatives

Integration is required so that different applications are interconnected and form a single entity. Integration should involve standard specifications and communication media that enable interoperability between health services [9]. Various initiatives to support system integration in Indonesia has been carried out including:

Kamus Data Kesehatan Indonesia (Kata Hat-I)

Kata Hat-I (is a list of information about data standards in clinical/health terminology in all Information Systems and Health Services in Indonesia in order to create common meaning and improve the validity and reliability of health data to improve communication of exchange, collection, and use of integrated data. The word Hat-I (https://idn-hdd.kemkes.go.id) is an initiative that aims to make local applications developed independently can be easily integrated, read and exchanged between systems.

SPBE Integration

Electronic-Based Governance System (SPBE) was regulated in Presidential Regulation No. 95 of 2018 concerning Electronic-Based Governance System. SPBE aimed to realize clean, effective, efficient, transparent, and accountable governance; realizing quality and reliable public services; and realize an integrated electronic-based governance system. SPBE services include government services(e-office, e-planning, e-budgeting, e-monev), civil servant (e-staffing, e-pension), community (e-complaints, e-health, e-education) and businesses (e-procurement, e-licensing). SPBE principles include effectiveness, integration of supporting resources, sustainability, efficiency, accountability and interoperability, and security.

The Need to Support Integration and Interoperability in Indonesia

Although there have been initiatives to support data integration and interoperability between digital health systems, the results of the analysis showed that Indonesia still needs strengthening several resources. The following figure summarizes the aspects found in the study based on the framework from Mansoor (2010) [13].

Table 3. The Need to Support Integration and Interoperability in Indonesia [13]

No	Aspects that need to be supported	Description and examples
1	Regulatory framework	Regulations and policy such as electronic data exchange for meaningful health data, the national guideline for data integration and interoperability, the use of electronic health records.
2	Informative structure	Standard health terminology and unique ID for different domains such as health facility registry, client registry, health workers registry.
3	Technical infrastructure	Communication network, electronic directory and data warehouse, identification, authentication, information structure: Service Program by the Ministry of Communication and Information Technology
4	Adequate and interoperable ICT system	Electronic health records, national patient discharge summary, administrative support systems, community-based health program information systems (immunization, nutrition)
5	Data Accessibility	● Access data between health and non health organization: sharing policy through compliance with data standards, metadata, interoperability ● Accessibility for the community

It was identified that several interoperability and integration requirements have been in place that require additional arrangement. Registration of health facilities with a unique identification is carried out by 3 different units in the MoH, the Directorate General of Health Services responsible for hospitals and private clinics, the Center for Data and Information of the Ministry of Health for primary health centers and the Directorate of Pharmaceutical Services for pharmaceutical facility registration. Unique ID for resident or client registry can be used Resident Number (NIK) from the Ministry of Home Affairs or membership number of the social health insurance (BPJS Kesehatan). Health Management Information System has

been managed by the Center for Data and Information of Ministry of Health through One Health Data application as the national health data warehouse for routine reporting. Registration of Health Workers have been attempted by different institutions such as the Human Resources Development Agency (BPSDM) of the MoH, the Indonesian Medical Council (KKI), as well as various professional organizations such as midwives, nurses, and others. Currently also being proposed is the Integrated Medical Record as a shared health records that is led by the Directorate of Health Services Ministry of Health that covers electronic medical record and medical discharge summary standards.

Civil registration is a legal identity for individuals to access public services. Unique National IDs can link important information collected from a variety of sectors including health. Multiple countries assign one unique civil registry ID at a time to health data. There are also those who add an identification number for health in addition to a unique civil registry ID, but the two data are interconnected. Connecting the health system with civil registration and national identity management systems will provide effectiveness and efficiency in universal health services [14].

Leadership and Governance

Leadership and governance are critical to ensure the process of integration and interoperability of health information systems [15,16]. It is a cross-sectoral collaboration that involves different ministries such as the Ministry of Health, Ministry of Communication and Information and the Ministry of Home Affairs. Our study found that The National Development Planning Agency has a strategic role to coordinate policy formulation for data sharing amongst different ministries.

Expectations of Interoperable and Integrated Information Technology

Based on identification and analysis of conditions related to MCH digitalization in Indonesia, the following information system architecture is proposed (Figure 3).
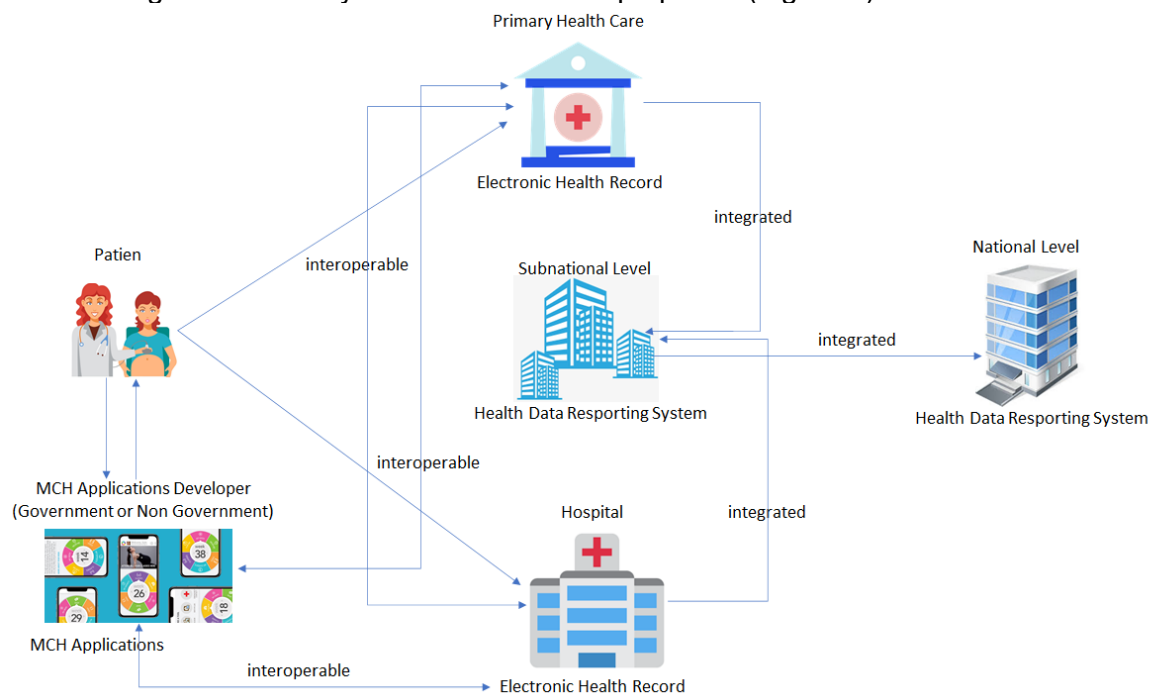

Fig 3. Proposed an integrated and interoperable health information system architecture for MCH services [17]

The proposed health information system architecture includes interoperability of individual patient data through the existing electronic health records (EHR) in health care facilities (Primary Health Care and hospitals). The MCH services should be incorporated into

the EHR system that has capability to be interoperable with other EHR systems and any MCH applications that are used by a patient or community. These applications can be developed by the government and the private sector. Any healthcare service application such as an EHR or MCH application should have capability to produce monthly reporting based on a standard that is required for the sub-national level up to national level.

Interoperability between systems in the context of healthcare services to support continuity of care and capability to generate routine reports as an output of such systems is a comprehensive function that must be considered in any digital health intervention. With such a health system architecture, it is expected that quality MCH services as part of the continuum of care will improve, efficient, sustainable and promote data use for decision making.

Conclusion and Recommendation

A number of digital health innovations for the healthcare service and routine program reporting of Maternal and Child Health (MCH) have been developed either at the National, Sub-national (provincial and district) and health facility levels. Unfortunately, the digital health initiatives were fragmented which has an impact on redundancy of data collection and fragmentation of efforts to digitize healthcare services and health information systems.
Interoperability of digital healthcare services and integration of digital MCH information systems under the framework of continuum of care (continuity between services) is indispensable, both for individual healthcare services and monitoring of maternal and child health programs. More technical regulations or guidelines are required for electronic data exchange between digital systems providers and integration of routine report (digitalization of management information systems). An institution or consortium needs to be established to develop terminology and vocabulary standards, unique ID for different registration systems, and provide infrastructure, facilitate maintenance and electronic data exchange amongst digital MCH applications.

Acknowledgment

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