

## DHIS2 as a tool for health impact assessment in low-resource settings: examining opportunities for expanding use of routine health data

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### Abstract

Efforts to promote evidence-informed health policy in low-resource settings face persistent challenges in acquiring the necessary data. Inconsistent and fragmented data collection processes impede efforts to evaluate needs and monitor impacts. Recently, however, technical solutions have offered opportunities to overcome these challenges. Implementation of the District Health Information Software, Version 2 (DHIS2) is continuing to expand. Currently being implemented by Ministries of Health in over 60 developing countries worldwide, DHIS2 offers a proven and affordable means of managing digital health information.

While DHIS2 has increased the amount and quality of data collection, there has to date been relatively little consideration of how its expanded use could inform rapid risk, vulnerability and impact assessments in low-resource settings. We address this knowledge gap by considering the potential of DHIS2 to be used to measure progress towards health and development goals.

We position DHIS2 within a framework for health impact assessment to examine how expanded use of the DHIS2 platform could support needs assessments and program evaluations. This research seeks to expand and improve evidence-informed practice in low-resource settings and contributes to a larger movement of promoting active and engaged thinking about optimal strategies of DHIS2 data use.

### 1. Introduction

Developing countries face complex public health challenges under situations of resource and human capacity constraint. As such, there is a premium for using all methods available to implement equitable and effective health policies and programs. The demand for reporting of data to regional and bilateral funding agencies, which is often poorly harmonized across agencies, places further demand on local health systems. Aligning reporting requirements and streamlining monitoring, evaluation and reporting processes could help alleviate this burden.

It is within this space that DHIS2 operates. Currently with over 60 national implementations worldwide, DHIS2 is the leading data warehousing and business analysis software for low-resource countries [1]. An open-source platform, DHIS2 is used to support data collection, analysis and presentation from district to national and supra-national jurisdictions. Available in eight languages, core features include a configurable data model with functionality for data aggregation, advanced visualization and system interoperability (for more information, please see <http://www.dhis2.org>).

While DHIS2 is well proven as a technology and supported by a global community of software developers and health practitioners, an important challenge remaining in many countries

currently implementing DHIS2 is a lack of knowledge and skills to analyze and use the data collected to inform local decisions [2].

We seek to encourage a culture of data use to provide evidence and insights on global health problems and solutions. We extend our discussion beyond purely technical considerations of DHIS2 implementations to the individuals expected to use the systems and data for action. Herein, we present a critical analysis of the value of DHIS2 in informing health impact assessments (HIA) in low-resource settings. With a focus is on how DHIS2 data can be leveraged for decision-making, we assume that the platform is properly deployed and locally accepted. The emphasis is on the potential value of aggregate-level data for monitoring and surveillance; while we do not discuss the value of DHIS2 for clinical decision-making, this should not be overlooked in broader evaluations of DHIS2. Drawing on a validated framework of HIA, we will examine the current state of DHIS2 implementations, key success, challenges and opportunities to expand the role of DHIS2 in informing HIA in low-resource settings.

## 2. Methodology

Data to inform this analysis were collected from academic and grey literature via searches of academic databases and the University of Oslo Health Information System Programme (HISP) repository. HISP is responsible for the conception, design and maintenance of DHIS2. Researchers also drew on their past experience in managing, developing, implementing and using the system to identify other insights or unpublished reports.

While the specifics of HIA methodologies depend upon the context and research question, a general approach consists of six sequential steps (**Table 1**). We positioned our analysis within the context of these steps.

*Table 1. Health impact assessment framework objectives [3].*

<b>Task</b>	<b>Objective</b>
<b>Scope</b>	<b>Confirm health impacts, populations and research questions under study, as well as relevant stakeholders</b>
<b>Assess</b>	<b>Estimate the health effects of program in question and alternatives, based upon evidence available</b>
<b>Recommend</b>	<b>Propose strategies to maximize net health benefit and promote health equity</b>
<b>Report</b>	<b>Disseminate findings and actionable recommendations to decision-makers, relevant stakeholders, and the public</b>
<b>Evaluate</b>	<b>Review HIA process and impact</b>
<b>Monitor</b>	<b>Monitor impact and progress towards health goals</b>

## 3. Current State of Implementation

DHIS2 implementations are concentrated in Africa and Asia, with some small-scale implementations in Latin America and the Middle East [4]. This paper focuses on Ministry-led implementations, noting that there is a growing global community of NGO and international donor users. Problematically, these systems often operate in parallel but do not exchange data;

this can fragment data collection and analysis. Current trends suggest that there will be an additional 20 implementing Ministries over the next three years [4]. While Ministries own the data collected from these implementations, some have chosen to make them publically available through web portals; such efforts to broaden data visibility and access can increase the value of data resources.

DHIS2 is designed to be a generic collection and analysis tool, typically applied across a broad range of health programs. It supports evidence-informed decision-making at all levels of health services. However, due to historic differences in resources and organization, integration of all routine reporting into a single platform is a recurring challenge. The fragmentation of reporting streams mirrors the fragmented international approach to the various diseases, but integration efforts are gaining momentum through initiatives like the Health Data Collaborative. Despite progress, there is a persisting funding gap to support standardization, integration and interoperability between platforms, through mechanisms such as data dictionaries and information use processes. Focusing on the proper deployment of a single system risks overlooking these problems, as even well-implemented systems will produce suboptimal benefits if they are operating in silos.

DHIS2 provides a vehicle for standardization of data collection processes. It provides a useful means of establishing disease burden baselines that can be compared across districts and over time, allowing for assessment of community needs and intervention impacts. In Nigeria, for example, routine data from DHIS2 on the use of HIV prevention of mother-to-child transmission services (PMTCT) was compared to uptake during a targeted campaign, finding an increase in service use of 30% relative to baseline [2]. This review focused on the academic uses of DHIS2 to track disease burdens, overlooking some of the other contributions that it can have, such as improving transparency and accountability in the provision of healthcare [5].

## 4. Critical Analysis

Since the launch of DHIS2 in 2005, the software platform has catalyzed some important successes. In particular, DHIS2 implementations can improve data reporting rates and accuracy. In three Palestinian hospitals, for example, reporting completeness and data accuracy increased from 72.1% to 100% and from 81% to 93.2%, respectively, over a ten-month period [6]. Similar effects were observed in Kenya [7] and Uganda [8]. Related to this are improvements in the ability to conduct cause analysis using standardized disease classification systems (e.g. ICD-10), install outbreak notification systems, conduct online data visualization to identify areas of high disease burden and move towards real-time surveillance [9]. Meanwhile, it has catalyzed advances in routine data collection, automated calculation of indicators and visualization of statistics.

Despite these successes, challenges persist. First, uptake by data managers and public health staff has not been universal, constrained in part by a transient health workforce [7]. Second, limited availability of human resource capacity has contributed to the perception of a high burden associated with data analysis and has constrained the use of data that are collected [8, 10]. Data that are collected but not used are an untapped resource, and processes are needed to realize the potential value of the data collected by DHIS2 to inform action. This will require strong

leadership and governance mechanisms to champion DHIS 2 adoption and drive action informed by the data.

It seems likely that a combination of suboptimal reporting rates, persisting data inaccuracies and insufficient local expertise for data cleaning, analysis and visualization contribute to a self-reinforcing cycle constraining both the reporting and use of quality health data. Meanwhile, a lack of population-level data results in the use of estimates and outdated census information, while the absence of a shared understanding of DHIS2 indicators further impedes proper data collection; these issues make it difficult to rely on data. Further, even if offering off-line support, limited access to Internet, computers and other necessary hardware and software present complex challenges across the life cycle of DHIS2 installations, pointing to the potential value of additional funding to expand capacity [1, 8]. Limited processes to encourage and evaluate data quality, timeliness and use are likely to impede the development of a culture of data use. Similarly, longitudinal retention of datasets by countries is often limited, and long-term data repositories could offer substantial cost savings and allow data comparisons over time. Important issues for immediate action include integration to resolve the lack of harmonization and conflicting reports resulting from vertical DHIS2 platforms maintained in parallel to government platforms by development and civil society organizations [2].

## 5. Opportunities for HIA

As routine data collection continues to expand, there will be increasing value in using available public health data to support decision-making. This section presents opportunities for improving the use of DHIS2 data to conduct HIA in low-resource settings, where an open-source and flexible platform is particularly valuable.

Data derived from well-implemented DHIS2 systems could be used during scoping to identify available health data and priority populations. Analysis and visualization of surveillance data across districts and populations could support more evidence-based tailoring of HIA research questions. A challenge persists, however, in integrating a national DHIS2 platform with vertical instances; these parallel platforms may use different population estimates, catchment areas or geospatial borders, which can produce inconsistent estimates across organizations. Stewardship of a nationally integrated platform by the local Ministry of Health can improve this situation, but will require substantial leadership alongside inter-sectoral and inter-agency collaboration.

Assessments to estimate the impact of a program or policy on health outcomes could benefit directly from the routine collection of standardized data and automated data analysis made possible through DHIS2. This would allow comparisons between districts with differential exposure to a health policy or hazard and assessments of change relative to baseline due to program implementation. This potential is likely to increase further with the continued expansion of the geographic range of DHIS2 installations and the scope of health data being collected. However, there is a pressing need for further training in data collection, cleaning, analysis and use, at both the health clinic and facility (data collection) and Ministry (data analysis) level. Such efforts should incorporate training on how to optimally configure DHIS2 to support data use and ensure that the necessary governance structures are in place to take action.

There is a gap in moving from data collection to use for informing decisions. Progress in incorporating data analysis into the development of recommendations will require strategies and processes to break the self-reinforcing cycle of suboptimal reporting, poor data quality and limited data use. Meanwhile, engagement of clinical end-users is necessary to promote adoption of data collection processes.

Results of an HIA should be reported internally and externally. Internal reporting would make findings available to relevant government sectors, while external reporting would share findings with the public and international community. Both are essential to effective and ethical health policy, though they are often accompanied by a substantial reporting burden. Well-crafted DHIS2 implementations have the potential to streamline dissemination through strong networks, though further training of local staff in data analysis and visualization would facilitate this effort.

Lastly, HIA approaches to continuous evaluation of impacts can be streamlined through automated calculations of routine data within the DHIS2 system. This would enable tracking of changes over time, monitoring health effects and evaluating the impact of the HIA recommendations. To support this effort, however, it would be necessary to develop evaluation frameworks and indicators to guide process and outcome assessments of the impact of policy and program decisions arising from the HIA. The World Health Organization is currently working to provide standardized metadata packages with the aim of improving standards for data capture, analysis and visualization; such an effort can improve the sustainability of data use while enhancing data-sharing capabilities between jurisdictions and countries.

## 6. Synthesis and Conclusion

This paper provides a critical analysis of the current state of DHIS2 implementation and data use. Positioning our discussion within the context of a validated framework for HIA, we discuss current strengths, weaknesses and opportunities for expanding the use of routinely collected public health data. We propose that DHIS2 holds value for HIA in low-resource settings, primarily as a vehicle for standardizing data collection processes and enhancing reporting rates and accuracy. There are obstacles, however, to moving from routine data collection to data use for HIA: we conclude that the key dimensions are limitations in data quality, analysis and access.

Platforms operating in parallel across different ministries, sectors or organizations can obscure a complete understanding of health conditions. Additional funding and cross-institutional collaboration is required to integrate these platforms and promote national stewardship of DHIS2 platforms, as well as enhance shared understandings of data through data dictionaries, metadata packages and formal process for integrating routine data collection into global health monitoring and evaluation frameworks. Efforts are required to build human resource capacity for HIA through training for data cleaning, analysis and visualization. Lastly, expanded accessibility to data, such as through public DHIS2 web portals, can further promote the value of DHIS2 for HIA and evidence-based health policy to improve health outcomes.

## 7. References

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