

District Health Information Software 2 (DHIS2) and Immunization: A Review of the Literature and Resource Guide

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Definition of Key Terms

DHIS2: District Health Information Software 2 is a tool for collection, validation, analysis, and presentation of aggregate and patient-based statistical data, tailored (but not limited) to integrated health information management activities. It is a generic tool rather than a pre-configured database application, with an open meta-data model and a flexible user interface that allows the user to design the contents of a specific information system without the need for programming.

WHO Packages: These are metadata packages that can easily be configured / adapted by countries, based on standards and best practices from WHO. These packages consist of DHIS2 metadata that provide standard configurations of DHIS2 according to WHO recommendations, aligned with a public health curriculum. These include the Tracker, Complete Aggregate and dashboard.

Tracker configuration packages include one or more tracker (case-based) programs and related metadata such as program indicators and dashboards.

Complete Aggregate configuration packages include data sets for routine aggregate reporting, as well as dashboards.

Dashboards configuration packages include indicators and dashboards only.

EPI Program configuration packages: The Expanded Program for Immunisation (EPI) that aims at ensuring universal access to all relevant vaccines for target groups has two standard configuration packages. These include an **aggregate package** that includes data collection and dashboards and a **dashboard** configuration package that includes dashboards only.

EPI tracker: This is an extension platform within DHIS2 that provides for collection, management and analysis of transactional, case-based data at the individual level with built-in reminders for tracking and following up defaulters.

Immunisation Analysis App: In addition to the standard configuration packages, an Immunisation Analysis DHIS2 app was developed to provide additional analytical outputs, and supplement the standard configuration package.

Introduction

This guide to resources highlights recommended published literature on DHIS2 and DHIS2 for immunization. It has been developed with an aim of **supporting countries with relevant information that can inform their implementation of DHIS2 for Immunization through learning from other country experiences**. It is intended for DHIS2 implementers and countries that intend to deploy and/or use DHIS2 to help improve immunization-related activities.

This guide provides a review of the evidence and what has been published in the peer-reviewed literature and highlights resource documents that are useful while dealing with various issues that countries come across during DHIS2 and immunization deployment. It revealed barriers and challenges to using digital entry systems at sub-national levels and provided some guidance on future areas for research to build evidence base on how DHIS2 can impact immunisation services. Although most of the studies reviewed included immunisation programming, immunisation data and reporting was not the focus of most evaluations. Some examined general data quality and data use culture for DHIS2 but more analysis was needed on immunisation specific data use and entry at the sub-national levels. This evidence review, therefore recommended the need for more evidence to support the use of DHIS2 to improve immunisation data for decision-making and program improvements in LMICs.

Additionally, this guide to resources provides useful resources on facility-based data, data quality, interoperability, electronic registry using DHIS2, case-based surveillance and reporting on VPDs, vaccine supply chain information systems, bottleneck analysis and scorecards, DHIS2 and birth notifications, Adverse Events Following Immunisation (AEFI), immunization campaign monitoring and other general DHIS2 resources.

Background

Many countries have and continue to adopt the District Health Information Software 2 (DHIS2) as a tool to strengthen their national Health Information systems (HIS). This has attracted dedicated support from partners like Gavi, the Vaccine Alliance and the World Health Organization (WHO) to work with the University of Oslo to integrate functionality that can help countries manage and monitor their immunization programs more effectively. This partner support has seen countries collect, store, validate, present and use aggregate health data to support facility data capture and management and individual level data processing as well harmonizing immunization data within their national health information systems using [DHIS2 immunization packages available through the WHO website](#).

Over twenty countries (20) in Africa installed and are using the DHIS2 immunisation modules including the immunisation analysis app and dashboards. These applications help users to quickly identify immunisation areas of focus and also use that information to respond to information needs in real time. Some countries have been able to achieve at least 98% completeness of immunisation data submitted into DHIS2; have forged partnerships with funding agencies to support scale up although most of them need to devise means to sustain the software beyond Gavi funding and WHO support; technology is well set up, adapted and in some cases integrated with other in country health systems with structures in place to support implementation.

Implementers have had varying experiences including among others the adoption of the DHIS2 platform as the sole national HMIS system; national scale up; effective use of applications for immunization with concerns over data quality; governance and the establishment of Technical Working Groups (TWGs) to guide and oversee implementation of DHIS2; government ownership, leadership and coordination; transition from parallel systems to DHIS2; standardization and harmonization of data collection tools (HMIS); and data generation and use.

Some countries have registered some success in deploying DHIS2 for immunization, while others have struggled. Implementing integrated information systems, an area that is strongly recommended by WHO has been a challenge. Other challenging areas have included; sustainable funding to support implementation and scale up; human resource and capacity issues; hardware support; data quality and use; internet and connectivity and system functionalities. Despite these challenges, available resources indicate that there are success stories from several countries from which others can learn. It is hoped that this guide to resources can provide relevant information / experience to help countries be able to address the issues that they are grappling with as they implement DHIS2 for immunisation programs.

Country Lessons Learned

Countries within the WHO African region convened in Kigali, Rwanda to share their experience implementing DHIS2. This was during the “DHIS2 Experience sharing and Learning in the use of DHIS2 Immunisation App in the African Region workshop” that took place from 28th – 31st January 2020. This workshop that attracted 64 participants from National Ministries of Health in Uganda, Kenya, Mali, Cameroon, Ghana, Nigeria, Rwanda, Togo and DRC and partners including Gavi, WHO, University of Oslo, JSI, HealthEnabled, CDC and PATH aimed at:

1. Getting lessons on the DHIS2 immunization App deployment and use process in countries including identifying corrective measures where needed for the implementation, use of the App and tools (content and software).

2. Identifying new content and features that will support an increase of the use of data out of the DHIS2 for action by the countries at both central and district level and meet their needs for data and information.
3. Updating countries on the progress related to ongoing projects such as Vaccine Preventable Disease (VPD) and epidemic prone disease surveillance within DHIS2,
4. Informing countries on interoperability between DHIS2 with electronic Logistic Management Information System (LMIS)
5. Facilitating learning and experience on the use of tracker and e-registry modules between countries
6. Allowing developers including Oslo University and different Health Information System Programs (HISP) in Africa to get real time feedback from selected countries on the challenges faced by countries in the use of the system and tools
7. Allowing WHO and other technical partners to get real time feedback from selected countries on the challenges faced by the countries with the content of the App and the WHO guidelines on Health Facility Data use
8. Allow countries to learn from each other's experiences being good or bad

Implementation summary

All countries represented at the workshop were already implementing DHIS2 with data entry done at different levels i.e. health facility and district levels. Many of them had configured and were using the immunisation App, WHO data quality App, a few were using the e-Tracker while others had their surveillance system in DHIS2 as well. Countries considered different approaches to using DHIS2 for Immunisation programs such as using the Immunisation App and Leveraging on immunisation data from the Aggregate system particularly for those that hadn't deployed the Immunisation Apps. Completeness of immunisation reporting was high in some countries. Togo for example, noted a 91% rate, 80% for Kenya with regard to routine immunisation within DHIS2 whereas Ghana noted a 98% completeness rate at all levels of use.

Although most countries were using DHIS2 as their main health information system, countries like DRC were still implementing parallel systems. They however expressed interest in learning from other countries that had managed their transition well to be able to fully transition to DHIS2 as a single system. Togo, Nigeria, Ghana and Cameroon had successfully transitioned from DVDMT to DHIS2 as their main software for all health data in their countries.

Government ownership and leadership, health data needs by MoH, readily available human resource to support implementation, technical assistance from HISP East Africa and West Africa, availability of computers and internet connectivity, harmonized data collection tools (HMIS), were among the existing strengths

As countries continued to deploy and roll out DHIS2 and the WHO Packages, they faced challenges that hindered effective implementation. These included; implementing parallel systems and dealing with transition to DHIS2; workforce; system functionalities; data use / utilization; Infrastructure and funding; internet and electricity and; procurement and maintenance of hardware and equipment including computers and tablets; Governance, integration and coordination between MoH programs and user departments.

Recommendations

The subsequent recommendations emerged from the discussions and targeted the DHIS2 implementing countries, funders and software developers.

DHIS2 Implementing Countries:

- ⇒ Coordination: Countries indicated the need to improve on in-country coordination during deployment and implementation particularly within key national ministries of health programs like EPI, HMIS / Data sections, surveillance divisions and sub national levels for better implementation and usage of DHIS2.
- ⇒ Data Use: Countries also shared that meaningful engagement of decision makers to ensure DHIS2 data usage is a priority especially now that many of them have data that can be used.
- ⇒ Security: Countries discussed the need to define and determine who accesses DHIS2.

Gavi / WHO:

- ⇒ Sharing lessons learned: Countries that have successfully used DHIS2 Immunisation applications should be documented and their experiences shared with other countries to improve their own performance. This can include key success stories on DHIS2 data usage.

University of Oslo:

- ⇒ Responsiveness and version control: Countries indicated challenges with managing multiple versions of DHIS2 and upgrading as well as receiving timely support. It was suggested that mechanisms for more timely support are put into place with guidance on managing and transitioning to new versions of DHIS2.
- ⇒ Mechanism for managing use access (see above): Countries are still faced with challenges of managing user access within DHIS2. There is therefore a need to improve the tool to better manage users.
- ⇒ Systematic approach to review standard packages: Countries would like opportunities to provide feedback to inform and improve the standard packages.

This workshop provided great insights on the use of DHIS2 by countries within the African region with some using only the aggregate while others were using both the aggregate and the WHO packages. Although Gavi’s goal is to support countries to implement the WHO recommendation of having integrated information system, some countries are still grappling with transitioning from parallel systems to DHIS2. There is still a need to address data quality issues and in-country coordination within various MoH programs to be able to use DHIS2 data.

DHIS2 and Immunization: Evidence Review

A review of published literature, articles and project documents reveal a number of lessons, barriers and challenges to using digital entry systems at sub-national levels. Case studies examining the roll-out of DHIS2 immunization reporting systems emphasize the need for integrated training to build a positive sense of data ownership for improved decision-making at all levels (Sahay, 2011; Usifoh et al., 2019; Nisingizwe et al., 2014; Etamesor et al., 2018; Braa et al., 2012). Audits of the quality of immunization data in DHIS2 vary greatly, showing improved completeness and timeliness of reporting in one study (Kiberu et al., 2014) but overreporting in others (Manya & Nielson, 2016; Jamin et al 2014; Ward et al 2017), dependent upon factors such as staff training and competing priorities or resources at the point of data-entry. Studies on facility-level and point-of-service data collection systems for immunization reveal improvements in data quality and efficiency but with an increased burden of data-entry duties, conflicting priorities and a need for special attention to local work flow and training (Adalety, 2017; Moyo et al. 2015; Anderson et al., 2014; Clarke et al., 2019). The review of these documents, discussed in more detail below, provide guidance on future areas for research to build the evidence base on how DHIS2 can impact immunization services.

Methodology

Articles, publications and grey literature written in English between the years 2000 and 2020 were extracted from five databases using the same search terms (see boxed text below): Google Scholar, PubMed, Cochrane Library, ClinicalTrials.gov and EBSCOhost (Academic Libraries). All citations were imported into RefWorks web-based citation manager for screening and categorization.

Standard criteria were used to identify documents for the final review process: relevant studies from LMICs, human vaccine-preventable diseases, relevant to immunization programming or

Search Terms

DHIS AND (vaccination OR immunization OR vaccine)

District health information system AND (vaccination OR immunization OR vaccine)

vaccine distribution. The details of the identification and screening process are outlined in the flowchart below.

The final 35 documents (journal articles, master's theses, project reports and conference proceedings) fall into two categories:

Process Evaluations of DHIS2 for immunization (28 references): Outputs, Feasibility, Design, Data Quality

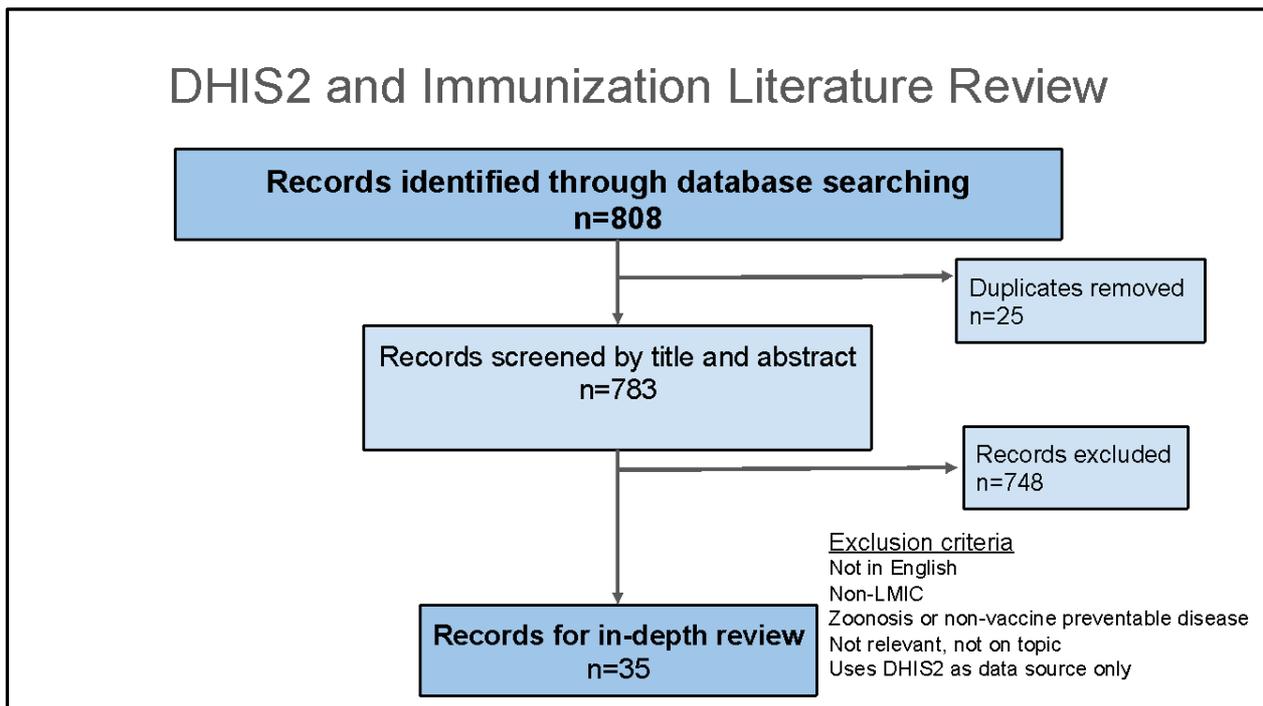
Process Evaluations of add-on applications (7 references): Analysis and field testing of e-Tracker, eLMIS modules, AEFI tracking module, other mobile data collection features

General / multi-region	1
Africa	28
Asia and Pacific	6

Evidence review – Key Lessons

Quantitative studies evaluating the use of DHIS2 for immunization programming focus on data quality including such aspects as completeness, accuracy and timeliness. Most of these included some immunization indicators within a broad review of DHIS2 data quality. In general, these studies show low quality and inconsistencies with data in DHIS2. However, completeness and timeliness of immunization reporting showed improvement after DHIS2 implementation in Uganda (Kiberu et al., 2014). In other settings, immunization data is prone to over-reporting and poor quality at the facility level (Manya and Nielsen, 2016; Jamin et al., 2014; Ward et al., 2017; Oguji et al., 2018); uncertain denominators and migratory populations contribute to data quality issues (Husain et al., 2012; Nisingizwe et al., 2014). In some cases, immunization data has the advantage of quantifiable commodities such as vaccine stock and vaccines administered that make it more reliable than other services provided at the health facility (Bhattacharya et al., 2019).

A number of case studies and situational analyses examined the state of DHIS2 roll-out, accountability, data use for decision-making, capacity needs and user satisfaction in



qualitative evaluations. These descriptive studies reveal challenges stemming from a lack of data ownership, accountability, and poor data-driven decision-making at sub-national levels (Sahay, 2011; Usifoh et al., 2019). Training on understanding data and its usefulness have shown promising results for improving data use and data quality (Nisingizwe et al., 2014; Etamesor et al., 2018; Braa et al., 2012); discrepancies in immunization data reported through DHIS2 can be used to pinpoint areas for training and targeted supportive supervision (Etamesor et al., 2018). Streamlining the reporting process and eliminating parallel reporting systems was also a key lesson to improve immunization data quality and use within DHIS2 (Ihekweazu et al., 2019; Sahay 2011; Mjelva, 2017).

A subset of publications examines applications that extend the functionality of DHIS2, most involving some form of data collection at the facility level or at point-of-service. The collection of longitudinal patient data involves a different set of implementation challenges and although immunization programming is included in these studies, immunization data and reporting was not the focus of most evaluations. Most articles examine the culture of data use and satisfaction of using facility-level data entry systems, with qualitative results indicating improved report timeliness, data transparency and patient record retrieval at the facility level (Adalety, 2017; Moyo et al. 2015; Anderson et al., 2014). Electronic data transfer eliminates the need for a monthly trip to the district health office to submit aggregate paper-based reports, freeing up resources and staff time (Adalety, 2017).

Despite healthcare workers enthusiasm to use digital data entry at the sub-district level, an increased data-entry burden is reported for frontline healthcare workers expected to complete two or more parallel reporting systems (Adalety, 2017; Moyo et al. 2015; Clarke et al., 2019). Data is often entered into the system after the service is provided, later in the day or up to a month after the service was delivered (Adalety, 2017; Ngoma et al., 2012). Reasons for data entry delay include perceptions that simultaneous data entry negatively affects the relationship with patients (Adalety, 2017; Clarke et al., 2019). Lack of trained staff to manage data entry was also cited as a barrier (Adalety, 2017; Anderson et al., 2014; Clarke et al., 2019). Pilot projects that utilize mobile devices for point-of-service data entry found low use of the system due to the extra cost of the mobile data that was not reimbursed and difficulties entering information on a small screen (Moyo et al. 2015; Maokola et al., 2011). If laptops are provided at health facilities for data entry, immunization outreach posts are not able to utilize the system at point-of-service due to lack of electricity or connectivity (Clarke et al., 2019). Recommendations stress the need to understand the local facility-level workflow, data collection practices and training needs and to build the trust of the frontline health workers through sustainability, reliability and a system that reduces workload rather than increases data entry burdens (Adalety, 2017; Clarke et al., 2019; Ngoma et al., 2012). Add-on modules and data transfer systems for longitudinal point-of service data collection should be standardized and customized through a participatory process involving stakeholders and end users (Adalety, 2017; Wijayarathne et al., 2019).

Overall there is a need for more evidence to support the use of DHIS2 to improve immunization data for decision-making and program improvements in LMICs. Only half of the studies in this review are articles published in peer-reviewed journals, highlighting the need for more rigorous research design to evaluate DHIS2 for immunization. Although some studies examine general data quality and data use culture for DHIS2, more analysis is needed on immunization-specific data use and entry at sub-national levels and how the data in DHIS2 can be used for informed decision-making to impact immunization programming. Evidence is needed on how manager's and frontline health worker's use of DHIS2 for immunization changes over time and the training needs, process and time needed to develop trust and reliance on the system for local decision-making. A better understanding of how DHIS2 can improve efficiency by eliminating parallel reporting requirements and integrating systems should also include cost analyses in LMIC settings to better advocate for investment in electronic data management systems.

DHIS2 and Immunization Resources

In addition to reviewing and documenting the state of the evidence and evaluation of the effective use of DHIS2 for immunization programse, the resources below provide relevant information on DHIS2 implementation that are relevant for immunization programs in the form of experiences, use cases, successes, challenges and lessons learnt. There are two sets

of resources that were identified to be of relevance: those that are specific to immunization programs and those that are general DHIS2 resources that are applicable to the effective use of DHIS2 by immunization programs.

DHIS2 and Immunization-Specific Resources

Facility-based Data

Analysis and use of health facility data: Guidance for Immunization Programme Managers

This is a working document that provides guidance for immunization Programme managers on the analysis and use of health facility data [\[link\]](#).

Strengthening health systems through improved reliability of health information: An evaluation of the Expanded Programme on immunization data management in Eastern Cape, South Africa

An initial review of District Health Information System (DHIS) data from Eastern Cape Province, South Africa, collected for the Expanded Programme on Immunisation (EPI), identified wide variations in reported rates of immunisation between sub-districts, with some consistently exceeding 100%. These impossible figures signal significant issues with data quality. To investigate these variations, and identify potential interventions, we designed a mixed-methods evaluation of the accuracy of reported immunisation coverage and challenges in data management.

This document concludes that ensuring data accuracy is a significant problem in Eastern Ape Province. There are some clear steps the Provincial Department of Health can take to reduce errors. These include the central procurement of materials required for data management, formation of Data Audit teams to verify data, integration between maternal Child and women's health sub-programs to improve communication and provision of training regarding data management processes [\[link\]](#).

Data for decision making: using a dashboard to strengthen routine immunization in Nigeria

This document highlights Nigeria's experiences in using DHIS2 to address poor routine immunization data quality which has been a long-standing problem for the country. It documents pre-implementation, Implementation and post implementation processes, challenges faced and lessons learnt for future implementation improvement.

This document noted three major key issues including; 1) Poor routine immunisation data quality has been a long-standing problem for Nigeria. The District Health Management Information System version 2 (DHIS2) Routine Immunisation Dashboard Project was

implemented to address this challenge on a countrywide scale. 2) The DHIS2 RI Dashboard Project contributed to improvement in completeness of routine health management information systems reports from 53% to 81% over a 3-year period. Timeliness of the reports improved substantially across the country in the same period. 3) Consistency in the implementation of agreed policies and strategies at subnational levels has a strong potential for stimulating an enduring improvement in health systems performance [\[link\]](#).

Data Quality

WHO Data Quality Review Modules

The DQR toolkit includes guidelines and tools that lay the basis for a common understanding of data quality so that a regular mechanism for data quality assessments can be institutionalized in the country. The toolkit enables countries to conduct regular data quality assessments in accordance with the following structure: Module 1: Framework and metrics (current document) Module 2: Desk review of data quality Module 3: Data verification and system assessment [\[link\]](#).

Interoperability

Interoperability between EPI information systems: DHIS2 and DVDMT

During this webinar, Senegal's experience with implementing DHIS2 and interoperability considerations in relation to DVDMT and DHIS2 was discussed. They highlighted successes, opportunities for improvement and the impact on data availability, quality and use. This webinar should be of interest to eHealth practitioners as well as immunization program personnel with an interest in increased efficiency in data collection, quality, and use. The practical issues of implementation should be of particular interest to countries in Africa that are implementing new systems and are working through issues of double entry of data and other challenges of transitioning from one information management system to another. [\[link\]](#).

Electronic Registry using DHIS2

Identifying and addressing challenges deploying an Electronic registry – the Ghana Health Service Experience

Introducing electronic registries in sub-Saharan Africa where internet connectivity is not always reliable, comes with a lot of challenges including errors and compromised data quality. During this webinar, the Ghana Health Service team share their experiences in implementing the DHMIS2 e-Tracker, challenges and lessons learned from the deployment in 86 health districts of the central region in Ghana. This presentation should be of interest to Data Management Specialists, EPI Managers, HMIS specialists and primary health care specialist committed to implementing health management systems [\[link\]](#).

Piloting of the e-Tracker App in the DHIS2 in Gambia (Webinar PPT)

In 2016, Gambia's EPI program piloted an Electronic Immunization registry (EIR) with the main objective of strengthening the data management capacity at central and regional levels in the country. In this webinar, they shared out their experiences on piloting the e-Tracker in DHIS2, the process, challenges and lessons learnt. They also shared out information on an evaluation that was conducted to; Assess user knowledge, attitudes and practices with regard to E-Tracker in the DHIS2 software as well as determine the extent of implementation of E-tracker guidelines; Understand best practices and challenges to achieving high and timely immunization coverage reports; Assess frequency, timeliness and quality of supervision of Central and regional levels of the participating health facilities on the E-tracker in the DHIS2 pilot and; Assess country readiness for national rollout and provide an estimated cost.

The presentation also highlighted recommendations from this evaluation that included among others; EPI to consider a phased expansion strategy, gradually moving from one region to another at an interval of two years to allow for consolidation of gains in new expansion regions; Undertake fundraising activities such as the preparation of high-quality funding proposals and share with potential donors including PATH, Gavi, UNICEF and WHO; Use higher level authority such as the Permanent Secretary and the Minister of Health and Social Welfare to explore possibility of private sector participation and financing of equipment and internet connectivity costs; The EPI Management and especially the RHDs must endeavour to undertake regular supervision to support implementation and post implementation regions [\[link\]](#).

Balancing Institutional Needs with Generic functionality in information systems: The Biography and evolution of DHIS2 Tracker following two implementations in Palestine

This thesis explores two aspects of the development and implementation of a generic configurational software platform - the localization or adaptation of such a platform to a specific local context, and the evolutionary developments taking place in such a platform. It further explores how these two aspects mutually influence each other.

The thesis concludes that the different trajectories of localisation and generic development aren't mutually exclusive. Every DHIS2 implementation needs to shape a configuration by utilizing the configurable layer. In some cases, this localisation process may be sufficient. In other cases, recognized improvements or the generification of particular functionality, lead to changes in the generic core. We can in this way see the trajectories influencing each other, and coming full circle, improvements in the generic core make it possible to better accommodate other use cases through the configurable layer [\[link\]](#).

Zambia Electronic Immunization Registry manual

The Zambia electronic immunization registry (ZEIR), powered by OpenSRP (Smart Register Platform), is an open source android application geared towards frontline health workers with offline functionality and is interoperable with other open source global goods such as District Health Information Software (DHIS2). ZEIR is standard based and has been built to ensure timely, complete and accurate immunization data that enables the tracking of children and their vaccination records [\[link\]](#).

Other electronic registries

There are other valuable resources on electronic immunization registries despite them not using DHIS2. Many of these can be accessed from the BID/BLN site. These include among others Reaching the last mile – a Q&A with a nurse using automated, electronic reports to trace immunisation defaulters; BID Initiative partners with I-TECH to track vaccinations with better data and; In Zambia, BID partners with UNICEF to reach more children with life-saving vaccines [\[link\]](#).

Case-based Surveillance and Reporting on VPDs

Measles Data Reporting in the district health Information System: A case Study of Gombe State

This study aimed at determining the reasons for the MCV2 reporting on DHIS2 platform for Gombe state. Using a cross sectional study among health workers in selected health facilities and LGA RI Officers, health facility registers were reviewed and data consistency ascertained. This study concluded that data entry error and knowledge gap on how to record measles data were identified as factors responsible for MCV2 data on the DHIS2 platform hence calling for targeted interventions towards improving the quality of Routine Immunisation data in Nigeria [\[link\]](#).

Interoperability of Surveillance Data Collection Tools (District Health Information System 2 and District Vaccine Data Management Tools) in Enugu State, Nigeria, From 2015-2018

Background Over the years, Nigeria has used District Vaccine Data Management Tool (DVTMT) for surveillance data collection including routine immunization. In 2012, Nigeria adopted District Health Information Software (DHIS2), a Java driving online real-time tool for data collection. In 2015, Enugu State commenced the use of DHIS2 alongside the traditional DVTMT as surveillance data capturing tools. This evaluation therefore looks at the two surveillance data tools to assess surveillance attributes, interoperability, effect in decision making, and preference of use [\[link\]](#).

Quality of routine facility data for monitoring priority maternal and newborn indicators in DHIS2: A case study from Gombe state Nigeria

This study used health facility reported data in DHIS2 for Gombe State, north-eastern Nigeria, to present a case study of data quality to monitor priority maternal and neonatal health indicators. It revealed that of 14 priority maternal and neonatal health indicators that could be tracked through facility-based data, 12 were included in Gombe's DHIS2. During July 2016-June 2017, facility-reported data in DHIS2 were incomplete at least 40% of the time, under-reported 10%-60% of the events documented in facility registers, and showed inconsistencies over time, between related indicators, and with an external data source. The best quality data elements were those that aligned with Gombe's health program priorities, particularly older health programs, and those that reflected contact indicators rather than indicators related to the provision of commodities or content of care.

This case study therefore demonstrates the high potential for effective monitoring of maternal and neonatal health using DHIS2. However, coordinated action at multiple levels of the health system is needed to maximize reporting of existing data; rationalize data flow; routinize data quality review, feedback, and supervision; and ensure ongoing maintenance of DHIS2 [link].

Vaccine Supply Chain Information Systems

Supporting Immunization Programs with Improved Vaccine Cold Chain Information Systems

This paper describes efforts to develop a Cold Chain Information System (CCIS) for Laos, in collaboration with UNICEF and the Lao Ministry of Health. The work builds on experience with deploying CCIS's in multiple countries along with developing analysis tools and data standards. The CCIS in Laos uses DHIS2, a widely used web-based health indicator system as the back end, which is integrated with SMS reporting from the district and health center level where internet is not guaranteed to be available. A central goal of the system is to allow regular reporting of vaccine stock levels and vaccine refrigerator status (measured by logging devices recording high and low temperature alarms). The system is designed with notifications to promote action by technicians or managers. The technical contributions of this work include the development of a new data model for DHIS2 and a text message system using an Android gateway to RapidSMS with a custom notification engine interfacing to DHIS2 [link].

Bottleneck Analysis and Scorecards

Promoting bottleneck analysis for action and accountability on maternal and child health

In this publication, UNICEF documents the bottleneck analysis tool using DHIS2 to support evidence-based decision-making and action on the RMNCAH Score card at the decentralized level in Uganda. This paper highlights two critical lessons learnt including; the

need to communicate the initiative's multi sectoral nature as in its early stages it was seen as a small pilot and no one was talking about it other than as an M&E tool although M7E wasn't its purpose but strengthening systems to improve quality care. The second lesson was investing in hybrid systems. *"There were huge expectations that once the BNA tools were developed for DHIS2, you would immediately get nice colour-coded charts saying exactly what the level of a particular medical stock is in a facility and what the bottleneck was to be addressed. But if this information is being collected on scraps of paper in clinics, of course it is not in the tool at this stage."* [\[link\]](#).

DHIS 2 manual for the Bottleneck Analysis App

This guide is intended to be used by users who can have administrative privilege to do system setup, and who have capable of doing some technical setup of interventions, indicators and sharing of objects related to BNA app [\[link\]](#).

DHIS2 and birth notifications

Generation of vital event notification from DHIS2 for strengthening CRVS system

This study focused on the DHIS2 system to see the feasibility of generating birth and death notifications upon collection of field data by the community health workers and designed and implemented necessary interfaces for the fieldworkers, DHIS2 and registrar general office in Bangladesh. Survey results show that birth registration rate within 45 days of birth is very low and it is only around 3% in Bangladesh. In order to strengthen registration system, coordination between registration agency and health department is necessary and a notification for birth/death event should be reported to the registration agency for further action. To address this issue, we have designed a system that will send a notification to the registrar general office when a birth record is obtained in the health information system [\[link\]](#).

Enhancing real-time reporting of maternal and new-born mortality through DHIS2

This study aims at unearthing the workflow challenges which hinder the prompt reporting of maternal and neonatal deaths and to understand the surveillance cycle in use then propose a suitable solution. Study results indicated that maternity staff were not aware that they were required to send death notifications to the IDSR office within 24 hours after the death occurs; only 8% of respondents had seen a maternal and perinatal death standard operating procedure; weekly reporting tool was not readily available in 38% of facilities and only 20% of facilities had a clear reporting cycle. There was an indication that the digitised maternity register was seen to improve the reporting process of the maternal and new-born deaths in Kenya hence a recommendation for its use to ensure efficient and easy data collection, transmission and analysis systems for quicker response [\[link\]](#).

Building a research registry for studying birth complications and outcomes in six Palestinian governmental hospitals

This publication describes the implementation of a registration (case record form; CRF) for obstetric interventions and childbirth events using e-health in a prospective birth cohort study in Palestine. Completeness and the reliability of the data is reported using the essential indicators in a case registration form (CRF) and subsequently entered into the District Health Information Software 2 (DHIS 2) system.

The study revealed that according to the hospital birth registries, a total of 34,482 births occurred in the six hospitals during the study period. Data on the mothers and children registered on CRF was almost complete in two hospitals (100% and 99.9%); in the other hospitals the completeness ranged from 72.1% to 98.7%. Eighty birth events were audited for 22 variables in the three hospitals in the West Bank. Out of 1760 registrations in each hospital, the rates of correct data registration ranged from 81% to 93.2% and data entry ranged from 84.5% to 93.1%. The registered and entered data on birth events in six hospitals was almost complete in five out of six hospitals and the collected data was considered reliable for research purposes. [[link](#)].

Adverse Events Following Immunization (AEFI)

Global Manual on Surveillance of Adverse Events Following Immunization

This manual provides guidance on setting-up AEFI surveillance systems with standardized methodologies and tools. It addresses the investigation of AEFI, how to analyze surveillance data, causality assessment and how to respond to serious AEFI, including communication. It also includes a description of the most common vaccine reactions provides references to the most recent references in vaccine pharmacovigilance [[link](#)].

Periodic Intensification of Routine Immunisation (PIRI)

Door – to- door immunization strategy for improving access and utilization of immunization services in Hard to reach areas: a case of Migori County, Kenya

This is a study that determines the effect of an enhanced door-to-door immunization strategy on improving immunization coverage in hard to reach areas of Migori. Some of the methods used included a cross-sectional review of DHIS2 Immunization data for July and August 2018 for Migori County.

This study made several recommendations to improve immunisation services in the county with significant multiple hard to reach hotspots including: 1) Health facilities should actively use routine immunization data to identify hard – to – reach areas to be targeted with outreaches to improve immunization coverage; 2) Outreach (mobile) immunization services should be more flexible to change locations and times of services provision in conformity

with the ‘socio – economic’ and migratory patterns of the residents; 3) Counties should invest more resources in strengthening the community health systems so that CHVs are motivated and retained to carry out demand creation, deliver community services, and that communities continue to demand and utilize health services among them immunization; 4) An in – depth qualitative analysis to understand the best strategies and solutions to guarantee a sustained access and utilization of immunization services for the special hard – to – reach populations [\[link\]](#).

General DHIS2 Resources

DHIS2 Implementation Guide

This is a quick guide to the implementation of DHIS2 and is targeted at Implementers and super users of the software [\[Link\]](#)

DHIS2 User Stories

This website captures stories of DHIS2 Users worldwide and provides an opportunity for users, implementers to learn how DHIS2 is being used to address challenges and solve problems in various domains. On the community platform (<https://community.dhis2.org/>) there are relevant user stories and discussions about best practices for DHIS2 [\[link\]](#).

Manual for the DHIS2 quality tool; Understanding the basics of improving data quality

This is a practical guide to use the DHIS2 quality tool [\[link\]](#).

DHIS2 Community Health Information System Guidelines

This document aims to serve as a practical guide for national and local-decision makers involved in the design, planning, deployment, governance and scale up of successful DHIS2 based CHIS that support community-based health service providers and the communities they work in. It covers the full information cycle, including: data collection, analysis, dissemination (feedback loops) and use/action taking for improved and equitable community-based health services. It provides an in-depth review of key questions that should be considered when addressing issues relevant for governance, design, development and use of large-scale CHIS. It is applicable to countries that are beginning the design process as well as for existing systems that are being strengthened, scaled up or integrated with other information systems such as the facility based or RHIS. It provides general guidelines whose applicability must be considered and adapted to different country and within country contexts [\[link\]](#).

Advancing Health Information Systems: Experiences from Implementing DHIS2 in Africa

In this document, Nielsen shares experiences from country implementation of DHIS2 in Uganda, Kenya and Malawi as well as the regional effort in West Africa. In each of these

country cases, lessons learnt and challenges encountered throughout their engagement in software development and implementation activities are shared.

This paper laid out a few lessons learned and challenges encountered implementing HIS. In particular, the online approach has reduced the need for ICT maintenance considerably, pushing the technical issues over to the mobile network operators. Although the connectivity is poor in many rural areas, the networks are improving. Connectivity therefore seems to be a temporary problem in most places, and something that will be dealt with independently of government budgets. Local capacity building for entering, processing and using data for action is a health system issue, however. It can only be dealt with through prolonged efforts amongst all management cadres in the sector with corresponding sustained funding. The challenge of lack of capacity for adapting and implementing software solutions persists. Here, a smaller number of highly specialized technical assistants are needed. The HISP network is cultivating such staff during regular Academies and exchanges throughout the region. Integrated health information systems need government policies underpinning their role. The Ministries of Health need to take firm action to support vertical programmes to store their data in the HIS backbone, from which they may retrieve it and eventually import it into other software. Vertical programmes will benefit from integrated systems by means [link].

Assessment of Data use of the District Health Information system (DHIS2): A case study of Nairobi County

This research study assesses the level of data use from the district Health Information system in Nairobi County. It determined the level of data use from DHIS2 at county and health facility level. This study established that facilities and counties use DHIS2 data for programme improvement, reporting and accountability and sharing data with partners. Majority of the facilities that indicated data use are the higher-level facilities. Only a few of level 3 facilities indicated that they use DHIS2 data due to lack of training and access rights. Majority of facilities indicated that they use DHIS2 data for sharing with partners. The use of DHIS2 data at the facility level can be attributed to training of health workers and the assignment of rights to the health workers.

It recommended that training of health workers should be intensified so that they can utilize DHIS2 data for decision making. More health workers should also be assigned access rights so that they can be able to access DHIS2. Provision of infrastructure (computers, internet) was also recommended as some facilities indicated that they didn't have the appropriate infrastructure [link].

Conclusion

This resources guide has been developed with an intention of having a living online document (or wiki) that can regularly be updated as new and useful information emerges as far as the implementation of DHIS2 for immunization programming is concerned.

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